

Nways Multiprotocol Access Services



Software User's Guide

Version 3.2

Nways Multiprotocol Access Services



Software User's Guide

Version 3.2

Note

Before using this document, read the general information under "Notices" on page xxiii.

Fifth Edition (November 1998)

This edition applies to Version 3.2 of the IBM Nways Multiprotocol Access Services and to all subsequent releases and modifications until otherwise indicated in new editions or technical newsletters.

Order publications through your IBM representative or the IBM branch office serving your locality. Publications are not stocked at the address below.

IBM welcomes your comments. A form for readers' comments is provided at the back of this publication. If the form has been removed, you may address your comments to:

Department CGF
Design & Information Development
IBM Corporation
P.O. Box 12195
RESEARCH TRIANGLE PARK NC 27709
USA

When you send information to IBM, you grant IBM a non-exclusive right to use or distribute the information in any way it believes appropriate without incurring any obligation to you.

© **Copyright International Business Machines Corporation 1997, 1998. All rights reserved.**

Note to U.S. Government Users — Documentation related to restricted rights — Use, duplication or disclosure is subject to restrictions set forth in GSA ADP Schedule Contract with IBM Corp.

Contents

Figures	xix
Tables	xxi
Notices	xxiii
Notice to Users of Online Versions of This Book	xxv
Trademarks	xxvii
Preface	xxix
Who Should Read This Manual	xxix
About the Software	xxix
Conventions Used in This Manual	xxx
Library Overview	xxx
Summary of Changes for the IBM 2216 Software Library	xxxii
Editorial Changes	xxxii
Software Features Supported by Network Utility	xxxiii

Part 1. Understanding and Using the Software 1

Chapter 1. Getting Started	3
Before You Begin	3
Migrating to the Current Release	3
Accessing the Software Using Local and Remote Consoles	3
Local Consoles	4
Remote Consoles	4
Logging In Remotely or Locally	5
Reloading the Router	6
Exiting the Router	6
Discussing the User Interface System	6
Understanding the First-Level User Interface	6
Chapter 2. Using the Software	9
Entering Commands	9
Connecting to a Process	9
Identifying Prompts	10
Getting Help	10
Exiting a Lower Level Environment	11
Getting Back to OPCON	11
Some Configuration Suggestions	11
Creating a First Configuration	11
Basing a Configuration on an Existing Configuration	12
Accessing the Second-Level Processes	13
Accessing the Configuration Process, CONFIG (Talk 6)	14
Accessing the Operating/Monitoring Process, GWCON (Talk 5)	15
Accessing the Secondary ELS Console Process, ELSCON (Talk 7)	15
Accessing the Third-Level Processes	15
Accessing Network Interface Configuration and Operating Processes	16
Accessing Feature Configuration and Operating Processes	20
Accessing Protocol Configuration and Operating Processes	21
Command History for GWCON and CONFIG Command Line	23
Repeating a Command in the Command History	23

Repeating a Series of Commands in the Command History	24
Chapter 3. Accessing the Firmware from the Command Line Interface	27
Accessing the Firmware Prompt	27
Boot Options Available for the 2216	27
Attended Mode	27
Unattended Mode	28
Chapter 4. The OPCON Process	29
Chapter 5. Using OPCON	31
Accessing the OPCON Process	31
OPCON Commands	31
Diags	32
Divert	32
Flush	33
Halt.	33
Intercept	34
Logout	34
Memory	34
Reload	35
Status.	35
Talk.	36
Telnet	37

Part 2. Understanding, Configuring, and Using Base Services 39

Chapter 6. Using BOOT Config to Perform Change Management.	41
Understanding Change Management	41
Using the Trivial File Transfer Protocol (TFTP)	41
Loading an Image at a Specific Time	42
Chapter 7. Configuring Change Management	43
Accessing the Change Management Configuration Environment	43
Change Management Configuration Commands	43
Add.	44
Copy	44
Describe	45
Disable	46
Enable	46
Erase	47
List	48
Lock	49
Set	50
TFTP	51
Timedload	52
Unlock	54
Update-firmware	55
Chapter 8. The Configuration Process (CONFIG - Talk 6) and Commands	57
What is CONFIG?	57
Config-Only Mode	58
Automatic Entry Into Config-Only Mode	58
Manual Entry Into Config-Only Mode	58
Quick Configuration	58
Manual Entry Into Quick Config Mode	59

Exiting from Quick Config Mode	59
Configuring User Access	59
Technical Support Access	60
Configuring Spare Interfaces	60
Restrictions for Spare Interfaces	61
Resetting Interfaces.	63
Restrictions for Resetting Interfaces	64
Using System Dumps	66
Chapter 9. Configuring and Monitoring the CONFIG Process	67
Entering and Exiting CONFIG	67
CONFIG Commands	67
Add.	68
Boot	75
Change	75
Clear	81
Delete.	83
Disable	84
Enable	85
Event	86
Feature	86
List	87
Load	90
Network	91
Patch	92
Performance	94
Protocol	94
Qconfig	94
Set	95
System Retrieve	100
System View	101
Time	102
Unpatch	103
Update	103
Write	103
Chapter 10. The Operating/Monitoring Process (GWCON - Talk 5) and	
Commands	105
What is GWCON?	105
Entering and Exiting GWCON	105
GWCON Commands	105
Activate	106
Buffer	106
Clear	107
Configuration	108
Disable	110
Enable	111
Error	111
Event	112
Feature	112
Interface	113
Memory	114
Network	115
Performance	116
Protocol	116
Queue.	116

Reset	117
Statistics	117
Test	118
Uptime	119
Chapter 11. The Messaging (MONITR - Talk 2) Process	121
What is Messaging (MONITR)?	121
Commands Affecting Messaging	121
Entering and Exiting the Messaging (MONITR) Process	121
Receiving Messages	121
Chapter 12. Using the Event Logging System (ELS).	123
What is ELS?	123
Entering and Exiting the ELS Configuration Environment	124
Event Logging Concepts	124
Causes of Events	124
Interpreting a Message	125
Using ELS	127
Managing ELS Message Rotation	128
Capturing ELS Output Using a Telnet Connection on a UNIX Host	128
Configuring ELS So Event Messages Are Sent In SNMP Traps.	129
Using ELS to Troubleshoot a Problem	129
ELS Example 1	129
ELS Example 2	130
ELS Example 3	130
Using and Configuring ELS Remote Logging	131
Syslog Facility and Level	131
Remote Workstation Configuration	131
Configuring the 2216 for Remote Logging.	133
Remote Logging Output	135
Additional Considerations.	138
Using ELS Message Buffering	139
Chapter 13. Configuring and Monitoring the Event Logging System (ELS)	143
Accessing the ELS Configuration Environment	143
ELS Configuration Commands	143
Add.	144
Advanced	144
Clear	144
Default	145
Delete.	145
Display	145
Filter	146
List	146
Nodisplay	148
Noremote	148
Notrace	150
Notrap.	150
Remote	151
Set	153
Trace	157
Trap	158
ELS Net Filter Configuration Commands	158
ELS Message Buffering Configuration Commands	161
Entering and Exiting the ELS Operating Environment	164
ELS Monitoring Commands	165

Advanced	165
Clear	165
Display	166
Files Trace TFTP.	166
Filter	167
List	167
Nodisplay	170
Noremote	170
Notrace	171
Notrap.	172
Packet Trace	172
Remote	173
Remove	174
Restore	175
Retrieve	175
Save	175
Set	175
Statistics	180
Trace	181
Trap	182
View	183
Packet-trace Monitoring Commands	183
ELS Net Filter Monitoring Commands	186
ELS Message Buffering Monitoring Commands	188
Chapter 14. Configuring and Monitoring Performance	195
Performance Overview.	195
Performance Reporting Accuracy	195
Accessing the Performance Configuration Environment.	195
Performance Configuration Commands	196
Disable	196
Enable	196
List	196
Set	197
Accessing the Performance Monitoring Environment.	197
Performance Monitoring Commands.	197
Disable	198
Enable	198
List	198
Report.	198
Set	198

Part 3. Understanding, Configuring and Operating Interfaces. 201

Chapter 15. Getting Started with Network Interfaces	203
Before You Continue	203
Network Interfaces and the GWCON Interface Command	203
Accessing Network Interface Configuration and Console Processes	203
Accessing Link Layer Protocol Configuration and Console Processes	204
Defining Spare Interfaces.	204
Chapter 16. Configuring IEEE 802.5 Token-Ring Network Interfaces	205
Accessing the Token-Ring Interface Configuration Process	205
Token-Ring Configuration Commands	205
List	205
LLC	206

Media	206
Packet-Size.	207
Set	207
Source-routing.	208
Speed.	208
Accessing the Interface Monitoring Process	208
Token-Ring Interface Monitoring Commands.	209
Dump	209
LLC	210
Token-Ring Interfaces and the GWCON Interface Command.	210
Statistics Displayed for 802.5 Token-Ring Interfaces	210
Chapter 17. Configuring and Monitoring the Fast Token-Ring Network	215
Accessing the FasTR Interface Configuration Process	215
FasTR Configuration Commands	215
List	216
LLC	216
Media	216
Packet-Size.	216
Set	217
Source-routing.	217
Speed.	218
Accessing the Interface Monitoring Process	218
FasTR Interface Monitoring Commands	218
Dump	218
LLC	219
FasTR Interfaces and the GWCON Interface Command	219
Statistics Displayed for FasTR Interfaces	219
Chapter 18. Using FDDI.	223
Fiber Distributed Data Interface (FDDI) Overview	223
Token-Passing Ring Network	223
Primary and Secondary Rings	223
Attachment of Devices.	223
Differences Between FDDI and Token-Ring	224
Device Classes A and B	224
FDDI Network Diagram	225
Chapter 19. Configuring and Monitoring FDDI	227
Accessing the FDDI Configuration Commands	227
FDDI Configuration Commands	227
LLC	227
List	228
Set	228
Accessing FDDI Monitoring Commands	230
FDDI Monitoring Commands	230
LLC	230
List	230
Srt-stats	230
FDDI Interfaces and the GWCON Command	231
Statistics Displayed from FDDI Interfaces.	231
Chapter 20. Configuring and Monitoring LLC Interfaces	235
Accessing the Interface Configuration Process	235
LLC Configuration Commands	235
List	236

Set	237
Accessing the Interface Monitoring Process	238
LLC Monitoring Commands	239
Clear-Counters	239
List	239
Set	244
Chapter 21. Using the Ethernet Network Interface	247
Displaying Ethernet Statistics through the Interface Command	247
Chapter 22. Configuring and Monitoring the Ethernet Network Interface	251
Accessing the Ethernet Interface Configuration Process	251
Ethernet Configuration Commands	251
Connector-Type	252
IP-Encapsulation	252
List	252
Physical-Address.	252
Accessing the Ethernet Interface Operating Process	253
Ethernet Interface Monitoring Commands	253
Collisions	253
Chapter 23. Using the 10/100 Mbps Ethernet Network Interface	255
Displaying 10/100 Mbps Ethernet Statistics	255
Chapter 24. Configuring and Monitoring the 10/100 Mbps Ethernet Network Interface	259
Accessing the Interface Configuration Process	259
10/100 Mbps Ethernet Configuration Commands	259
Duplex	260
IP-Encapsulation	260
List	260
Physical-Address.	261
Speed.	261
Accessing the 10/100 Mbps Interface Monitoring Process	261
10/100 Mbps Ethernet Interface Monitoring Commands.	262
Collisions	262
Chapter 25. Overview of LAN Emulation	265
LAN Emulation Benefits	265
LAN Emulation Components	266
Addressing in ATM	267
ESI	268
ATM Addresses of LAN Emulation Components	268
Overview of Related ILMI Functions.	269
Manual Configuration of the Signaling Version	269
Locating the LECS Using ILMI	269
Overview of the LECS Function	270
Sample Situations for Use of the LECS Assignment Policies	272
More Information About TLVs	273
Connecting to the LES.	274
Address Registration	275
Address Resolution	275
Connecting to the BUS	275
BUS Functions	276
Establishing Data Direct VCCs.	277
Overview of Extensions for LAN Emulation	277

Broadcast Manager	277
BCM Support for IP	278
BCM Support for IPX	278
BCM Support for NetBIOS	279
BCM Support for Source Route Bridging	279
LAN Emulation Reliability	280
LAN Emulation Security	281
Key Configuration Parameters for LAN Emulation	282
Chapter 26. Using ATM	283
ATM and LAN Emulation	283
How to Enter Addresses	283
ATM-LLC Multiplexing	284
ATM Virtual Interface Concepts	284
Advantages of Using ATM Virtual Interfaces	284
Disadvantages of using ATM Virtual Interfaces	285
Chapter 27. Configuring and Monitoring ATM	287
Accessing the ATM Interface Configuration Process	287
ATM Configuration Commands	287
ATM Interface Configuration Commands	288
Add	289
List	289
QoS Configuration	290
Remove	290
Set	290
Enable	294
Disable	294
Accessing the Virtual ATM Interface Configuration Process	294
ATM Virtual Interface Configuration Commands	295
Add	295
List	295
Remove	295
Accessing the ATM Monitoring Process	296
ATM Monitoring Commands	296
Interface	296
ATM-LLC	297
ATM Interface Monitoring Commands (ATM INTERFACE+ Prompt)	297
List	297
Trace	298
Wrap	299
ATM-LLC Monitoring Commands	299
List	300
ATM Virtual Interface Monitoring Commands	300
Chapter 28. Using LAN Emulation Clients.	301
LAN Emulation Client Overview	301
Chapter 29. Configuring and Monitoring LAN Emulation Clients	303
Configuring LAN Emulation Clients	303
Add	303
Config	304
List	304
Remove	304
Configuring an ATM Forum-Compliant LE Client	305
ARP Configuration	305

RIF-Timer (for Token-Ring Forum-compliant LEC only)	307
Source-Routing (for Token-Ring Forum-Compliant LEC only).	307
IP-Encapsulation (for Ethernet ATM Forum-Compliant LEC only)	308
List	308
QoS	308
Set	308
Accessing the LEC Monitoring Environment	318
LEC Monitoring Commands	319
List	319
MIB.	323
QoS Information	326
Chapter 30. Using Channel Adapters	327
Host Definition Planning	327
IOCP Definition for the 2216	328
Defining the 2216 to the Operating System	332
Defining the 2216 to Host Programs.	334
Planning for 2216 Support	347
2216 Channel Adapter Problem Analysis and Resolution	347
Reconfiguration	347
Channel Adapter Overview	348
LAN Channel Station (LCS) Support.	350
Link Services Architecture (LSA) Support	352
Multi-Path Channel+ (MPC+) Support	359
Configuring the Channel Adapter Interface	365
Chapter 31. Configuring and Monitoring the ESCON and Parallel Channel Adapters.	367
Accessing the Channel Interface	367
Channel Adapter Configuration Commands	368
Add.	368
Delete.	382
Mod	383
List (ESCON)	385
List (PCA)	386
Set (PCA Only)	386
Accessing the Channel Interface Monitoring Process	386
Channel Interface Monitoring Commands	387
List	387
Net	390
Channel Adapter LCS Interface Monitoring Commands	390
List	390
Channel Adapter LSA Interface Monitoring Commands	392
List	392
Channel Adapter MPC+ Interface Monitoring Commands	393
List	394
Chapter 32. Configuring Serial Line Interfaces	399
Accessing the Interface Configuration Process	399
Clocking and Cable Type.	399
Network Interfaces and the GWCON Interface Command	400
Chapter 33. Using the X.25 Network Interface	401
Basic Configuration Procedures	401
Setting the National Personality	402
Understanding the X.25 Defaults	402

Null Encapsulation	404
Limitations	404
Configuration Changes	404
Configuring Null Encapsulation and Closed User Groups (CUG)	404
Understanding Closed User Groups	405
Bilateral Closed User Groups	406
Types of Extended Closed User Groups	406
Establishing X.25 Circuits with Closed User Groups on a Device	406
Configuring X.25 Closed User Groups	407
Chapter 34. Configuring and Monitoring the X.25 Network Interface	409
X.25 Configuration Commands.	409
Set	410
Enable	414
Disable	415
National Enable	415
National Disable	418
National Set	418
National Restore	423
Add.	424
Change	430
Delete.	432
List	433
Accessing the Interface Monitoring Process	435
X.25 Monitoring Commands.	436
List	436
Parameters	437
Statistics	437
X.25 Network Interfaces and the GWCON Interface Command	439
Statistics Displayed for X.25 Interfaces.	439
Chapter 35. Using XTP	443
The X.25 Transport Protocol	443
Configuration Information.	444
DTE Address Wildcards	445
XTP Backup Peer Function	446
Searching for a Remote DTE	446
Connection Request Timer	447
Local XTP	447
XTP and Closed User Groups	447
Configuring XTP	448
Configuration Procedures.	448
Setting the Data Link	449
Configuring the IP Interface	449
Configuring X.25	449
Setting the National Personality	451
Defining the IP Address	451
Setting the Internal IP Address.	451
Configuring XTP	451
Sample Configuration of Remote Routers.	453
Chapter 36. Configuring and Monitoring XTP	457
XTP Configuring Commands	457
Add.	457
Change	460
Delete.	460

Enable	462
Disable	462
Set	462
List	462
XTP Monitoring Commands	464
Add.	464
Delete.	465
List	465
Chapter 37. Using Frame Relay Interfaces	469
Frame Relay Overview	469
Frame Relay Network	470
Frame Relay Switched Virtual Circuits	471
Frame Relay Interface Initialization	471
Orphan Circuits	472
Configuring PVC States to Affect the Frame Relay Interface State.	473
Frame Relay Frame.	474
Frame Forwarding over the Frame Relay Network	476
Protocol Addresses	476
Multicast Emulation and Protocol Broadcast	476
Frame Relay Network Management	477
Management Status Reporting	477
Full Status Report	477
Link Integrity Verification Report	478
Consolidated Link Layer Management (CLLM)	478
Frame Relay Data Rates	478
Committed Information Rate (CIR)	478
Orphan Permanent Virtual Circuit CIR	479
Committed Burst (Bc) Size	479
Excess Burst (Be) Size	480
Line Speed	480
Minimum Information Rate	480
Maximum Information Rate	481
Variable Information Rate.	481
Circuit Congestion	481
CIR Monitoring	482
Congestion Monitoring.	482
Congestion Notification and Avoidance.	482
Bandwidth Reservation over Frame Relay	484
Displaying the Frame Relay Configuration Prompt	484
Frame Relay Basic Configuration Procedure.	484
Enabling Frame Relay PVC Management.	485
Enabling Frame Relay SVC Management.	486
Chapter 38. Configuring and Monitoring Frame Relay Interfaces	487
Frame Relay Configuration Commands	487
Add.	488
Change	495
Disable	496
Enable	498
List	502
LLC	508
Remove	508
Set	510
Accessing the Frame Relay Monitoring Prompt.	515
Frame Relay Monitoring Commands.	516

Clear	516
Disable	516
Enable	517
List	517
LLC	526
Notrace	526
Set	526
Trace	528
Frame Relay Interfaces and the GWCON Interface Command	528
Statistics Displayed For Frame Relay Interfaces	528
Chapter 39. Using Point-to-Point Protocol Interfaces	531
PPP Overview	531
PPP Data Link Layer Frame Structure	532
The PPP Link Control Protocol (LCP)	533
LCP Packets	534
Link Establishment Packets	536
Link Termination Packets	537
Link Maintenance Packets	537
PPP Authentication Protocols	537
Password Authentication Protocol (PAP)	538
Challenge-Handshake Authentication Protocol (CHAP)	538
Microsoft PPP CHAP Authentication (MS-CHAP)	539
Shiva Password Authentication Protocol (SPAP)	539
Configuring PPP Authentication	539
Configuring PPP Callback	541
Using AAA with PPP	542
The PPP Network Control Protocols	542
AppleTalk Control Protocol	542
Banyan VINES Control Protocol	543
Bridging Control Protocol	543
Callback Control Protocol	543
DECnet IV Control Protocol	543
IP Control Protocol	543
IPv6 Control Protocol	544
IPX Control Protocol	544
OSI Control Protocol	545
APPN HPR Control Protocol	545
APPN ISR Control Protocol	545
Using and Configuring Virtual Connections	545
VC Considerations	545
Configuring a VC	546
Chapter 40. Configuring and Monitoring Point-to-Point Protocol Interfaces	547
Accessing the Interface Configuration Process	547
Accessing the PPP Interface Configuration Prompt	547
Point-to-Point Configuration Commands	548
Disable	548
Enable	549
List	552
LLC	556
Set	556
Accessing the Interface Monitoring Process	565
Point-to-Point Monitoring Commands	566
Clear	566
List	566

LLC	589
Point-to-Point Protocol Interfaces and the GWCON Interface Command	589
Chapter 41. Using the Multilink PPP Protocol	593
MP Considerations	594
Multi-Chassis MP	595
Configuring a Multilink PPP Interface	595
Configuring MP on PPP Dial Circuits	595
Configuring MP on PPP Serial Links	596
Configuring MP on Layer-2-Tunneling Nets	596
Configuring Multi-Chassis MP	597
Chapter 42. Configuring and Monitoring Multilink PPP Protocol (MP)	599
Accessing the MP Configuration Prompt	599
MP Configuration Commands for Multilink PPP Interfaces	599
Disable	599
Enable	600
Encapsulator	600
List	600
Set	601
Monitoring MP Interface Status	603
Accessing the MP Monitoring Commands	603
Multilink PPP Protocol Monitoring Commands	603
List	603
Chapter 43. Configuring SDLC Relay	609
Basic Configuration Procedure	609
Accessing the SDLC Relay Configuration Environment	609
SDLC Relay Configuration Commands	610
Add	610
Delete	611
Disable	611
Enable	612
List (for network SRLY)	612
List (for protocol SDLC)	613
Set	614
Accessing the SDLC Relay Monitoring Environment	616
SDLC Relay Monitoring Commands	617
Clear-Port-Statistics	617
Disable	618
Enable	618
List	619
SDLC Relay Interfaces and the GWCON Interface Command	619
Chapter 44. Using SDLC Interfaces	621
Basic Configuration Procedure	621
Configuring Switched SDLC Call-In Interfaces	621
SDLC Configuration Requirements	622
Chapter 45. Configuring and Monitoring SDLC Interfaces	623
Accessing the SDLC Configuration Environment	623
SDLC Configuration Commands	624
Add	624
Delete	625
Disable	625
Enable	625

List	626
Set	628
Accessing the SDLC Monitoring Environment	634
SDLC Monitoring Commands	634
Add.	635
Clear	635
Delete.	635
Disable	635
Enable	636
List	636
Set	639
Test	641
SDLC Interfaces and the GWCON Interface Command.	642
Statistics Displayed for SDLC Interfaces	642
Chapter 46. Using the V.25bis Network Interface	645
Before You Begin	645
Configuration Procedures.	645
Adding V.25bis Addresses	645
Configuring the V.25bis Interface	646
Adding Dial Circuits.	647
Configuring Dial Circuits	647
Chapter 47. Configuring and Monitoring the V.25bis Network Interface	649
Accessing the Interface Configuration Process	649
V.25bis Configuration Commands.	649
List	650
Set	651
Accessing the Interface Monitoring Process	653
V.25bis Monitoring Commands.	653
Calls	654
Circuits	655
Parameters	655
Statistics	656
V.25bis and the GWCON Commands	658
Statistics for V.25bis Interfaces and Dial Circuits	658
Chapter 48. Using the ISDN Interface	661
ISDN Overview	661
ISDN Adapters and Interfaces	661
Dial Circuits.	662
Addressing	663
Oversubscribing and Circuit Contention	663
Cost Control Over Demand Circuits	663
Caller ID and LIDS	664
ISDN Cause Codes	664
Sample ISDN Configurations	666
Frame Relay over ISDN Configuration	666
WAN Restoral Configuration	666
Channelized T1/E1	667
Requirements and Restrictions for ISDN Interfaces	668
Switches/Services Supported	668
ISDN Interface Restrictions	668
Dial Circuit Configuration Requirements	668
Before You Begin	668
Configuration Procedures.	668

Adding ISDN Addresses	669
Configuring ISDN Parameters	669
Configuring the ISDN Interface.	670
Adding Dial Circuits	671
Configuring Dial Circuits	671
I.431 Switch Variant.	673
Native I.431 Support	673
Chapter 49. Configuring and Monitoring the ISDN Interface.	675
ISDN Configuration Commands	675
Block-Calls	675
List	676
Remove	676
Set	676
Cause Code	680
Accessing the Interface Monitoring Process	680
ISDN Monitoring Commands	681
Block-Calls	681
Calls	682
Channels.	682
Circuits	682
Dial-dump	683
L2_Counters	684
L3_Counters	684
TEI	684
Parameters	684
Statistics	685
ISDN and the GWCON Commands	686
Interface — Statistics for ISDN Interfaces and Dial Circuits	686
Configuration - Information on Router Hardware and Software	687
Chapter 50. Configuring and Monitoring Dial Circuits	689
Dial Circuit Configuration Commands	689
Delete.	690
Encapsulator	690
List	691
Set	692
Dial Circuit Monitoring Commands	695
Callback	696
Appendix A. Quick Configuration Reference.	697
Quick Configuration Tips	697
Making Selections	697
Exiting and Restarting	697
When You're Done	698
Starting the Quick Configuration Program.	698
Configuring LAN Emulation	698
Configuring Bridging	699
Configuring Protocols	700
Configuring IP	701
Configuring IPX	702
Configuring DECnet (DNA)	704
Restarting the IBM 2216	706
Appendix B. X.25 National Personalities	707
GTE-Telenet	707

DDN	707
Appendix C. Making a Router Load File from Multiple Disks	709
Assembling a Load File Under DOS.	709
Assembling a Load File Under UNIX	709
Disassembling a Load File Under DOS	710
Disassembling a Load File Under UNIX	711
Appendix D. Remote AAA Attributes	713
Radius	713
Keywords	713
TACACS+	714
List of Abbreviations	715
Glossary	725
Index	749
Readers' Comments — We'd Like to Hear from You.	769

Figures

1. Multiprotocol Access Services	7
2. Relationship of Processes and Commands	8
3. Memory Utilization	35
4. Message Generated by an Event	125
5. Syslog Message Description.	131
6. syslog.conf Configuration File	133
7. Configuring the 2216 for Remote Logging	134
8. Configuring Subsystems and Events for Remote Logging	135
9. Sample Contents from Syslog News Info File	136
10. Output from Talk 2	137
11. Sample Contents from <i>Syslog_user_alert</i> File	137
12. Example of Setting Up a Static ARP Entry.	138
13. Example of Recurring Sequence Numbers in Syslog Output	139
14. Configuring ELS Message Buffering	141
15. FDDI Network Diagram	225
16. Physical and Logical Views of a Simple LAN Emulation Network	266
17. Default Connections Between LE Clients and the LES	274
18. Default Connection Between LE Clients (LECs) and BUS	276
19. LAN Emulation Redundancy.	280
20. ESCON Channel Configuration Example	328
21. EMIF Host Configuration Example	330
22. Parallel Channel Adapter Configuration Example	331
23. 2216 Connected to a Host through an ESCON/PCA Channel Adapter - Logical View	348
24. 2216 Virtual Net Handlers for LCS and LSA	350
25. 2216 Virtual Net Handlers for MPC+.	350
26. Configuring LAN Channel Station (LCS) Virtual Net Handlers.	351
27. Configuring Link Services Architecture (LSA) Virtual Net Handlers	353
28. Configuring Virtual Net Handlers for LSA Direct Connection	354
29. Configuring Virtual Net Handlers for LSA APPN Connection	355
30. Configuring Virtual Net Handlers for LSA DLSw Connection	356
31. Configuring Virtual Net Handlers for LSA DLSw Local Conversion	358
32. Different types of MPC+ Connections	360
33. Configuring Virtual Net Handlers for APPN over Multi-Path Channel+ (MPC+)	361
34. Configuring Virtual Net Handlers for UDP+ over MPC+	362
35. Configuring Virtual Net Handlers for TCP/IP over MPC+	364
36. Closed User Group Null Encapsulation	405
37. Configuration Before and After XTP	444
38. Sample XTP Configuration	448
39. DLCIs in Frame Relay Network.	470
40. DLCIs in Frame Relay Network.	472
41. Orphan Circuit	473
42. Frame-Relay Frame Format	474
43. Congestion Notification and Throttle Down	483
44. Examples of Point-to-Point Links	532
45. PPP Frame Structure	533
46. LCP Frame Structure (in PPP Information Field)	535
47. Multichassis MP	597
48. Frame Relay over ISDN Configuration	666
49. Using ISDN for WAN Restoral	667

Tables

1. Code Features supported in the 2216 Model 400 and Network Utilityxxxiii
2. Processes, Their Purpose, and Commands to Access	10
3. Network Architecture and the Supported Interfaces	18
4. OPCON Commands.	31
5. Change Management Configuration Commands	43
6. Quick Config Capabilities	58
7. CONFIG Command Summary	67
8. Access Permission	74
9. IBM 2216 Feature Numbers and Names	86
10. Additional Functions Provided by the Set Prompt Level Command.	99
11. Default and Maximum Settings for Interfaces.	100
12. GWCON Command Summary	105
13. Logging Levels.	125
14. Packet Completion Codes (Error Codes)	126
15. ELS Configuration Command Summary	143
16. ELS Net Filter Configuration Commands	159
17. ELS Message Buffering Configuration Commands.	161
18. ELS Monitoring Command Summary	165
19. Packet Trace Monitoring Command Summary	183
20. ELS Net Filter Monitoring Commands	186
21. ELS Message Buffering Monitoring Commands	188
22. PERF Configuration Command Summary	196
23. PERF Monitoring Command Summary	197
24. Token-Ring Configuration Command Summary	205
25. Token-Ring 4/16 Valid Packet Sizes	207
26. Token-Ring Monitoring Command Summary	209
27. FasTR Configuration Command Summary	215
28. FasTR Monitoring Command Summary.	218
29. FDDI Configuration Command Summary	227
30. FDDI Monitoring Command Summary	230
31. LLC Configuration Command Summary	235
32. LLC Monitoring Command Summary.	239
33. Ethernet Configuration Command Summary	251
34. Ethernet monitoring command Summary	253
35. 10/100 Mbps Ethernet Configuration Command Summary	259
36. Ethernet Monitoring Command Summary	262
37. ATM Configuration Command Summary	287
38. ATM INTERFACE Configuration Command Summary	288
39. ATM Virtual Interface Configuration Command Summary	295
40. ATM monitoring command Summary.	296
41. ATM INTERFACE monitoring command Summary.	297
42. ATM LLC Configuration Command Summary	300
43. LAN EMULATION Client Configuration Commands Summary	303
44. LAN Emulation Client Configuration Commands Summary.	305
45. ATM LAN Emulation Client ARP Configuration Commands Summary	305
46. ATM LAN Emulation Client ARP Config Commands Summary	306
47. LE Config monitoring command Summary.	319
48. Channel Interface Configuration Commands	368
49. Channel Interface Monitoring Commands	387
50. Channel Adapter LCS Interface Monitoring Commands	390
51. Channel Adapter LSA Interface Monitoring Commands	392
52. Channel MPC+ Interface Monitoring Commands	393
53. Set Command	402

54.	National Enable Parameters	403
55.	National Set Parameters	403
56.	Establishing Incoming X.25 Circuits for Closed User Groups	406
57.	X.25 Configuration Commands Summary	409
58.	Line Speeds When Internal Clocking is Used for 2216 Interfaces	413
59.	Line Speeds When External Clocking is Used for 2216 Interfaces	413
60.	Example VC Definitions	414
61.	X.25 Monitoring Command Summary	436
62.	XTP Configuration Commands Summary	457
63.	XTP Monitoring Commands Summary	464
64.	Protocol Address Mapping	476
65.	Frame Relay Management Options	485
66.	Frame Relay Configuration Commands Summary	487
67.	Line Speeds When Internal Clocking is Used for 2216 Interfaces	514
68.	Line Speeds When External Clocking is Used for 2216 Interfaces	514
69.	Frame Relay Management Options	514
70.	Transmit Delay Units and Range for the 2216 Serial Interface	515
71.	Frame Relay Monitoring Commands Summary	516
72.	LCP Packet Codes	535
73.	Point-to-Point Configuration Command Summary	548
74.	Cable types for 2216 Interfaces	559
75.	Line Speeds When Internal Clocking is Used for 2216 Interfaces	560
76.	Line Speeds When External Clocking is Used for 2216 Interfaces	560
77.	Point-to-Point Monitoring Command Summary	566
78.	MP Configuration Commands	599
79.	MP Monitoring Commands	603
80.	SDLC Relay Configuration Commands Summary	610
81.	Cable Types for 2216 Interfaces	615
82.	Valid Values for Frame Size in Set Frame-Size Command	615
83.	Line Speeds When Internal Clocking is Used for 2216 Interfaces	616
84.	Line Speeds When External Clocking is Used for 2216 Interfaces	616
85.	SDLC Relay Monitoring Commands Summary	617
86.	SDLC Configuration Commands Summary	624
87.	Cable types for 2216 Interfaces	629
88.	Valid Values for Frame Size in Link Frame-Size Command	630
89.	Line Speeds When Internal Clocking is Used for 2216 Interfaces	632
90.	Line Speeds When External Clocking is Used for 2216 Interfaces	632
91.	SDLC Monitoring Commands Summary	634
92.	V.25bis Configuration Commands Summary	649
93.	V.25bis Monitoring Command Summary	653
94.	ISDN Q.931 Cause Codes	664
95.	ISDN Configuration Command Summary	675
96.	ISDN Cause Codes Command Summary	680
97.	ISDN Monitoring Command Summary	681
98.	Dial Circuit Configuration Commands Summary.	689
99.	Dial Circuit Configuration Commands Summary.	695

Notices

References in this publication to IBM products, programs, or services do not imply that IBM intends to make these available in all countries in which IBM operates. Any reference to an IBM product, program, or service is not intended to state or imply that only IBM's product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any of IBM's intellectual property rights may be used instead of the IBM product, program, or service. Evaluation and verification of operation in conjunction with other products, except those expressly designated by IBM, are the user's responsibility.

| IBM may have patents or pending patent applications covering subject matter in this
| document. The furnishing of this document does not give you any license to these
| patents. You can send license inquiries, in writing, to the IBM Director of Licensing,
| IBM Corporation, North Castle Drive, Armonk, NY 10504-1785, U.S.A.

The licensed program described in this document and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement.

| This document is not intended for production use and is furnished as is without any
| warranty of any kind, and all warranties are hereby disclaimed including the
| warranties of merchantability and fitness for a particular purpose.

Notice to Users of Online Versions of This Book

For online versions of this book, you are authorized to:

- Copy, modify, and print the documentation contained on the media, for use within your enterprise, provided you reproduce the copyright notice, all warning statements, and other required statements on each copy or partial copy.
- Transfer the original unaltered copy of the documentation when you transfer the related IBM product (which may be either machines you own, or programs, if the program's license terms permit a transfer). You must, at the same time, destroy all other copies of the documentation.

You are responsible for payment of any taxes, including personal property taxes, resulting from this authorization.

THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Some jurisdictions do not allow the exclusion of implied warranties, so the above exclusion may not apply to you.

Your failure to comply with the terms above terminates this authorization. Upon termination, you must destroy your machine-readable documentation.

Trademarks

The following terms are trademarks of the IBM Corporation in the United States or other countries or both:

Advanced Peer-to-Peer Networking	IBM	PS/2
AIX	Micro Channel	RS/6000
AIXwindows	NetView	System/370
APPN	AS/400	Nways
VTAM	BookManager	ESCON

UNIX is a registered trademark in the United States and other countries licensed exclusively through X/Open Company Limited.

Microsoft, Windows, Windows NT, and the Windows logo are trademarks or registered trademarks of Microsoft Corporation.

Other company, product, and service names may be trademarks or service marks of others.

Preface

This manual contains the information that you will need to use the router user interface for configuration and operation of the Multiprotocol Access Services base code installed on your Nways device. With the help of this manual, you should be able to perform the following processes and operations:

- Configure, monitor, and use the Multiprotocol Access Services base code.
- Configure, monitor, and use the interfaces and Link Layer software supported by your Nways device .

This manual contains the information you will need to configure bridging and routing functions on an Nways device. The manual describes all of the features and functions that are in the software. A specific Nways device might not support all of the features and functions described. If a feature or function is device-specific, a notice in the relevant chapter or section indicates that restriction.

This manual supports the IBM 2216 and refers to this product as either “the router” or “the device”. The examples in the manual represent the configuration of an IBM 2216 but the actual output you see may vary. Use the examples as a guideline to what you might see while configuring your device.

Who Should Read This Manual

This manual is intended for persons who install and manage computer networks. Although experience with computer networking hardware and software is helpful, you do not need programming experience to use the protocol software.

To get additional information: Changes may be made to the documentation after the books are printed. If additional information is available or if changes are required after the books have been printed, the changes will be in a file (named README) on diskette 1 of the configuration program diskettes. You can view the file with an ASCII text editor.

About the Software

IBM Nways Multiprotocol Access Services is the software that supports the IBM 2216 (licensed program number 5765-C90). This software has these components:

- The base code, which consists of:
 - The code that provides the routing, bridging, data link switching, and SNMP agent functions for the device.
 - The router user interface, which allows you to configure, monitor, and use the Multiprotocol Access Services base code installed on the device. The router user interface is accessed locally through an ASCII terminal or emulator attached to the service port, or remotely through a Telnet session or modem-attached device.

The base code is installed at the factory on the 2216.

- The Configuration Program for IBM Nways Multiprotocol Access Services (referred to in this book as the *Configuration Program*) is a graphical user interface that enables you to configure the device from a stand-alone workstation. The Configuration Program includes error checking and online help information.

The Configuration Program is not pre-loaded at the factory; it is shipped separately from the device as part of the software order.

You can also obtain the Configuration Program for IBM Nways Multiprotocol Access Services from the IBM Networking Technical Support home page. See *Configuration Program User's Guide for Nways Multiprotocol and Access Services Products*, GC30-3830, for the server address and directories.

Conventions Used in This Manual

The following conventions are used in this manual to show command syntax and program responses:

1. The abbreviated form of a command is underlined as shown in the following example:

```
reload
```

In this example, you can enter either the whole command (reload) or its abbreviation (rel).

2. Keyword choices for a parameter are enclosed in brackets and separated by the word or. For example:

```
command [keyword1 or keyword2]
```

Choose one of the keywords as a value for the parameter.

3. Three periods following an option mean that you enter additional data (for example, a variable) after the option. For example:

```
time host ...
```

In this example, you enter the IP address of the host in place of the periods, as explained in the description of the command.

4. In information displayed in response to a command, defaults for an option are enclosed in brackets immediately following the option. For example:

```
Media (UTP/STP) [UTP]
```

In this example, the media defaults to UTP unless you specify STP.

5. Keyboard key combinations are indicated in text in the following ways:

- **Ctrl-P**
- **Ctrl -**

The key combination **Ctrl -** indicates that you should press the Ctrl key and the hyphen simultaneously. In certain circumstances, this key combination changes the command line prompt.

6. Names of keyboard keys are indicated like this: **Enter**
7. Variables (that is, names used to represent data that you define) are denoted by italics. For example:

```
File Name: filename.ext
```

Library Overview

The following list shows the books in the IBM 2216 library, arranged according to tasks.

Information updates and corrections: To keep you informed of engineering changes, clarifications, and fixes that were implemented after the books were printed, refer to the IBM 2216 home pages at:

<http://www.networking.ibm.com/216/216prod.html>

Planning

GA27-4105

IBM 2216 Introduction and Planning Guide

This book is shipped with the IBM 2216. It explains how to prepare for installation and perform an initial configuration.

Installation

GA27-4106

IBM 2216 Nways Multiaccess Connector Installation and Initial Configuration Guide

This booklet is shipped with the IBM 2216. It explains how to install the IBM 2216 and verify its installation.

GX27-3988

2216 Nways Multiaccess Connector Hardware Configuration Quick Reference

This reference card is used for entering and saving hardware configuration information used to determine the correct state of an IBM 2216.

Diagnostics and Maintenance

SY27-0350

2216 Nways Multiaccess Connector Service and Maintenance Manual

This book is shipped with the IBM 2216. It provides instructions for diagnosing problems with and repairing the IBM 2216.

Operations and Network Management

The following list shows the books that support the Multiprotocol Access Services program.

SC30-3886

Software User's Guide

This book explains how to:

- Configure, monitor, and use the Multiprotocol Access Services software.
- Use the Multiprotocol Access Services command-line router user interface to configure and monitor the network interfaces and link-layer protocols shipped with the IBM 2216.

SC30-3993

Using and Configuring Features

SC30-3884

Protocol Configuration and Monitoring Reference Volume 1

SC30-3885

Protocol Configuration and Monitoring Reference Volume 2

These books describe how to access and use the Multiprotocol Access Services command-line user interface to configure and monitor the routing protocol software shipped with the product.

They include information about each of the protocols that the devices support.

SC30-3682

Event Logging System Messages Guide

This book contains a listing of the error codes that can occur, along with descriptions and recommended actions to correct the errors.

Configuration

GC30-3830

Configuration Program User's Guide for Nways Multiprotocol and Access Services Products

This book discusses how to use the Configuration Program.

Safety

SD21-0030

Caution: Safety Information—Read This First

This book, shipped with the IBM 2216, provides translations of caution and danger notices applicable to the installation and maintenance of a IBM 2216.

Marketing

URL: <http://www.networking.ibm.com/216/216prod.html>

This IBM Web page provides product information through the World Wide Web.

Summary of Changes for the IBM 2216 Software Library

The changes consist of:

In addition to these functional changes, a new product, Network Utility, is now available. The models of this product provide a subset of the capabilities of the 2216. See Table 1 on page xxxiii for more information.

Editorial Changes

This edition continues a number of editorial changes to this book and the other software books that will:

- Reorganize the material
- Remove any unnecessary and redundant information
- Improve retrievability
- Add additional clarification to some information

The first step in reorganization has been completed as follows:

- The part titled **Understanding, Using and Configuring Features** has been moved into the *Using and Configuring Features* book from the *Nways Multiprotocol Access Services Software User's Guide*.

Summary of Changes

- The chapters on using, configuring, and monitoring the DIALs feature have been moved into the *Using and Configuring Features* book.

This reorganization will take place over a number of editions. If you would like to comment on these changes, please mail or fax your comments on the form for readers' comments at the back of this publication.

Software Features Supported by Network Utility

Each model of Network Utility provides a subset of the software features of the 2216, as shown in Table 1. The 2216 Model 400 Web Server Cache (WSC) supports IP protocols and does not provide APPN features.

Table 1. Code Features supported in the 2216 Model 400 and Network Utility

Feature or Protocol	Available for 2216 Model 400 Base	Available for 2216 Model 400 WSC	Available for Network Utility Model TN1	Available for Network Utility Model TX1
TN3720e	yes ¹	—	yes ¹	—
Network Dispatcher	yes	yes	yes	yes
TN3720e Server Advisor (or Network Dispatcher Advisor)	yes	yes ²	yes	yes ²
Bandwidth reservation and Priority queuing	yes	yes	yes	yes
MAC filtering	yes	yes	yes	yes
WAN restoral	yes	yes	—	—
WAN reroute	yes	yes	—	—
Data compression	yes	yes	yes	yes
Data Link Switching (DLSw)	yes	—	yes	yes
Encryption	yes	yes	—	—
Quality of Service (QoS)	yes	yes	yes	yes
IPsec (IP Security)	yes	yes	—	—
L2TP	yes	yes	—	—
Network Address Translation	yes	yes	—	—
AAA (Authentication, Authorization, and Accounting Security)	yes	yes	yes	yes
RSVP	yes	yes	yes	yes
IPv6	yes	—	yes	yes
Thin Server	yes	—	—	—
Web Server Cache	—	yes	—	—
IPX	yes	—	—	—
Appletalk	yes	—	—	—
DECnet IV	yes	—	—	—
OSI	yes	—	—	—
Banyan Vines	yes	—	—	—

Summary of Changes

Table 1. Code Features supported in the 2216 Model 400 and Network Utility (continued)

Feature or Protocol	Available for 2216 Model 400 Base	Available for 2216 Model 400 WSC	Available for Network Utility Model TN1	Available for Network Utility Model TX1
DIALs	yes	yes	—	—
APPN features				
Branch Extender	yes	—	yes	yes
Dependent LU Requestor (DLuR)	yes	—	yes	yes
Enterprise Extender	yes	—	yes	yes
Extended Border Node	yes	—	yes	yes
High-performance routing (HPR)	yes	—	yes	yes
Network node (NN)	yes	—	yes	yes
<ol style="list-style-type: none"> 1. This is a separately priced feature 2. When communicating with a TN3270e server on an IBM routing product 				

Part 1. Understanding and Using the Software

Chapter 1. Getting Started

This chapter shows you how to get started with using the following components related to the IBM 2216 Model 400 Switch (2216) and the Multiprotocol Access Services:

- Router console terminals
- Router software (Multiprotocol Access Services)
- Router software user interface

The information in this chapter is divided into the following sections:

- “Before You Begin”
- “Accessing the Software Using Local and Remote Consoles”
- “Discussing the User Interface System” on page 6

Before You Begin

Before you begin, refer to the following checklist to verify that your router is installed correctly.

HAVE YOU...

- Installed all necessary hardware?
- Connected the console terminal (video terminal) to the router?

Attention: If you are using a service port-attached terminal to configure or monitor your IBM 2216 and your service terminal is unreadable, you need to change some parameters in your configuration.

Refer to your hardware documentation.

- Connected your router to the network using the correct network interfaces and cables?
- Run all necessary hardware diagnostics?

For more information on any of these procedures, refer to the *IBM 2216 Nways Multiaccess Connector Installation and Initial Configuration Guide*.

Migrating to the Current Release

Refer to the *2216 Nways Multiaccess Connector Service and Maintenance Manual* for information about migrating to a new code level.

Accessing the Software Using Local and Remote Consoles

The router console lets you use the router user interface to monitor and change the function of the router’s networking software (Multiprotocol Access Services). The router supports local and remote consoles.

Local Consoles

Local consoles are either directly connected by an EIA 232 (RS-232) cable, or connected via modems to the router. You may need to use a local console during the initial software installation. After the initial setup connection, you can connect using Telnet, as long as IP forwarding has been enabled. (Refer to *Protocol Configuration and Monitoring Reference* for more information on enabling IP forwarding.)

When the configured router is started for the first time, a boot message appears on the screen, followed by the OPERator's CONsole or OPCON prompt (*). The * prompt indicates that the router is ready to accept OPCON commands.

You will need to use an ASCII terminal attached to the 2216 service port to initially configure it.

Important: Garbage, random characters, reverse question marks, or the inability to connect your terminal to the 2216 service port can have many causes. The following list contains some of those causes:

- The most common cause of garbage or random characters on the service console is that the baud rate is not synchronized with the IBM 2216.

If the 2216 is set to a specific baud rate, the terminal or terminal emulator must be set to the same baud rate.

If the IBM 2216 is set to autobaud (this is the default), press the terminal break key sequence and press **Enter**.

A typical break key sequence for PC terminal emulators is Alt-B (refer to the terminal emulator documentation). Most ASCII terminals have a **Break** key (often used in conjunction with the **Ctrl** key).

Refer to your hardware documentation for more information.

- Defective terminal or device (ac) grounds.
- Defective, incorrectly shielded, or incorrectly grounded EIA 232 (RS-232) cable between the terminal and the IBM 2216.
- Defective terminal or terminal emulator.
- Defective IBM 2216 system board.
- High ambient electromagnetic interference (EMI) levels.
- Power line disturbances.

Once the 2216 is initially configured, you will not need a local console for router operation, as long as IP is enabled.

The router software automatically handles console activity. When upgrading the software, you might have to use the local console. For information on attaching and configuring local consoles, refer to the *IBM 2216 Nways Multiaccess Connector Installation and Initial Configuration Guide*.

Remote Consoles

Remote consoles attach to the router using a standard remote terminal protocol. Remote consoles provide the same function as local consoles, except that a local console must be used for initial configuration. You can use no more than two remote consoles at the same time on a router. You can connect remote consoles to the router through a Telnet connection. You have the option to disable this feature.

Telnet Connections

The router supports both Telnet Client and Server. The remote console on the router acts as a Telnet server. The router acts as a Telnet client when connecting from the router to either another router or a host using the **telnet** command in the OPCON (*) process.

Remote Login Names and Passwords

During a remote login, the router prompts you for a login name and password. You can display the login name when logged in to the router from a remote console by using a router **status** command.

Logging In Remotely or Locally

Logging in to a local console is the same as logging in to a remote console except that you must connect to the router by starting Telnet on your host system. To log in remotely, begin at step 1. To log in locally, begin at step 3.

To log in from a remote console:

1. Connect to the router by starting Telnet on your host system. Your host system is the system to which remote terminals are connected.
2. Supply the router's name or Internet Protocol (IP) address.

To use router names, your network must have a name server. Issue either the router name or the IP address as shown in the following example:

```
% telnet brandenburg
```

or

```
% telnet 128.185.132.43
```

At this point, it makes no difference whether you have logged in remotely or locally.

3. If you are prompted, enter your login name and password.

```
login:  
Password:
```

It is possible that there is a login and no password. The password controls access to the router. If a password has not been set, press the **Enter** key at the Password: prompt. Logins are not set automatically. For security, you can set up user names and passwords using the **add user** command in the CONFIG process. For additional information, see the **add user** configuration command, on page 73. Remember to reload to activate any changes.

Note: If you do not enter a login name and valid password within 1 minute of the initial prompt, or if you enter an incorrect password three times in succession, the router drops the Telnet connection.

4. Press the **Enter** key to display the asterisk (*) prompt.

You may have to press the **Enter** key more than once or press **Ctrl-P** to obtain the * prompt.

Once at this level, you can begin to enter commands from the keyboard. Press the **Backspace** key to delete the last character typed in on the command line. Press the **Delete** key or **Ctrl-U** to delete the whole command line entry so that

you can reenter a command. See “Command History for GWCON and CONFIG Command Line” on page 23 for information on how to access previously entered commands.

You can also use local Telnet commands on your Telnet client to close the Telnet connection.

Note: If you use a VT100 terminal, do not press the **Backspace** key, because it inserts invisible characters. Use the **Delete** key.

5. Exit the router as described in “Exiting the Router”.

Reloading the Router

Use the **reload** command to reboot the device by loading a new copy of the configuration from memory. Whenever you change a user-configurable parameter that is not dynamically configurable, you must reload the device for the change to take effect. For example:

```
* reload
```

```
The configuration has been changed, save it? (Yes or [No] or Abort)
```

```
Are you sure you want to reload the gateway? (Yes or [No]): yes
```

Exiting the Router

Return to the * prompt and close the Telnet connection. For example:

```
IP Config> exit  
Config> Ctrl-P  
* logout  
  
%
```

You can also use local Telnet commands on your Telnet client to close the Telnet connection.

Discussing the User Interface System

The software (Multiprotocol Access Services) is a multitasking system that schedules use of the CPU among various processes and hardware devices. The router software:

- Provides timing and memory management, and supports both local and remote operator consoles from which you can view and modify the router’s operational parameters.
- Consists of functional modules that include various user interface processes, all network interface drivers, and all protocol forwarders purchased with the router.

Understanding the First-Level User Interface

The user interface to the software consists of the main menu (process) and several subsidiary menus (processes). These menus are related to the multiple levels of processes in the software.

The first level of processes consists of the OPCON and CONFIG-ONLY processes. In most cases, you will use the OPCON process to access the second level to configure or operate the base services, features, interfaces, and protocols you will run on your IBM 2216.

The second level of processes consists of the processes listed by the **status** command. You use the talk *pid* command to access the second-level processes. There are processes that you cannot use in the software. See Table 2 on page 10 for an overview of the processes.

Figure 1 shows the processes and how they fit within the structure of the router software.

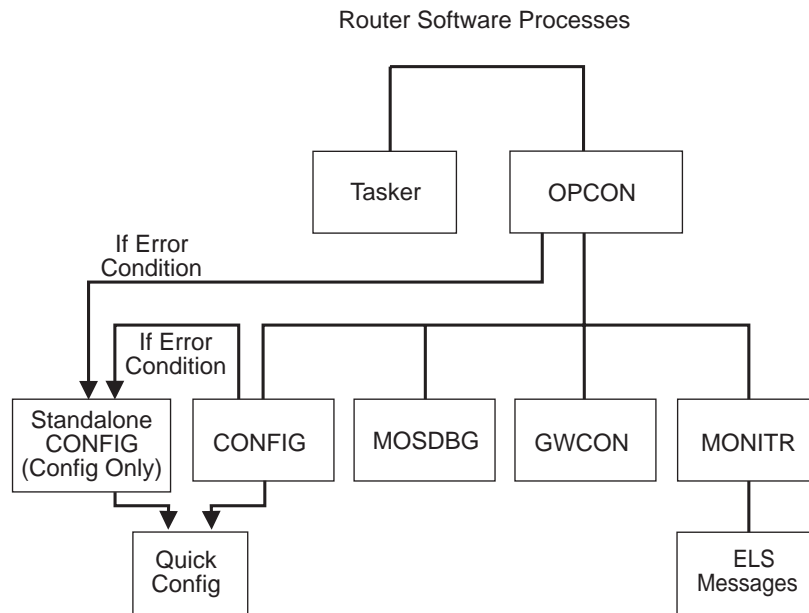


Figure 1. Multiprotocol Access Services

Figure 2 on page 8 is an example of the relationship between the various process levels.

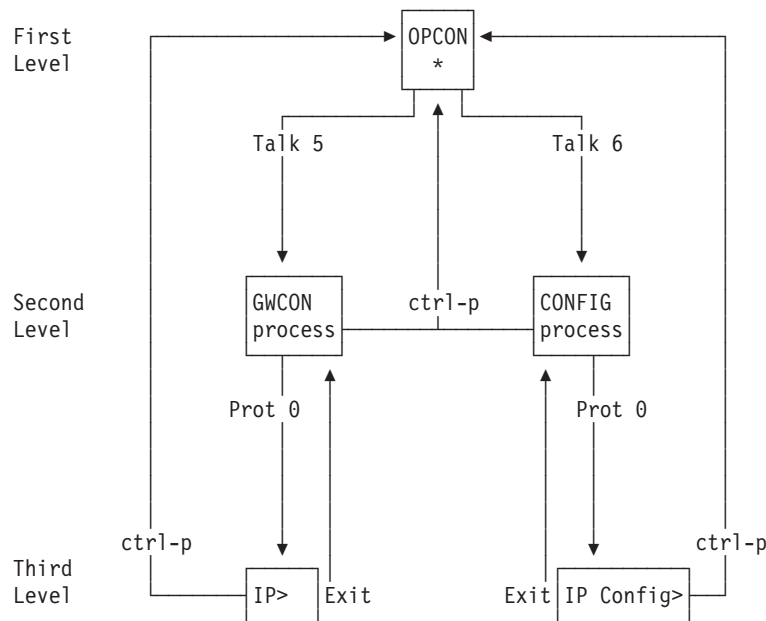


Figure 2. Relationship of Processes and Commands

Note: Also shown in Figure 2 are the various commands to access each process level and return from each process level.

See “Chapter 4. The OPCON Process” on page 29 for more information about OPCON, and “Config-Only Mode” on page 58 for more information about CONFIG-ONLY.

The ROPCON process handles processing from remote consoles and is essentially the same as the OPCON process.

Quick Configuration Process

Quick Configuration, or Quick Config, allows you to quickly configure portions of the router without dealing with the specific operating system commands. When you initially load or reload the router with no configuration, you enter Config-Only and you can access Quick Config menus from that process. If the router has devices configured and the devices do not have any protocols configured, the router automatically starts Config-Only and then enters Quick Config.

You can also enter Quick Config from the CONFIG process using the **qconfig** command.

System Security

Multiple users with login permissions can be added using the **add user** command. See “Configuring User Access” on page 59 for details on security issues and for information on the **set password** and **add user** commands.

Chapter 2. Using the Software

This chapter describes how to use the software. It consists of:

- “Entering Commands”
- “Connecting to a Process”
- “Some Configuration Suggestions” on page 11
- “Accessing the Second-Level Processes” on page 13
- “Accessing the Third-Level Processes” on page 15
- “Command History for GWCON and CONFIG Command Line” on page 23

Entering Commands

When typing a command, remember the following:

- Type only enough sequential letters of the command to make it unique among the available commands. For example, to execute the **reload** command you must enter **rel** as a minimum. The minimum number of required characters are underlined in the command syntax chapters.
- Commands are not case-sensitive.
- Sometimes, only the first letter of the command (and subsequent options) is required to execute the command. For example, typing **s** at the * prompt followed by pressing the **Enter** key causes the **status** command to be executed.

Connecting to a Process

When you start the router, the console displays a boot message. The OPCON prompt (*) then appears on the screen indicating that you are in the OPCON process and you can begin entering OPCON commands. This is the command prompt from which you communicate with different processes.

To connect your console to a process:

1. Find out the process ID (PID) number of a process by entering the **status** command at the * prompt.

The **status** command displays information about the router processes, such as the process IDs (PIDs), process names and status of the process. Issuing the **status** command is shown in the following example:

```
* status
Pid  Name      Status TTY  Comments
1    COpCn1    RDY   TTY0
2    Monitr    DET   --
3    Tasker    RDY   --
4    MOSDBG    DET   --
5    CGWCon    DET   --
6    Config    DET   --
7    ELScon    DET   --
8    ROpCn1    IDL   TTY1 128.185.210.125
9    ROpCn2    IDL   TTY2
```

2. Use the **talk pid** command, where *pid* is the number of the process to which you want to connect. (For more information about these and other OPCON commands, refer to “Chapter 4. The OPCON Process” on page 29.)

Note: Not every process listed has a user interface (for example, the **talk 3** process). The **talk 4** command is for use by IBM service representatives.

Identifying Prompts

Each process uses a different prompt. You can tell which process your console is connected to by looking at the prompt. (If the prompt does not appear when you enter the **talk pid** command, press the **Return** key a few times.)

The following list shows the prompts for the five main processes:

Table 2. Processes, Their Purpose, and Commands to Access

Process	Level and Purpose	Command to Access	Input Prompt
OPCON	Level 1 - access to all secondary levels	Ctrl-P	asterisk (*)
CONFIG	Level 2 - base services configuration and access to configuration third level	talk 6	Config >
GWCON	Level 2 - base services operation and monitoring and access to operations and monitoring on third level	talk 5	plus sign (+)
MONITR	level 2 - message display	talk 2	(none)
ELSCon	level 2 - direct monitoring and access to ELS console	talk 7	ELS Secondary Console>
MOSDBG	level 2 - diagnostic environment	talk 4	db>
DIAGS	level 2 - run hardware diagnostics	diags	

Note: Only enter the **talk 4** command under the direction of a service representative.

At the OPCON prompt level, you can begin to enter commands from the keyboard. Use the **Backspace** key to delete the last character typed in on the command line. Use **Ctrl-U** to delete the whole command line entry so that you can reenter a command. See "Command History for GWCON and CONFIG Command Line" on page 23 for information on how to access previously entered commands.

Getting Help

At the command prompts, you can obtain help in the form of a listing of the commands available at that level. To do this, type **?** (the **help** command), and then press **Enter**. Use **?** to list the commands that are available from the current level. You can usually enter a **?** after a specific command name to list its options. For example, the following information appears if you enter **?** at the ***** prompt:

```
*?
DIAGS hardware diagnostics
DIVERT output from process
FLUSH output from process
HALT output from process
INTERCEPT character is
LOGOUT
MEMORY statistics
RELOAD

STATUS of process(es)
TALK to process
TELNET to IP-Address
```

Exiting a Lower Level Environment

The multiple-level nature of the software places you in secondary, tertiary, and even lower level environments as you configure or operate the 2216. To return to the next higher level, enter the **exit** command. To get to the secondary level, continue entering **exit** until you receive the secondary level prompt (either Config> or +).

For example, to exit the IP protocol configuration process:

```
IP config> exit
Config>
```

If you need to get to the primary level (OPCON), enter the intercept character (**Ctrl P** by default).

Getting Back to OPCON

To get back to the OPCON prompt (*), press **Ctrl-P**. You must always return to OPCON before you can communicate with another process. For example, if you are connected to the GWCON process and you want to connect to the CONFIG process, you must press **Ctrl-P** to return to OPCON first. The **Ctrl-P** key combination is the default *intercept character*.

If you use the intercept character from a third-level or lower level process to return to the * prompt, the next time you use the **talk** command, you will reenter the third level process. This link goes away when the router is re-initialized.

Some Configuration Suggestions

Configuring a 2216 is different depending on whether you are configuring for the first time, creating a configuration based on an existing configuration, or just updating a configuration. Use the following sections as a guide to the best procedure to use, depending on your needs.

Creating a First Configuration

This procedure assumes that you have no other 2216 that contains a configuration similar to the one for the 2216 you are configuring. The procedure also assumes that you have just taken the 2216 out of the box. Although this procedure specifies an order, you can perform the actual configuration (after step 3) in any order.

To configure a IBM 2216 for the first time:

1. Examine the 2216 you are configuring to determine which interfaces you need to configure. Note these for later use.
2. Connect to the 2216 as described in “Accessing the Software Using Local and Remote Consoles” on page 3.
3. Initially configure a port on the 2216 and at least an internal IP address for the device using Quick Config as described in “Quick Configuration” on page 58 or “Appendix A. Quick Configuration Reference” on page 697. Configure the minimum needed to allow you to Telnet into the device.
4. Configure any base services, such as boot options. Access the configuration process as described in “Accessing the Configuration Process, CONFIG (Talk 6)” on page 14.

5. Configure the interfaces. Access the interface configuration process as described in “Accessing the Network Interface Configuration Process” on page 16 .
6. Configure any required features. Access the feature configuration process as described in “Accessing Feature Configuration and Operating Processes” on page 20 .
7. Configure any protocols that will run through this device. Access the protocol configuration process as described in “Accessing Protocol Configuration and Operating Processes” on page 21.

Note: At the very least, you will configure IP in this step.

8. Reload the router as described in “Reloading the Router” on page 6.

Basing a Configuration on an Existing Configuration

This section describes how to:

- Base a configuration on the configuration in an operating 2216
- Permanently update the configuration in a 2216
- Temporarily update the configuration of a 2216 while the 2216 is operating

Basing on an Existing Configuration

If you already have a 2216 that has the same interfaces, features, and protocols that you want to configure on a new 2216, you can save time by basing the configuration on the existing 2216. You can perform this type of configuration either using the command line interface or by using the configuration program that comes with the 2216. In both cases, the procedures assume that the 2216 is not in your production network.

To base a configuration on an existing configuration using the command line interface:

1. Obtain a copy of the configuration you want to use.
 - a. Enter **talk 6** at the OPCON (*) prompt.
 - b. Enter **boot** at the Config> prompt.
 - c. Enter the **copy configuration file** command at the Boot config> prompt. See “Chapter 6. Using BOOT Config to Perform Change Management” on page 41 for more information.
2. Connect to the 2216 that you are configuring.
3. Load the configuration you obtained in step 1 into the 2216 using TFTP GET. See “Chapter 6. Using BOOT Config to Perform Change Management” on page 41.
4. Update the configuration.
5. Write the configuration. See “Chapter 8. The Configuration Process (CONFIG - Talk 6) and Commands” on page 57.
6. Reload the 2216.

To base a configuration on an existing configuration using the configuration program:

1. Start the configuration program.
2. Retrieve the configuration from the 2216 on which you want to base the new configuration.

3. Make the changes you need for the new configuration. These changes include addresses, the host names, users, and other items.
4. Save the configuration with a different name from the name that you used to retrieve the configuration.
5. Send the configuration to the 2216 you are configuring.
6. Reload the 2216.

For more about using the configuration program, see *Configuration Program User's Guide for Nways Multiprotocol and Access Services Products GC30-3830*.

Permanently Updating a Configuration

To permanently update a configuration:

1. Access the 2216 you are updating as described in "Accessing the Software Using Local and Remote Consoles" on page 3. You will see the * prompt.
2. Enter the **talk 6** command to access the configuration process.
3. Enter the appropriate commands to access the third-level process that configures the areas that you are changing.
4. Enter **exit** as many times as needed to return to the configuration process.
5. Write the configuration. See "Chapter 8. The Configuration Process (CONFIG - Talk 6) and Commands" on page 57.
6. Reload the 2216.

Temporarily Updating a Configuration

The ability to temporarily update a configuration allows you to make changes to some of the operating characteristics of a 2216 until you can make permanent updates to the configuration. This enables you to implement changes immediately to resolve problems or improve performance and avoid an outage during a peak period. You can then make permanent updates to the configuration and schedule an outage so you can reload to pick up the change.

To temporarily update a configuration:

1. Access the 2216 you are updating as described in "Accessing the Software Using Local and Remote Consoles" on page 3. You will see the * prompt.
2. Enter the **talk 5** command to access the operating/monitoring process.

Note: Not all interface types, protocols, or features allow you to make temporary config changes via talk 5 commands.
3. Enter the appropriate commands to access the third-level process that monitors the areas that you are changing.
4. Enter **exit** as many times as needed to return to the operating/monitoring process.
5. Enter **Ctrl-P** to return to the * prompt.
6. Exit the router as described in "Exiting the Router" on page 6

Accessing the Second-Level Processes

All interfaces, features, and protocols have commands that you use to access the following processes:

- The configuration process to initially configure and enable the interface, feature, or protocol, as well as perform later configuration changes.
- The operating/monitoring process to display information about each interface, feature, or protocol, to make temporary configuration changes, or to activate configuration changes.

You can also configure or operate some base system services through the second-level processes. The commands to perform these functions are described starting in “Chapter 8. The Configuration Process (CONFIG - Talk 6) and Commands” on page 57.

The next sections describe the procedures for accessing the second-level processes.

Accessing the Configuration Process, CONFIG (Talk 6)

Each protocol configuration process is accessed through the router’s CONFIG process. CONFIG is the second-level process of the router user interface that lets you communicate with third-level processes. Protocol processes are examples of third-level processes.

The CONFIG command interface is made up of levels that are called modes. Protocol configuration command interfaces are modes of the CONFIG interface. Each protocol configuration interface has its own prompt. For example, the prompt for the TCP/IP protocol command interface is `IP config>`.

The next sections describe these procedures in more detail.

Entering the CONFIG Process

To enter the CONFIG command process from OPCON and obtain the CONFIG prompt, enter the OPCON **talk** command and the PID for CONFIG. The PID for CONFIG is 6.

```
* talk 6
```

The console displays the CONFIG prompt (`Config>`). If the prompt does not appear, press the **Return** key again.

Quick Configuration Process: Quick Configuration, or Quick Config, allows you to quickly configure portions of the router without dealing with the specific operating system commands. You enter the Quick Config menus from the CONFIG process using the **qconfig** command (see “Quick Configuration” on page 58).

Reloading the Router

Changes that you make to the protocol parameters through CONFIG do not take effect until you either activate the net that contains any dynamic changes or reload the router software.

Note: You must enter the **write** command to save the changes in the device’s flash memory.

Accessing the Operating/Monitoring Process, GWCON (Talk 5)

To view information about the interfaces, features, or protocols or to change parameters while running, you must access and use the operating (monitoring) process. Operating command interfaces are modes of the GWCON interface. Within the GWCON mode, each interface, feature, or protocol interface has its own prompt. For example, the prompt for the TCP/IP protocol is IP>.

Note: Any parameters you change in this process will not remain active across any event that causes the 2216 to reload the operational code, such as a power outage or entering the **reload** command.

The next sections describe these procedures in more detail.

Entering the GWCON Command Process

To enter the GWCON process from OPCON and obtain the GWCON prompt, enter the **talk** command and the PID for GWCON. For example:

```
* talk 5
```

The GWCON prompt (+) then displays on the console. If the prompt does not appear, press **Return** again.

Accessing the Secondary ELS Console Process, ELSSCon (Talk 7)

The Secondary ELS Console provides convenient access to GWCON talk 5 ELS without disrupting the current state of GWCON. You may be in the middle of a **ping** in talk 5, or deep inside a talk 5 menu structure, and want to control ELS without disrupting the current state of GWCON. Talk 7 serves this purpose.

In the following example, another ELS event is displayed while performing a **ping** command.

Note: The intercept character (Ctrl-P by default) is used to obtain the OPCON prompt (*).

```
*talk 5
+protocol ip
IP>ping 10.0.0.9
PING 10.0.0.2 -> 10.0.0.9: 56 data bytes, ttl=64, every 1 sec.

*talk 7

ELS Secondary Console>display event ip.7
Complete
ELS Secondary Console>
*talk 2
00:20:48 IP.007: 10.0.0.2 -> 10.0.0.9
00:20:49 IP.007: 10.0.0.2 -> 10.0.0.9
```

Accessing the Third-Level Processes

After accessing the second level, you must enter commands on the third level to configure or operate the interfaces, features, and protocols in your IBM 2216. The following sections describe how to access the third level processes.

Accessing Network Interface Configuration and Operating Processes

This section describes how to get started with accessing the network interface configuration and operating processes. Accessing these processes lets you change and monitor software-configurable parameters for network interfaces used in your router.

Accessing the Network Interface Configuration Process

Use the following procedure to access the router's configuration process. This process gives you access to a specific interface's *configuration* process.

1. At the OPCON prompt, enter the OPCON **talk** command and the PID for CONFIG. (For more details about this command, refer to "Chapter 4. The OPCON Process" on page 29.)

```
* talk 6
```

After you enter the **talk 6** command, the CONFIG prompt (Config>) displays on the console. If the prompt does not appear when you first enter **CONFIG**, press **Return** again.

Use the **add device** command to create a network interface. The **add device** command automatically assigns the interface number and supports the following types of devices (Enter **add device ?** to get a list of the supported device types):

- a. Multi-port adapters

When you specify a multi-port adapter device name with the **add device** command, you are prompted for the adapter's slot number and the port number on the adapter that you want to use for the interface.

If you want to use multiple ports on an adapter, you must enter the add device command multiple times and specify a different port number each time.

For example, you would enter the following commands to create interfaces for ports 0 and 1 on the 8-port X.21 adapter in slot 7.

```
Config> add device x21
Device Slot #(1-8) [1]? 7
Device Port #(0-7) [0]? 0
Defaulting Data-link protocol to PPP
Adding X.21 PPP device in slot 7 port 0 as interface #6
Use "set data-link" command to change the data-link protocol
Use "net 6" to configure X.21 PPP parameters

Config> add device x21
Device Slot #(1-8) [1]? 7
Device Port #(0-7) [0]? 1
Defaulting Data-Link protocol to PPP
Adding X.21 PPP device in slot 7 port 1 as interface #7
Use "set data-link" command to change the data-link protocol
Use "net 7" to configure X.21 PPP parameters
```

Note: The serial adapter port numbers are 0-based. The port numbers for all other multi-port adapters are 1-based.

The 4-port ISDN Channelized T1 and E1 adapters allow you to configure multiple ports with one **add device** command. When you add one of these adapters, the software will prompt you for a range of ports to add. The following example shows how you would add a 4-port ISDN Channelized T1 and E1 adapter into slot 4 that is using dial-in nets:

```
Device Slot #(1-8) [1]? 3
Device Port Range (1-8)
Lowest Port #(1) [1]? 2
```

```

Highest Port #(8) [8]? 2
Automatically add dial-in nets for this base net? (Yes or [No]): yes
Automatically enable IP for these dial-in nets?(Yes or [No]): yes
Enable as a Multilink PPP link?(Yes or [No]): yes
Adding 23 dial-in nets on top of base net 14
Adding 8-port ISDN Primary T1/J1 devices in slot 3 port 2 as interfaces #14.
Use "net 14" to configure 8-port ISDN Primary T1/J1 parameters.

```

b. Single-port adapters

When you specify a single-port adapter device name with the **add device** command, you are prompted for the adapter's slot number.

The following example adds an interface for the 1-port ISDN-PRI T1/J1 adapter in slot 2:

```

Config> add device t1-isdn
Device Slot #(1-8) [1]? 2
Adding ISDN Primary T1/J1 device in slot 2 port 1 as interface #7
Use "net 7" to configure ISDN Primary T1/J1 parameters

```

c. Dial circuits

The following example adds a dial circuit interface:

```

Config> add device dial-circuit
Enter the number of PPP Dial Circuit interfaces [1]?
Adding device as interface 8
Base net for this circuit[0]?4
Defaulting Data-link protocol to PPP
Use "set data-link" command to change the data-link protocol
Use "net 8" command to configure circuit parameters

```

d. The following example adds a dial-in circuit:

```

Config>add device dial-in
Enter the number of dial-in interfaces [1]?
Adding device as interface 5
Base net for this circuit [0]? 5
Defaulting Data-link protocol to PPP
Use "set data-link" command to change the data-link protocol
Use "net 5" command to configure circuit parameters

```

e. Multilink PPP

The following example adds a multilink PPP interface:

```

Config>add device multilink-ppp
Enter the number of Multilink PPP interfaces [1]?
Adding device as interface 7
Defaulting Data-link protocol to PPP
Use "net 7" command to configure circuit parameters

```

Notes:

- a. When you create interfaces for serial adapters or dial circuits, the default data-link type is PPP. However, you can use the **set data-link** command to change the data-link type. Refer to Table 3 on page 18 for the data-link types supported on serial ports and dial circuits, and to the description of the **set data-link** command on page 95.
2. At the Config> prompt, enter the **list devices** command to display the network interface numbers for which the router is currently configured, as follows:

```

Config> list devices

Ifc 0 Token Ring                Slot: 1 Port: 1
Ifc 1 Token Ring                Slot: 1 Port: 2
Ifc 2 Token Ring                Slot: 2 Port: 1
Ifc 3 Token Ring                Slot: 2 Port: 2
Ifc 4 Ethernet                  Slot: 4 Port: 1
Ifc 5 Ethernet                  Slot: 4 Port: 2
Ifc 6 Ethernet                  Slot: 5 Port: 1
Ifc 7 Ethernet                  Slot: 5 Port: 2
Ifc 8 Ethernet                  Slot: 6 Port: 1
Ifc 9 Ethernet                  Slot: 6 Port: 2
Ifc 10 V.35/V.36 Frame Relay    Slot: 8 Port: 0
Ifc 11 V.35/V.36 X.25          Slot: 8 Port: 1
Ifc 12 V.35/V.36 PPP           Slot: 8 Port: 2
Ifc 13 V.35/V.36 PPP           Slot: 8 Port: 3
Ifc 14 V.35/V.36 PPP           Slot: 8 Port: 4
Ifc 15 V.35/V.36 PPP           Slot: 8 Port: 5

```

3. Record the interface numbers.

4. Enter the CONFIG **network** command and the number of the interface you want to configure. For example:

```
Config> network 1
```

The appropriate configuration prompt (such as TKR Config> for token-ring), now displays on the console.

Note: Not all network interfaces are user-configurable. For interfaces that cannot be configured, you receive the message:

```
That network is not configurable
```

IBM 2216 Device Support Restrictions: The following rules apply when adding devices to the IBM 2216:

- As many as two ATM interfaces may be defined.
- As many as eight ISDN-PRI interfaces may be defined with the following restrictions:
 - No more than four 1-port adapters may be used
 - No more than one 4-port ISDN Channelized T1 and E1 adapter may be used
- Adding a LAN device in slot 3, 4, 7, or 8 will disable the other slot in the pair. For example, if you add a LAN device to slot 4, slot 3 will be disabled. Likewise, if you add the device to slot 3, slot 4 will be disabled. The same rules apply for adding a LAN device in slots 7 and 8.
- All interfaces on a V.35/V.36 adapter must use either V.35 cables or V.36 cables. The type of fan out cable attached to the V.35/V.36 adapter determines which type of cables (V.35 or V.36) can be used.

Displaying the Interface Configuration: From the same interface configuration prompts, you can list configuration information specific to that selected interface by using the **list** command. For example:

```
TKR Config> list
```

```
Token-Ring configuration:
```

```
PACKET SIZE (INFO FIELD): 4472
Speed:                    16 Mb/sec
Media:                    Shielded
```

```
RIF Aging Timer:         120      Source Routing:         Enabled
MAC Address:              000000000000
```

Configuring the Network Interface: Refer to the specific chapters in this guide for complete information on configuring your IBM 2216's network interfaces.

Table 3 lists network architectures and the supported interfaces for each architecture.

Table 3. Network Architecture and the Supported Interfaces

Network Architecture	Supported Interfaces
ATM	1-Port ATM 155-Mbps MMF 1-Port ATM 155-Mbps SMF
802.5 Token-Ring	2-Port Token-Ring
Ethernet	<ul style="list-style-type: none"> • 1-port 10/100-Mbps Ethernet • 2-Port 10-Mbps Ethernet

Table 3. Network Architecture and the Supported Interfaces (continued)

Network Architecture	Supported Interfaces
ISDN	<ul style="list-style-type: none"> • 1-Port ISDN-PRI (T1/J1) * • 1-Port ISDN-PRI (E1) * • 4-port ISDN Channelized T1 and E1 * <p>Note: The interfaces marked with an asterisk (*) can be used either as ISDN or channelized interfaces.</p>
Point-to-Point	8-port V.24/EIA 232E, 6-port V.35/V.36, 8-port X.21, 1-port HSSI, and dial circuit interfaces
Frame Relay	8-port V.24/EIA 232E, 6-port V.35/V.36, 8-port X.21, 1-port HSSI, and dial circuit interfaces
X.25	8-port V.24/EIA 232E, 6-port V.35/V.36, and 8-port X.21 adapters
SDLC Relay	8-port V.24/EIA 232E, 6-port V.35/V.36, and 8-port X.21
SDLC	8-port V.24/EIA 232E, 6-port V.35/V.36, 8-port X.21, and dial circuit interfaces
V.25bis	8-port V.24/EIA 232E
Dial-In	A PPP dial circuit interface that has configuration parameters defaulted to support DIALs
Multilink PPP (MP)	Supported on any PPP link
ESCON Channel Adapter	LAN Channel Station (LCS), Link Services Architecture (LSA), and Multi-Path Channel+ (MPC+)
Parallel Channel Adapter	LAN Channel Station (LCS), Link Services Architecture (LSA), and Multi-Path Channel+ (MPC+)
L2TP	Supports virtual PPP DIALs connections through the Layer 2 Tunneling Protocol (L2TP).
FDDI	1-port FDDI

Notes:

1. PPP dial circuit interfaces can use ISDN or V.25bis as the base network interface.
2. FR dial circuit interfaces can use an ISDN or a V.25bis network as the base network interface.
3. Dial-In circuit interfaces can use an ISDN network as the base network interface.
4. SDLC dial circuits use V.25bis as the base network interface.

Accessing the Network Interface Console Process

To monitor information related to a specific interface, access the interface console process by using the following procedure:

1. At the OPCON prompt, enter the OPCON **talk** command and the PID for GWCON. For example:
 - * talk 5
2. The GWCON prompt (+) is displayed on the console. If the prompt does not appear when you first enter GWCON, press **Return** again.
3. At the GWCON prompt, enter the **configuration** command to see the protocols and networks for which the router is configured. For example:

+configuration

Multiprotocol Access Services

2216-MAS Feature 2822 V3.2 Mod 0 PTF 0 RPQ 0 MAS.EF9 cc4_2a

```
Num Name Protocol
0 IP DOD-IP
3 ARP Address Resolution
4 DN DNA Phase IV
6 VIN Banyan Vines
7 IPX NetWare IPX
10 BGP Border Gateway Protocol
11 SNMP Simple Network Management Protocol
12 OSPF Open SPF-Based Routing Protocol
22 AP2 AppleTalk Phase 2
23 ASRT Adaptive Source Routing Transparent Enhanced Bridge
26 DLS Data Link Switching
27 XTP X.25 Transport Protocol
28 APPN Advanced Peer-to-Peer Networking [HPR]
30 APPN Advanced Peer-to-Peer Networking [ISR]
```

```
Num Name Feature
2 MCF MAC Filtering
```

16 Networks:

Net	Interface	MAC/Data-Link	Hardware	State
0	TKR/0	Token-Ring/802.5	Token-Ring	Up
1	TKR/1	Token-Ring/802.5	Token-Ring	Up
2	TKR/2	Token-Ring/802.5	Token-Ring	Up
3	TKR/3	Token-Ring/802.5	Token-Ring	Up
4	Eth/0	Ethernet/IEEE 802.3	Ethernet	Up
5	Eth/1	Ethernet/IEEE 802.3	Ethernet	Up
6	Eth/2	Ethernet/IEEE 802.3	Ethernet	Up
7	Eth/3	Ethernet/IEEE 802.3	Ethernet	Up
8	Eth/4	Ethernet/IEEE 802.3	Ethernet	Up
9	Eth/5	Ethernet/IEEE 802.3	Ethernet	Up
10	FR/0	Frame Relay	V.35/V.36	Up
11	X25/0	X.25	V.35/V.36	Up
12	PPP/0	Point to Point	V.35/V.36	Up
13	PPP/1	Point to Point	V.35/V.36	Up
14	PPP/2	Point to Point	V.35/V.36	Up
15	PPP/3	Point to Point	V.35/V.36	Up

4. Enter the GWCON **network** command and the number of the interface you want to monitor. For example:

```
+ network 11
X.25>
```

In this example, the X.25 console prompt is displayed on the console. You can then view information about the X.25 interface by entering the X.25 console commands.

Monitoring the Network Interface: Refer to the specific chapters in this manual for complete information on monitoring your 2216's network interfaces.

Accessing Feature Configuration and Operating Processes

To help you access the Multiprotocol Access Services feature configuration and operating processes, this section outlines both of these procedures.

Accessing the Feature Processes

Use the **feature** command from the CONFIG process to access configuration commands for specific Multiprotocol Access Services features outside of the protocol and network interface configuration processes.

Use the **feature** command from the GWCON process to access console commands for specific features that are outside of the protocol and network interface console processes.

Enter a question mark after the **feature** command to display a listing of the features available for your software release. For example:

```
Config> feature ?  
  
WRS  
BRS  
MCF  
TSF  
Feature name or number [1] ?
```

To access a particular feature's configuration or operating prompt, enter the **feature** command at the Config> or + (GWCON) prompt, respectively, followed by the feature number or short name. For example:

```
Config> feature mcf  
  
MAC filtering user configuration  
  
Filter Config>
```

Table 9 on page 87 lists the available feature numbers and names.

Once you access the configuration or operating prompt for a feature, you can begin entering specific commands for the feature. To return to the previous prompt level, enter the **exit** command at the feature's prompt.

Accessing Protocol Configuration and Operating Processes

This section describes how to access the protocol configuration and operating processes.

Entering a Protocol Configuration Process

To enter the desired protocol configuration process from the CONFIG> prompt:

1. At the CONFIG> prompt, enter the **list configuration** command to see the numbers and names of the protocols purchased in your copy of the software. See page 88 for sample output of the **list configuration** command.
2. From the Config> prompt, enter the **protocol** command with the number or short name (for example, IP, IPX, and ARP) of the protocol you want to configure. The protocol number and short name is obtained from the **list configuration** command display. In the following example, the command has been entered for accessing the IP protocol configuration process:

```
Config> protocol IP  
  
or  
  
Config> protocol 0
```

The protocol configuration prompt then displays on the console. The following example shows the IP protocol configuration prompt:

```
IP config>
```

You can now begin entering the protocol's configuration commands. See the corresponding protocol section of the *Protocol Configuration and Monitoring Reference* for more information on specific protocol configuration commands.

In summary, the **protocol** command lets you enter the configuration process for the protocol software installed in your router. The **protocol** command enters a protocol's command process. After entering the protocol command, the prompt of the specified protocol appears. From the prompt, you can enter commands specific to that protocol.

Entering a Protocol Operating Process

To enter a protocol console process from the GWCON prompt:

1. At the GWCON prompt, enter the **configuration** command to see the protocols and networks configured for the router. For example:

```
+configuration
```

```
Multiprotocol Access Services
```

```
2216-MAS Feature 2822 V3.2 Mod 0 PTF 0 RPQ 0 MAS.EF9 cc4_2a
```

```
Num Name Protocol
0 IP DOD-IP
3 ARP Address Resolution
4 DN DNA Phase IV
6 VIN Banyan Vines
7 IPX NetWare IPX
10 BGP Border Gateway Protocol
11 SNMP Simple Network Management Protocol
12 OSPF Open SPF-Based Routing Protocol
22 AP2 AppleTalk Phase 2
23 ASRT Adaptive Source Routing Transparent Enhanced Bridge
26 DLS Data Link Switching
27 XTP X.25 Transport Protocol
28 APPN Advanced Peer-to-Peer Networking [HPR]
30 APPN Advanced Peer-to-Peer Networking [ISR]
```

```
Num Name Feature
2 MCF MAC Filtering
```

```
16 Networks:
```

Net	Interface	MAC/Data-Link	Hardware	State
0	TKR/0	Token-Ring/802.5	Token-Ring	Up
1	TKR/1	Token-Ring/802.5	Token-Ring	Up
2	TKR/2	Token-Ring/802.5	Token-Ring	Up
3	TKR/3	Token-Ring/802.5	Token-Ring	Up
4	Eth/0	Ethernet/IEEE 802.3	Ethernet	Up
5	Eth/1	Ethernet/IEEE 802.3	Ethernet	Up
6	Eth/2	Ethernet/IEEE 802.3	Ethernet	Up
7	Eth/3	Ethernet/IEEE 802.3	Ethernet	Up
8	Eth/4	Ethernet/IEEE 802.3	Ethernet	Up
9	Eth/5	Ethernet/IEEE 802.3	Ethernet	Up
10	FR/0	Frame Relay	V.35/V.36	Up
11	X25/0	X.25	V.35/V.36	Up
12	PPP/0	Point to Point	V.35/V.36	Up
13	PPP/1	Point to Point	V.35/V.36	Up
14	PPP/2	Point to Point	V.35/V.36	Up
15	PPP/3	Point to Point	V.35/V.36	Up

2. Enter the GWCON **protocol** command with the protocol number or short name of the desired protocol displayed in the configuration information.

In the following example, the command has been entered for accessing the IP protocol console process.

```
+ protocol 0
```

or
+ protocol IP

The protocol console prompt then displays on the console. This example shows the IP protocol console prompt:

IP>

You can now begin entering the protocol's commands. See the corresponding protocol section of the *Protocol Configuration and Monitoring Reference* for more information on specific protocol console commands.

Command History for GWCON and CONFIG Command Line

The Command History contains up to the last 50 commands entered by the user in GWCON (Talk 5) or CONFIG (Talk 6) command line menus.

Backward and Forward retrieve keys can be used to recall previously entered commands. In addition, a facility is provided to enable the advanced user to repeat a particular series of commands.

Repeating a Command in the Command History

By pressing **Ctrl-B** (backward) or **Ctrl-F** (forward) at any command line prompt in a GWCON or CONFIG menu, the current command line is replaced by the previous or next command in the Command History. The Command History is common to both GWCON and CONFIG. That is, a command entered while in a GWCON menu can be retrieved from within CONFIG and a command entered while in a CONFIG menu can be retrieved from within GWCON.

The Command History contains the most recently entered commands, up to a maximum of the last 50 commands. If only three commands have been entered since a restart, pressing **Ctrl-F** or **Ctrl-B** circles through only those three commands. If no commands have been entered thus far, **Ctrl-F** or **Ctrl-B** results in a "bell", the same bell you see when trying to backspace beyond the beginning of a line of text.

Note: A command aborted by pressing **Ctrl-U** will not be entered into the Command History.

To enter two similar commands:

```
display sub 1es  
display sub 1ec
```

Enter:

```
display sub 1es, then press Enter  
Ctrl-B for Backward, and the current line is replaced with-  
display sub 1es  
Press Backspace and replace "s" with "c" to get  
display sub 1ec and then press Enter
```

Repeating a Series of Commands in the Command History

There is an additional feature for advanced users to facilitate repeating a particular series of GWCON or CONFIG commands. C1, C2,...,Cn in the Command History is referred to as a *repeat sequence*. This feature may be more convenient than simply using **Ctrl-B** and **Ctrl-F** when you must repeat a given task that requires multiple commands. Enter **Ctrl-R** (repeat) to set the start of the *repeat sequence* at command C1. Enter **Ctrl-N** (next) successively to retrieve the next command(s) in the repeat sequence. Commands are not automatically entered, but are placed on the current command line allowing you to modify or enter the command.

To produce the desired behavior of a repeat sequence, the first command retrieved using the first **Ctrl-N** (next) depends on the manner in which the start of the repeat sequence was set using **Ctrl-R** (repeat).

Setting the start of the repeat sequence with **Ctrl-R** can be done in two ways:

1. When C1 is initially entered
2. When C1 is retrieved from the Command History with **Ctrl-B** or **Ctrl-F**.

Starting a Repeat Sequence As Commands Are Entered

If you enter **Ctrl-R** as command C1 is being keyed in, and then enter commands C2, C3... Cn. **Ctrl-N** will successively bring commands C1, C2, ... Cn, C1, C2, ... Cn, C1, ... to the command line.

In Example 1, the start of the repeat sequence is set as the first command is keyed in. The user knows ahead of time that the same commands to be entered in GWCON need to be repeated in CONFIG.

Example 1

1. As the first command in the sequence is keyed in, use **Ctrl-R** (repeat) to set the start of the repeat sequence.

```
*talk 5
+event Ctrl-R
```

then press **Enter** to set the start of the repeat sequence.

2. Continue typing the subsequent commands in the sequence:

```
Event Logging System user console
ELS>display sub les
ELS>display sub lec
ELS>exit
+
```

3. To enter these same commands in CONFIG, press **Ctrl-P** (the default OPCON intercept character) and go to CONFIG.

```
+--press Ctrl-P-
*talk 6
Config>Ctrl-N for NEXT to retrieve the start of
this sequence-
Config>event Enter
Event Logging System user configuration
ELS config>Ctrl-N for NEXT to retrieve the next
command in sequence-
ELS config>display sub les Enter
ELS config>Ctrl-N for NEXT to retrieve the next
command in sequence-
ELS config>display sub lec Enter
```

```

ELS config>Ctrl-N for NEXT to retrieve the next
command in sequence-
ELS config>exit Enter
Config>

```

Starting a Repeat Sequence After All Commands Are Entered

On the other hand, if you first enter C1, C2, ... Cn, and retrieve C1 via **Ctrl-B** or **Ctrl-F**. Entering **Ctrl-R**, entering **Ctrl-N** successively brings commands C2,..., Cn, C1, C2,..., Cn, C1,...,Cn to the command line (see Example 2). The first occurrence of C1 is bypassed since C1 is already available on the command line at the time it was retrieved, and does not need to be recalled again by the first **Ctrl-N**.

In Example 2, all the commands are entered and then the first command in the sequence to be repeated is retrieved. A sequence of commands has been entered in GWCON, and the same sequence needs to be repeated in CONFIG.

Example 2

1. Enter the following commands in GWCON:

```

*talk 5
+event
Event Logging System user console
ELS>display sub les
ELS>display sub lec
ELS>exit
+

```

2. To enter these same commands in CONFIG, press **Ctrl-P** (the default OPCON intercept character) and go to CONFIG.

```

+Ctrl-P-
*talk 6
Config>Ctrl-B four times to retrieve the start of
the four command sequence in this example-
Config>event
Config>event Ctrl-R for REPEAT to set the start of
the repeat sequence-
Config>event Enter
Event Logging System user configuration
ELS config>Ctrl-N for NEXT to retrieve the next
command in sequence-
ELS config>display sub les Enter
ELS config>Ctrl-N for NEXT to retrieve the next
command in sequence-
ELS config>display sub lec Enter
ELS config>Ctrl-N for NEXT to retrieve the next
command in sequence-
ELS config>exit Enter
Config>

```

If the OPCON **intercept** command described in “Chapter 4. The OPCON Process” on page 29 has been used to redefine the OPCON intercept character from the default character **Ctrl-P** to one of the Command History control characters, **Ctrl-B**, **Ctrl-F**, **Ctrl-R**, or **Ctrl-N**, the OPCON intercept character will take priority. For example, if the intercept character has been changed to **Ctrl-F**, then **Ctrl-F** will not retrieve Forward in the Command History, but will instead place the user back at the OPCON prompt (*).

Chapter 3. Accessing the Firmware from the Command Line Interface

This section covers boot options that can be set from the Firmware and Operational command prompt. For information about file transfer and file management, refer to *IBM 2216 Nways Multiaccess Connector Installation and Initial Configuration Guide*.

The 2216 is designed to boot from one of the integrated image banks. With the hard drive installed, the 2216 has two image banks that can be used to IML or boot the device. The 2216 also has options to come up in Attended or Unattended mode. Attended mode requires direct interaction with a user at a console attached on the serial port.

The device can be booted from the hard drive, known as Bank A and B.

Accessing the Firmware Prompt

Before booting the router, note that:

- You will need a terminal or IP workstation connected to the 2216. This can be a VT100 TTY device connected directly through the serial port. You can connect an IP workstation using SLIP to connect into the 2216. The default 2216 IP address is 10.1.1.2 and the workstation address should be 10.1.1.3.

Important: To access the Firmware prompt, you can stop the 2216 boot. To stop it, you must have a TTY console directly attached to the serial port. When the 2216 starts its boot sequence, press **Ctrl-C** from the console to interrupt the boot sequence.

Another way to control booting is to configure the 2216 to come up in Attended mode. Attended mode can be configured from the Firmware command set.

Boot Options Available for the 2216

The 2216 can be configured for Unattended mode. In Unattended mode, you must have chosen which load image and which configuration to load. You are provided with two banks to choose among. The structure of the image banks is as follows:

- IMAGE - Status of image
- CONFIG 1 - Status of Config
- CONFIG 2 - Status of Config
- CONFIG 3 - Status of Config
- CONFIG 4 - Status of Config

See "List" on page 48 for a description of file statuses.

Attended Mode

When the 2216 is configured to come up in Attended mode, you are given access to the Firmware command set. From this level of commands, you can select the Image Bank from which to load and the config. You can at this point load new config files or image files. This connection is either a TTY or Telnet connection. You can transfer files using the Xmodem protocol for TTY or TFTP for IP connections.

Important: In release 2, multiple load modules make up a single device load. If you are transferring a load into a bank using XMODEM, you must transfer the files individually. The following applies:

1. Transfer LML.ld first
2. You must ensure all files that make up the load transfer successfully. When there is an error transferring a file, you will receive a message box containing "ERROR WRITING FILE". Otherwise, you can assume the file has transferred successfully.
3. When all files have transferred, the status of the bank will change from "Corrupt" to "Avail".

In Attended mode, you can start booting the 2216 by pressing **F9** or **<Esc>9** to start the operating system.

Unattended Mode

This is the normal mode for the 2216. It will come up on the Active, Local, or Pending image and config based on your choice.

Chapter 4. The OPCON Process

The Operator Console process (OPCON) is the root-level process of the router software user interface. The main function of OPCON is to control which processes are connected to consoles. Using OPCON commands, you can:

- Manipulate the output from a process
- Change the intercept character
- Display information about router memory usage
- Reload the router software (reboot)
- Telnet to other routers or hosts
- Display status information about all router processes
- Communicate with processes at the secondary level
- Escape to the MOS system debugging tool

Chapter 5. Using OPCON

This chapter describes the OPCON interface configuration and operational commands. It includes the following sections:

- “Accessing the OPCON Process”
- “OPCON Commands”

Accessing the OPCON Process

When the router starts for the first time, a boot message appears on the console. Then the OPCON prompt (*) appears on the console, indicating that the OPCON process is active and ready to accept commands.

The OPCON process allows you to configure, change, and monitor all of the router’s operating parameters. While in the OPCON process, the router is forwarding data traffic. When the router is booted and enters OPCON, a copyright logo and an asterisk (*) prompt appears on the locally attached console terminal. This is the OPCON (OPerator’s CONsole) prompt, the main user interface that allows access to second-level processes.

Some changes to the router’s operating parameters made while in OPCON take effect immediately without requiring reinitializing of the router. If the changes do not take effect, use the **reload** command at the * prompt.

At the * prompt, an extensive set of commands enables you to check the status of various internal software processes, monitor the performance of the router’s interfaces and packet forwarders, and configure various operational parameters.

OPCON Commands

This section describes the OPCON commands. Each command includes a description, syntax requirements, and an example. The OPCON commands are summarized in Table 4. To use them, access the OPCON process and enter the appropriate command at the OPCON prompt (*).

Table 4. OPCON Commands

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Diags	Displays device status and the contents of the hardware test log and the hardware error log.
Divert	Sends the output from a process to a console or other terminal.
Flush	Discards the output from a process.
Halt	Suspends the output from a process.
Intercept	Sets the OPCON default intercept character.
Logout	Logs out a remote console.
Memory	Reports the router’s memory usage.
Reload	Reloads the router software.
Status	Shows information about all router processes.
Talk	Connects to another router process and enables the use of its commands.

Table 4. OPCON Commands (continued)

Command	Function
Telnet	Connects to another router.

Diags

Use the **diags** command to display the Diagnostic Main Menu. The diagnostic menus allow you to enable, disable and test hardware adapters or ports. Diagnostic menus have on-screen help for the various options and status information that is available.

You can use the “b” (back) key to return to any previous menu. Use the “e” (exit) key to exit the diagnostics and return to the OPCON command prompt.

See the *Service and Maintenance Manual* for the 2216 for more information on diagnostic support.

Syntax:

diags

Divert

Use the **divert** command to send the output from a specified process to a specified terminal. This command allows you to divert the output of several processes to the same terminal to simultaneously view the output. The **divert** command is commonly used to redirect MONITR output messages to a specific terminal. The router allows only certain processes to be redirected.

After entering the command, enter the PID and tty# (number of the output terminal). To obtain these values, use the OPCON status command. The terminal number can be the number of either the local console (tty0) or one of the remote consoles (tty1, tty2). The following example shows Event Logging System messages generated by the MONITR process (2) being sent to a remote console *tty1* (1).

Event messages are displayed immediately even though you may be in the middle of typing a command. The display and keyboard have separate buffers to prevent command confusion. The following example shows the MONITR process connected to TTY1 after executing the **divert 2 1** command. If you want to stop the output, enter **halt 2**. The **halt** command is described in “Halt” on page 33.

Syntax:

divert *pid tty#*

Example: divert 2 1

```
Copyright Notices:
Copyright IBM Corp. 1994, 1997
MOS Operator Control
```

```
* divert 2 1
```

```
* status
Pid  Name      Status TTY  Comments
1    COpCN1    IOW   TTY0 gzs
2    Monitr    IDL   TTY0
3    Tasker    RDY   --
4    MOSDBG    DET   --
5    CGWCon    DET   --
```

```

6   Config  DET    --
7   ELSCon  DET    --
8   ROpCN1  IDL    TTY1
9   ROpCN2  RDY    TTY2 jlg@128.185.40.40

```

Flush

Use the **flush** command to clear the output buffers of the MONITR process. This command is generally used before displaying the contents of the MONITR's FIFO buffer to prevent messages from scrolling off the screen. Accumulated messages are discarded.

The router allows only certain processes to be redirected. To obtain the *pid* and *tty#*, use the OPCON **status** command. In the following example, after executing the **flush 2** command, the output of the MONITR process is sent to the SNK (it has been flushed).

Syntax:

```
flush pid
```

Example: flush 2

```

* status
Pid  Name      Status TTY  Comments
1   COpCN1    IOW   TTY0 gzs
2   Monitr    IDL   SNK
3   Tasker    RDY   --
4   MOSDBG    DET   --
5   CGWCon    DET   --
6   Config    DET   --
7   ELSCon    DET   --
8   ROpCN1    IDL   TTY1
9   ROpCN2    RDY   TTY2 jlg@128.185.40.40

```

Halt

Use the **halt** command to suspend all subsequent output from a specified process until the **divert**, **flush**, or **talk** OPCON command is issued to the process. The router cannot redirect all processes. **Halt** is the default state for output from a process. To obtain the PID for this command, use the OPCON **status** command. In the following example, after executing the **halt 2** command, the MONITR process is no longer connected to TTY1. Event messages no longer appear.

Syntax:

```
halt pid
```

Example: halt 2

```

* status
Pid  Name      Status TTY  Comments
1   COpCN1    IOW   TTY0 gzs
2   Monitr    IDL   --
3   Tasker    RDY   --
4   MOSDBG    DET   --
5   CGWCon    DET   --
6   Config    DET   --
7   ELSCon    DET   --
8   ROpCN1    IDL   TTY1
9   ROpCN2    RDY   TTY2 jlg@128.185.40.40

```

Intercept

Use the **intercept** command to change the OPCON intercept character. The intercept character is what you enter from other processes to get back to the OPCON process. The default intercept key combination is **Ctrl-P**.

The intercept character **must** be a control character. Enter the ^ (shift 6) character followed by the letter character you want for the intercept character.

Note: Do not set the intercept character to the return key or to a printable character. If you change the OPCON intercept character from the default, **Ctrl-P**, to one of the Command History control characters, **Ctrl-B**, **Ctrl-F**, **Ctrl-R**, or **Ctrl-N**, the OPCON intercept character will take priority.

For example, if you change the intercept character to **Ctrl-F**, then **Ctrl-F** will not retrieve Forward in the Command History, but will instead return to the OPCON prompt (*). See “Command History for GWCON and CONFIG Command Line” on page 23 for information on how to access previously entered GWCON or CONFIG commands.

Syntax:

intercept *character*

Example: `intercept ^u`

From this example, the intercept character is now **Ctrl-U**.

Logout

Use the **logout** command to terminate the current session for the user who enters the logout command. If the console login is enabled, this command will require the next user to log in using an authorized userid/password combination. If the console login is not enabled, the OPCON prompt appears again.

Syntax:

logout

Memory

Use the **memory** command to obtain and display information about the router's global heap memory usage. The display helps you to determine if the router is being utilized efficiently. For an example of memory utilization, see Figure 3 on page 35 .

See “Memory” on page 114 for memory usage via talk 5.

Syntax:

memory

Example:

```
memory
Number of bytes:  Busy = 319544, Idle = 1936, Free = 1592
```

Busy Specifies the number of bytes currently allocated.

- Idle** Specifies the number of bytes previously allocated but freed and available for reuse.
- Free** Specifies the number of bytes that were never allocated from the initial free storage area.

Note: The sum of the Idle and Free memory equals the total available heap memory.

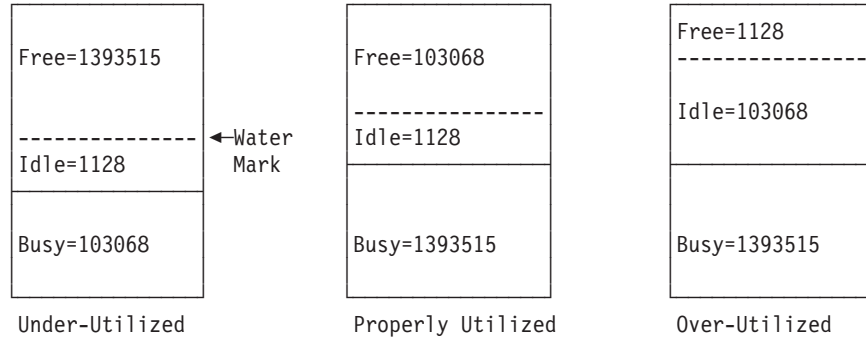


Figure 3. Memory Utilization

Reload

Use the **reload** command to reboot the router by loading in a new copy of the router software. When you use this command from a remote console, you install a new software load without going to the router. This command executes the same functions as pressing the reset button except that the router will not dump (if so configured). Before the reload takes effect, you are prompted to confirm the reload. You are also prompted if you have not saved the configuration changes.

Syntax:

reload

Example:

```
reload
Are you sure you want to reload the gateway (Yes or No)?
```

Status

Use the **status** command to display information about all router processes. By entering the PID after the **status** command, you can look at the status of only the desired process. The following example shows the total status display.

Syntax:

status *pid*

Example: status

Pid	Name	Status	TTY	Comments
1	COpCN1	IOW	TTY0	
2	Monitr	IDL	--	
3	Tasker	RDY	--	
4	MOSDBG	DET	--	

```

5  CGWCon  IOW  --
6  Config  IOW  TTY1
7  ELSCon  DET   --
8  ROpCN1  IOW  TTY1 128.185.46.101
9  ROpCN2  RDY  TTY2 128.185.46.104

```

Pid Specifies the PID. This is the process to talk to or from OPCON, or it can be an argument to the STATUS command to request status information about a specific process.

Name Specifies the process name. It usually corresponds to the name of the program that is running in the process.

Status

Specifies one of the following:

IDL Specifies that the process is idle and waiting for completion of some external event, such as asynchronous I/O.

RDY Specifies that the process is ready to run and is waiting to use the CPU.

IOW Specifies that the process is waiting for synchronous I/O, usually its expected standard input, to complete.

DET Specifies that the process has output ready to be displayed and it is either waiting to be attached to a display console or waiting to have its output diverted to a specified console.

FZN Specifies that the process is frozen due to an error. This usually means the process is trying to use a device which is faulty or incorrectly configured.

TTY n Specifies the output terminal, if any, to which the process is currently connected.

TTY0 Local console

TTY1 or TTY2
Telnet consoles.

SNK Process has been flushed.

Two dashes (--)
Process has been halted.

Comments

Specifies the user's login IP address provided during login when a user is logged in using Telnet (ROpCon).

Talk

Use the **talk** command to connect to other router processes, such as GWCON, MONITR, or CONFIG. After connecting to a new process, you can send specific commands to and receive output from that process. You cannot talk to the TASKER or OPCON process. See "Command History for GWCON and CONFIG Command Line" on page 23 for information on how to access previously entered GWCON or CONFIG commands.

To obtain the PID, use the OPCON **status** command. Once you are connected to the second-level process, such as CONFIG, use the intercept character, **Ctrl-P**, to return to the * prompt.

Syntax:

`talk` *pid*

Example: `talk 5`

When using third-level processes, such as IP Config or IP, use the **exit** command to return to the second level.

Telnet

Use the **telnet** command to remotely attach to another router or to a remote host. The only optional parameter is the terminal type that you want to emulate.

You can use the **telnet** command with IPv4 or with IPv6 addresses.

A router has a maximum of five Telnet sessions: two servers (inbound to the router), and three clients (outbound from the router).

Note: To use Telnet in a pure bridging environment, enable Host Services.

Syntax:

`telnet` *ip-address terminal-type*

Example 1: `telnet 128.185.10.30` or `telnet 128.185.10.30 23` or `telnet 128.185.10.30 vt100`

```
Trying 128.185.10.30 ...
Connected to 128.185.10.30
Escape character is '^['
```

Example 2: `telnet 1:9::10`

```
Trying 1:9::10 ...
Connected to 1:9::10
Escape character is '^['
```

When telnetting to a non-existent IP address, the router displays:

```
Trying 128.185.10.30 ...
```

To enter the Telnet command mode, type the escape character-sequence, which is **Ctrl-]**, at any prompt.

```
telnet>
```

If you Telnet into a router,

- Press **← Backspace** to delete the last character typed on the command line.

Note: When using a VT100 terminal, do not press **← Backspace** because it inserts invisible characters. Press **Delete** to delete the last character.

- Press **Ctrl-U** at the `telnet>` prompt to delete the whole command line entry so that you can reenter a command.

The Telnet command mode consists of the following subcommands:

close Close current connection

display Display operating parameters

mode Try to enter line-by-line or character-at-a-time mode

- open** Connect to a site
- quit** Exit Telnet
- send** Transmit special characters ('send ?' for more)
- set** Set operating parameters ('set ?' for more)
- status** Print status information
- toggle** Toggle operating parameters ('toggle ?' for more)
- z** Suspend Telnet
- ?** Print help information

The **status** and **send** subcommands have one of two responses depending on whether or not the user is connected to another host. For example:

Connected to a host:

```
telnet> status
Connected to 128.185.10.30  Operating in character-at-a-time mode.  Escape character is ^].
telnet> send ayt
```

Note: The send command currently supports only ayt.

Not connected to a host:

```
telnet> status
Need to be connected first.
telnet> send ayt
Need to be connected first.
```

Use the **close** subcommand to close a connection to a remote host and terminate the Telnet session. Use the **quit** subcommand to exit the **telnet** command mode, close a connection, and terminate a Telnet session.

```
telnet> close
```

or

```
telnet> quit
logout
*
```

Part 2. Understanding, Configuring, and Using Base Services

Chapter 6. Using BOOT Config to Perform Change Management

This chapter describes how to use the Boot/Dump Configuration process. This chapter includes the following sections:

- “Understanding Change Management”
- “Using the Trivial File Transfer Protocol (TFTP)”
- “Loading an Image at a Specific Time” on page 42

Understanding Change Management

Change management is the handling of software and configuration data for an IBM 2216. This involves:

1. Moving code and configuration data to and from the IBM 2216
- 2.
3. Selecting and activating specific combinations of software and configuration.

The change management functions are available by entering the **boot** command at the `Boot config>` prompt (talk 6), or the firmware should the box be in a condition where the hard drive or compact flash does not contain viable software (that is, you cannot access talk 6).

The IBM 2216 code and configuration data storage resource is divided into areas called “system banks” (banks for short), each containing a single version of the operational code and any other files pertinent to that release of the code. Up to four configuration files are associated with each bank’s software.

The general change management model of the IBM 2216 is to introduce new code and/or configuration data to the system while the system runs at its present level and then activate the changed code or configuration data set later. If for some reason the new code or configuration does not function as expected, you have the ability to revert to the previous version of the configuration.

Using the Trivial File Transfer Protocol (TFTP)

TFTP is a file transfer protocol that runs over the Internet UDP protocol. This implementation provides multiple, simultaneous TFTP file transfers between an IBM 2216’s non-volatile configuration memory, image bank, and remote hosts.

TFTP allows you to:

- Get a configuration file from a server to an IBM 2216
- Put a configuration file from an IBM 2216 to a server
- Get load modules from a server to an IBM 2216
- Put load modules from an IBM 2216 to a server

TFTP transfers involve a *client* node and a *server* node. The client node generates a TFTP Get or Put request onto the network. The IBM 2216 acts as a client node by generating TFTP requests from the IBM 2216 console using the `Boot config>` process **tftp** command.

Using BOOT Config

The client can transfer a copy of a configuration file or image file stored in the image bank of a server.

The server is any device (for example, a personal computer or workstation) that receives and services the TFTP requests. When the IBM 2216 acts as a server, transfers are transparent to the user. Use the ELS subsystem TFTP message log to view the transfer in progress.

Loading an Image at a Specific Time

There may be occasions when you may want to load a device on a specific day and time when you will be unavailable. You can configure the device to perform a timed load using the **timedload activate** command. Other commands allow you to view a device's scheduled load information or cancel a scheduled load. See "Change Management Configuration Commands" on page 43 for information on these commands.

Chapter 7. Configuring Change Management

This chapter describe the Change management configuration commands. It includes the following sections:

- “Accessing the Change Management Configuration Environment”
- “Change Management Configuration Commands”

Accessing the Change Management Configuration Environment

To enter the change management configuration command environment, use the CONFIG **boot** command. When the router’s software is initially loaded, it is running in the OPCON process, signified by the * prompt. From the * prompt:

1. Enter **talk 6**.
2. At the Config> prompt, type **boot**.

To return to the CONFIG process, type **exit**.

Change Management Configuration Commands

This section describes the Change Management Configuration commands. Each command includes a description, syntax requirements, and an example. Table 5 summarizes the Change Management Configuration commands.

After accessing the Change Management Configuration environment, enter the configuration commands at the Boot config> prompt.

Table 5. Change Management Configuration Commands

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Add	Adds an optional description to a configuration file.
Copy	Copies boot files and configuration files to or from banks.
Describe	Displays information about the stored loadfile images.
Disable	Turns off various change management functions.
Enable	Turns on various change management functions.
Erase	Erases a stored image or a configuration file.
List	Displays information about configuration files and scheduled load information.
Lock	Prevents the device from overwriting the selected configuration with any other configuration.
Set	Selects code bank and configuration to be used.
TFTP	Initiates TFTP file transfers between the IBM 2216 and remote servers.
Timeload	Schedules a load into the device on a specific day and time, cancels a scheduled load, or displays scheduled load information.
Unlock	Removes the lock from a configuration allowing the configuration to be updated by the device.
Update Firmware	Installs the Firm.Id load module that you have received on either Bank A or Bank B of your 2216
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Add

Use the **add** command to add an optional description to a configuration file.

Syntax:

```
add configuration file description  
load image description
```

Example: Boot config> add

```
+----- BankA -----+----- Description -----+----- Date -----+  
| IMAGE - NONE          |                               | 01 Jan 1970 00:01 |  
| CONFIG 1 - AVAIL     | test config for pubs         | 01 Jan 1970 01:26 |  
| CONFIG 2 - AVAIL *   | test config for pubs         | 01 Jan 1970 01:13 |  
| CONFIG 3 - AVAIL     |                               | 01 Jan 1970 01:39 |  
| CONFIG 4 - AVAIL     |                               | 01 Jan 1970 01:52 |  
+----- BankB -----+----- Description -----+----- Date -----+  
| IMAGE - ACTIVE       |                               | 01 Jan 1970 00:30 |  
| CONFIG 1 - AVAIL     | test config for pubs         | 01 Jan 1970 00:54 |  
| CONFIG 2 - AVAIL     |                               | 01 Jan 1970 00:01 |  
| CONFIG 3 - AVAIL     |                               | 01 Jan 1970 00:14 |  
| CONFIG 4 - ACTIVE *  |                               | 01 Jan 1970 00:24 |  
+-----+-----+-----+  
* - Last Used Config      L - Config File is Locked
```

```
Select the source bank: (A, B): [A]  
Select the source configuration: (1, 2, 3, 4): [1] 3  
Enter the description of the file: ( ) New config for today
```

Attempting to set description for bank A configuration 3.

Operation completed successfully.

Boot config>list

```
+----- BankA -----+----- Description -----+----- Date -----+  
| IMAGE - NONE          |                               | 01 Jan 1970       |  
| CONFIG 1 - AVAIL     | test config for pubs         | 01 Jan 1970 00:58 |  
| CONFIG 2 - AVAIL *   | test config for pubs         | 01 Jan 1970 01:13 |  
| CONFIG 3 - NONE      | New config for today         | 09 Jan 1970 00:58 |  
| CONFIG 4 - AVAIL     |                               | 01 Jan 1970 01:05 |  
+----- BankB -----+----- Description -----+----- Date -----+  
| IMAGE - ACTIVE       |                               | 01 Jan 1970       |  
| CONFIG 1 - AVAIL     | test config for pubs         | 01 Jan 1970 00:54 |  
| CONFIG 2 - AVAIL     |                               | 01 Jan 1970 00:01 |  
| CONFIG 3 - AVAIL     |                               | 01 Jan 1970 00:14 |  
| CONFIG 4 - ACTIVE *  |                               | 01 Jan 1970 00:24 |  
+-----+-----+-----+  
* - Last Used Config      L - Config File is Locked
```

Auto-boot mode is enabled. Fast-boot mode is disabled.

Copy

Use the **copy** command to copy configuration files and load images to and from banks.

Syntax:

```
copy configuration file  
load image
```

Example: Boot config>copy load

```
+----- BankA -----+----- Description -----+----- Date -----+  
| IMAGE - AVAIL        |                               | 01 Jan 1970 00:01 |  
| CONFIG 1 - AVAIL     | test config for pubs         | 01 Jan 1970 01:26 |  
+-----+-----+-----+
```


Example: Boot config>describe

BANK A			BANK B		
Product ID -	2216-MAS		Product ID -	2216-MAS	
Version	3	Release 2	Version	3	Release 2
Maint.	0	PTF 0	Maint.	0	PTF 0
Feat.	2822	RPQ 0	Feat.	2822	RPQ 0
Date	31 Dec	1996	Date	31 Dec	1996

Disable

Use the **disable** command to turn off various change management functions.

Syntax:

```
disable                auto-boot
                        fast-boot
```

auto-boot

Disabling auto-boot causes the router boot sequence to stop at the service recovery interface, without running the router operational code. The default auto-boot mode is “enabled”.

Example:

```
Boot config>disable auto-boot
Auto-boot mode is now disabled
```

fast-boot

Disabling fast-boot causes the router to run diagnostic tests when the router is booting during a power-on or a software reload. This provides better hardware error detection but results in slower boot times. This is the default mode, and is recommended whenever the router is in a production environment.

Enable

Use the **enable** command to turn on various change management functions.

Syntax:

```
enable                auto-boot
                        fast-boot
```

auto-boot

Enabling auto-boot causes the router boot to the router operational code without stopping at the service recovery interface. The default auto-boot mode is “enabled”

Note: To enable auto-boot mode using this command, you must also have unattended mode selected in the firmware.

fast-boot

Enabling fast-boot causes the router to skip diagnostic tests when the router is booting during a power-on or a software reload. This reduces hardware error detection but results in faster boot times. The default mode is “disabled,” which is recommended whenever the router is in a production environment.

Example:

```
Boot config>enable fast-boot
Fast-boot mode is now enabled
```

Erase

Use the **erase** command to erase a stored image or a configuration file

Syntax:

```
erase configuration [file]
load [image]
```

config or load

Erases a configuration file or a load image. Enter the config number to be erased after the **erase** command.

Example: Boot config>erase load

```
+----- BankA -----+----- Description -----+----- Date -----+
| IMAGE - CORRUPT          |                               | 01 Jan 1970 00:01 |
| CONFIG 1 - AVAIL        | test config for pubs         | 01 Jan 1970 01:26 |
| CONFIG 2 - AVAIL        | * test config for pubs       | 01 Jan 1970 01:13 |
| CONFIG 3 - NONE         |                               | 01 Jan 1970 00:58 |
| CONFIG 4 - AVAIL        |                               | 01 Jan 1970 00:39 |
+----- BankB -----+----- Description -----+----- Date -----+
| IMAGE - ACTIVE          |                               | 01 Jan 1970 00:01 |
| CONFIG 1 - AVAIL        | test config for pubs         | 01 Jan 1970 00:54 |
| CONFIG 2 - AVAIL        |                               | 01 Jan 1970 00:01 |
| CONFIG 3 - AVAIL        |                               | 01 Jan 1970 00:14 |
| CONFIG 4 - ACTIVE      | *                               | 01 Jan 1970 00:24 |
+-----+-----+-----+
* - Last Used Config      L - Config File is Locked
```

```
Select the bank to erase: (A, B): [A] a
Erase SW load image from bank A.
```

Operation completed successfully.

Boot config>list

```
+----- BankA -----+----- Description -----+----- Date -----+
| IMAGE - NONE            |                               | 01 Jan 1970       |
| CONFIG 1 - AVAIL        | test config for pubs         | 01 Jan 1970 00:26 |
| CONFIG 2 - AVAIL        | * test config for pubs       | 01 Jan 1970 01:13 |
| CONFIG 3 - AVAIL        |                               | 01 Jan 1970 00:58 |
| CONFIG 4 - AVAIL        |                               | 01 Jan 1970 00:39 |
+----- BankB -----+----- Description -----+----- Date -----+
| IMAGE - ACTIVE          |                               | 01 Jan 1970       |
| CONFIG 1 - AVAIL        | test config for pubs         | 01 Jan 1970 00:54 |
| CONFIG 2 - AVAIL        |                               | 01 Jan 1970 00:01 |
| CONFIG 3 - AVAIL        |                               | 01 Jan 1970 00:14 |
| CONFIG 4 - ACTIVE      | *                               | 01 Jan 1970 00:24 |
+-----+-----+-----+
* - Last Used Config      L - Config File is Locked
```

Auto-boot mode is enabled. Fast-boot mode is disabled.

Example: Boot config>erase configuration

```
+----- BankA -----+----- Description -----+----- Date -----+
| IMAGE - NONE            |                               | 01 Jan 1970 00:01 |
| CONFIG 1 - AVAIL        | test config for pubs         | 01 Jan 1970 00:26 |
| CONFIG 2 - AVAIL        | * test config for pubs       | 01 Jan 1970 01:13 |
| CONFIG 3 - AVAIL        |                               | 01 Jan 1970 01:26 |
| CONFIG 4 - AVAIL        |                               | 01 Jan 1970 01:39 |
+----- BankB -----+----- Description -----+----- Date -----+
| IMAGE - ACTIVE          |                               | 01 Jan 1970 00:01 |
| CONFIG 1 - AVAIL        | test config for pubs         | 01 Jan 1970 00:54 |
| CONFIG 2 - AVAIL        |                               | 01 Jan 1970 00:01 |
```

```

| CONFIG 3 - AVAIL | | 01 Jan 1970 00:14 |
| CONFIG 4 - ACTIVE * | | 01 Jan 1970 00:24 |
+-----+-----+
* - Last Used Config      L - Config File is Locked

```

Select the source bank: (A, B): [A]
 Select the configuration to erase: (1, 2, 3, 4): [1] 3
 Erase SW configuration file from bank A, configuration 3.

Operation completed successfully.

```

Boot config>list
+----- BankA -----+----- Description -----+----- Date -----+
| IMAGE - NONE | | | |
| CONFIG 1 - AVAIL | test config for pubs | 01 Jan 1970 00:14 |
| CONFIG 2 - AVAIL * | test config for pubs | 01 Jan 1970 01:13 |
| CONFIG 3 - NONE | | | |
| CONFIG 4 - AVAIL | | | |
+----- BankB -----+----- Description -----+----- Date -----+
| IMAGE - ACTIVE | | | |
| CONFIG 1 - AVAIL | test config for pubs | 01 Jan 1970 00:54 |
| CONFIG 2 - AVAIL | | | |
| CONFIG 3 - AVAIL | | | |
| CONFIG 4 - ACTIVE * | | | |
+-----+-----+
* - Last Used Config      L - Config File is Locked

```

Auto-boot mode is enabled. Fast-boot mode is disabled.

Notice that the list command displays **NONE** by bank A, config 3.

If the erasure fails, a message indicating the failure appears on the console with the banks that failed.

List

Use the **list** command to display information about which load images and configuration files are available and active. This command may also be used to display boot options and scheduled load information.

Syntax:

list

Example: Boot config>list

```

+----- BankA -----+----- Description -----+----- Date -----+
| IMAGE - AVAIL | | | |
| CONFIG 1 - AVAIL | test config for pubs | 01 Jan 1970 01:26 |
| CONFIG 2 - AVAIL * | test config for pubs | 01 Jan 1970 01:13 |
| CONFIG 3 - NONE | | | |
| CONFIG 4 - AVAIL | | | |
+----- BankB -----+----- Description -----+----- Date -----+
| IMAGE - ACTIVE | | | |
| CONFIG 1 - AVAIL | test config for pubs | 01 Jan 1970 00:54 |
| CONFIG 2 - AVAIL | | | |
| CONFIG 3 - AVAIL | | | |
| CONFIG 4 - ACTIVE * | | | |
+-----+-----+
* - Last Used Config      L - Config File is Locked
Auto-boot mode is enabled. Fast-boot mode is disabled.

```

Time Activated Load Schedule Information...

The router is scheduled to reload as follows.

Date: June 26, 1997

```
Time: 16:30
The load modules are in bank A.
The configuration is CONFIG 1 in bank A.
Boot config>
```

The possible file status descriptors are:

ACTIVE

The file is currently loaded and is running on the 2216

AVAIL This is a valid file that can be made ACTIVE.

CORRUPT

The file was damaged or not loaded into the 2216 completely. The file must be replaced.

LOCAL

The file will be used only on the next reload or reset. After the file is used, it will be placed in AVAIL state.

PENDING

This file will be loaded on the next reload, reset, or power-up of the 2216.

Lock

Use the **lock** command to prevent the device from overwriting the selected configuration with any other configuration.

Syntax:

lock

Example: Boot config>lock

BankA	Description	Date
IMAGE - NONE		01 Jan 1970 01:03
CONFIG 1 - AVAIL	test config for pubs	01 Jan 1970 00:26
CONFIG 2 - AVAIL *	test config for pubs	01 Jan 1970 01:13
CONFIG 3 - NONE		01 Jan 1970 00:58
CONFIG 4 - AVAIL		01 Jan 1970 00:26
BankB	Description	Date
IMAGE - ACTIVE		01 Jan 1970 00:01
CONFIG 1 - AVAIL	test config for pubs	01 Jan 1970 00:54
CONFIG 2 - AVAIL		01 Jan 1970 00:01
CONFIG 3 - AVAIL		01 Jan 1970 00:14
CONFIG 4 - ACTIVE *		01 Jan 1970 00:24

* - Last Used Config L - Config File is Locked

Auto-boot mode is enabled. Select the source bank: (A, B): [A]

Select the source configuration: (1, 2, 3, 4): [1] 4
 Attempting to lock bank A and configuration 4.

Operation completed successfully.

Boot config>list

BankA	Description	Date
IMAGE - NONE		01 Jan 1970
CONFIG 1 - AVAIL	test config for pubs	01 Jan 1970 00:13
CONFIG 2 - AVAIL *	test config for pubs	01 Jan 1970 01:13
CONFIG 3 - NONE		01 Jan 1970 00:58
CONFIG 4 - AVAIL L		01 Jan 1970 00:26
BankB	Description	Date
IMAGE - ACTIVE		01 Jan 1970 00:54
CONFIG 1 - AVAIL	test config for pubs	01 Jan 1970 00:01
CONFIG 2 - AVAIL		01 Jan 1970 00:14
CONFIG 3 - AVAIL		01 Jan 1970 00:24
CONFIG 4 - ACTIVE *		01 Jan 1970 00:24

```

+-----+-----+-----+
* - Last Used Config      L - Config File is Locked
Auto-boot mode is enabled.  Fast-boot mode is disabled.

```

Note: Note that bank A config 4 is marked with an “L.”

Set

Use the **set** command to select the code bank, the configuration to use, and the duration of use. The valid durations are:

once The configuration is active for the next boot only.

always

The configuration is active for all subsequent boots until changed again.

Syntax:

set

Example: Boot config>set

```

+----- BankA -----+----- Description -----+----- Date -----+
| IMAGE - NONE                |                               | 01 Jan 1970 01:03 |
| CONFIG 1 - AVAIL            | test config for pubs         | 01 Jan 1970 00:13 |
| CONFIG 2 - AVAIL *          | test config for pubs         | 01 Jan 1970 01:13 |
| CONFIG 3 - NONE             |                               | 01 Jan 1970 00:58 |
| CONFIG 4 - AVAIL            |                               | 01 Jan 1970 00:26 |
+----- BankB -----+----- Description -----+----- Date -----+
| IMAGE - ACTIVE              |                               | 01 Jan 1970 00:01 |
| CONFIG 1 - AVAIL            | test config for pubs         | 01 Jan 1970 00:54 |
| CONFIG 2 - AVAIL            |                               | 01 Jan 1970 00:01 |
| CONFIG 3 - AVAIL            |                               | 01 Jan 1970 00:14 |
| CONFIG 4 - ACTIVE *         |                               | 01 Jan 1970 00:24 |
+-----+-----+-----+
* - Last Used Config      L - Config File is Locked

```

Select the source bank: (A, B): [A] b

Select the source configuration: (1, 2, 3, 4): [1] 4

Select the duration to use for booting: (once, always): [always]

Set SW to boot using bank B and configuration 4, always.

Operation completed successfully.

Boot config>list

```

+----- BankA -----+----- Description -----+----- Date -----+
| IMAGE - NONE                |                               | 01 Jan 1970       |
| CONFIG 1 - AVAIL            | test config for pubs         | 01 Jan 1970 00:13 |
| CONFIG 2 - AVAIL *          | test config for pubs         | 01 Jan 1970 01:13 |
| CONFIG 3 - NONE             |                               | 01 Jan 1970 00:58 |
| CONFIG 4 - AVAIL            |                               | 01 Jan 1970 00:26 |
+----- BankB -----+----- Description -----+----- Date -----+
| IMAGE - ACTIVE              |                               | 01 Jan 1970       |
| CONFIG 1 - AVAIL            | test config for pubs         | 01 Jan 1970 00:54 |
| CONFIG 2 - AVAIL            |                               | 01 Jan 1970 00:01 |
| CONFIG 3 - AVAIL            |                               | 01 Jan 1970 00:14 |
| CONFIG 4 - ACTIVE *         |                               | 01 Jan 1970 00:24 |
+-----+-----+-----+
* - Last Used Config      L - Config File is Locked

```

Auto-boot mode is enabled. Fast-boot mode is disabled.

TFTP

Use the **tftp** command to initiate TFTP file transfers between the 2216 and remote servers.

Note: When you unzip an image, you will see multiple files ending in “.ld”. Use the **tftp get load modules** command to get multiple load modules.

Syntax:

```
tftp get                config
                        load modules

tftp put                config
                        load single image
                        load modules
```

Example: Boot config>tftp get load single

```
+----- BankA -----+----- Description -----+----- Date -----+
| IMAGE - NONE                |                               | 01 Jan 1970 01:03 |
| CONFIG 1 - AVAIL           | test config for pubs         | 01 Jan 1970 00:01 |
| CONFIG 2 - AVAIL *         | test config for pubs         | 01 Jan 1970 01:13 |
| CONFIG 3 - NONE            |                               | 01 Jan 1970 00:58 |
| CONFIG 4 - AVAIL           |                               | 01 Jan 1970 00:14 |
+----- BankB -----+----- Description -----+----- Date -----+
| IMAGE - ACTIVE              |                               | 01 Jan 1970 00:01 |
| CONFIG 1 - AVAIL           | test config for pubs         | 01 Jan 1970 00:54 |
| CONFIG 2 - AVAIL           |                               | 01 Jan 1970 00:01 |
| CONFIG 3 - AVAIL           |                               | 01 Jan 1970 00:14 |
| CONFIG 4 - ACTIVE *        |                               | 01 Jan 1970 00:24 |
+-----+-----+-----+
* - Last Used Config      L - Config File is Locked
```

```
Specify the server IP address (dotted decimal): : [1.2.3.4] 192.9.200.1
Specify the remote file name: : (/u/bin) /usr/2216load/c200-rtr.img
Select the destination bank: (A, B): [A] a
TFTP SW load image
get: /usr/2216load/c200-rtr.img
from: 192.9.200.1
to: bank A.
```

Operation completed successfully.

Note for Dynamic Loading of Software: All of the load modules in the specified directory will be retrieved as part of the load going into the bank. For loads for releases prior to Version 1, Release 2, this will be a single load module. For Version 1, Release 2 loads and later, this may be multiple load modules.

Example: Boot config>tftp get load modules

```
+----- BankA -----+----- Description -----+----- Date -----+
| IMAGE - NONE                |                               | 01 Jan 1970 01:03 |
| CONFIG 1 - AVAIL           | test config for pubs         | 01 Jan 1970 00:01 |
| CONFIG 2 - AVAIL *         | test config for pubs         | 01 Jan 1970 01:13 |
| CONFIG 3 - NONE            |                               | 01 Jan 1970 00:58 |
| CONFIG 4 - AVAIL           |                               | 01 Jan 1970 00:14 |
+----- BankB -----+----- Description -----+----- Date -----+
| IMAGE - ACTIVE              |                               | 01 Jan 1970 00:01 |
| CONFIG 1 - AVAIL           | test config for pubs         | 01 Jan 1970 00:54 |
| CONFIG 2 - AVAIL           |                               | 01 Jan 1970 00:01 |
| CONFIG 3 - AVAIL           |                               | 01 Jan 1970 00:14 |
| CONFIG 4 - ACTIVE *        |                               | 01 Jan 1970 00:24 |
```

```
+-----+-----+-----+-----+
* - Last Used Config      L - Config File is Locked
```

```
Specify the server IP address (dotted decimal): : [1.2.3.4] 192.9.200.1
Specify the remote modules directory: : (/u/bin) /usr/2216load/
Select the destination bank: (A, B): [A] a
TFTP SW load image
get: /usr/2216load/LML.1d
from: 192.9.200.1
to: bank A.
```

Operation completed successfully.

Notes:

When putting files to a server:

1. Make sure that the files on the target server have the appropriate permissions that would allow anyone to write to those files. If not, the put operation will fail.
2. You must be aware of the files you are putting to the target server. To determine whether the image in the bank is a single module or multiple modules, use the **describe** command. A load prior to Version 1, Release 2 is a single module. Loads at Version 1, Release 2 or after are multiple modules.

Timedload

Use the **timedload** command to schedule a load on a device, cancel a scheduled load, or view scheduled load information.

This command allows you to load the device outside peak network traffic periods when support personnel may not be present.

Note: You may also use the Configuration Program to schedule a reload for a device, which is not affected by reloads or power outages. These circumstances would normally cause the reload to be lost. See the chapter "Using the Configuration Program" in *Configuration Program User's Guide* for details.

Syntax:

```
timedload          _activate
                    _deactivate
                    _view
```

activate

Schedules a load on the device. You will be prompted for information for a time-activated load similar to the **tftp get load** and **tftp get config** commands. See "TFTP" on page 51 for information about the parameters.

Time of day to load the device

Specifies the date and time to load the device. Specify the value as YYYYMMDDHHMM, where:

YYYY is the four-digit year

Note: If the current month on the device is December, the year data must be the current year or the following year. Otherwise, if the current month on the device is January through November, the year data must be the current year.

MM is the two digit month.

MM Valid Values: 01 to 12 with 01 representing January.
DD is the two-digit day of the month.
DD Valid Values: 01 to 31, depending on the value of MM.
HH is the two-digit hour in 24-hour time.
HH Valid Values: 00 to 23
MM is the two-digit minute of the hour.
MM Valid Values: 00 to 59

The following are examples of scheduling a load from different sources.

Example 1. Load modules and configuration source is a remote host:

Boot config>timedload activate

Bank	Description	Date
BankA		
IMAGE - AVAIL		01 Jan 1970 00:01
CONFIG 1 - AVAIL	test config for pubs	01 Jan 1970 01:26
CONFIG 2 - AVAIL *	test config for pubs	01 Jan 1970 01:13
CONFIG 3 - NONE		01 Jan 1970 00:58
CONFIG 4 - AVAIL		01 Jan 1970 00:39
BankB		
IMAGE - ACTIVE		01 Jan 1970 00:01
CONFIG 1 - AVAIL	test config for pubs	01 Jan 1970 00:54
CONFIG 2 - AVAIL		01 Jan 1970 00:01
CONFIG 3 - AVAIL		01 Jan 1970 00:14
CONFIG 4 - ACTIVE *		01 Jan 1970 00:24

* - Last Used Config L - Config File is Locked

Time Activated Load Processing...

Select the bank to use: (A, B): [A] a
Do you want to put load modules into the bank? (Yes, No, Quit): [Yes] yes
Do you want to retrieve a SINGLE image or a set of MODULES? [MODULES]? modules
Specify the server IP address (dotted decimal): : [1.2.3.4] 192.9.200.1
Specify the remote modules directory: : (/u/bin) /usr/601bin/205img
The destination bank is bank A
TFTP SW load image
get: /usr/601bin/205img/
from: 192.9.200.1
to: bank A.
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'
tftp: connect to '192.9.200.1'

Operation completed successfully.

Do you want to put a configuration into the bank? (Yes, No, Quit): [Yes] yes
Specify the server IP address (dotted decimal): : [1.2.3.4] 192.9.200.1
Specify the remote file name: : (config.dat) /tftpboot/192.9.200.6.config
The destination bank is bank A
Select the destination configuration: (1, 2, 3, 4): [1] 1
TFTP SW configuration file
get: /tftpboot/192.9.200.6.config
from: 192.9.200.1
to: bank A, configuration 1.
tftp: connect to '192.9.200.1'

Operation completed successfully.

Time of day to load the router (YYYYMMDDHHMM) []? 199706261630
The load timer has been activated.
Boot config>

Example 2. Load modules and configuration source is a bank:

Boot config>**timedload activate**

BankA	Description	Date
IMAGE - AVAIL		01 Jan 1970 00:01
CONFIG 1 - AVAIL	test config for pubs	01 Jan 1970 01:26
CONFIG 2 - AVAIL *	test config for pubs	01 Jan 1970 01:13
CONFIG 3 - NONE		01 Jan 1970 00:58
CONFIG 4 - AVAIL		01 Jan 1970 00:39

BankB	Description	Date
IMAGE - ACTIVE		01 Jan 1970 00:01
CONFIG 1 - AVAIL	test config for pubs	01 Jan 1970 00:54
CONFIG 2 - AVAIL		01 Jan 1970 00:01
CONFIG 3 - AVAIL		01 Jan 1970 00:14
CONFIG 4 - ACTIVE *		01 Jan 1970 00:24

* - Last Used Config L - Config File is Locked

Time Activated Load Processing...

Select the bank to use: (A, B): [A] **a**

Do you want to put load modules into the bank? (Yes, No, Quit): [Yes] **no**

Do you want to put a configuration into the bank? (Yes, No, Quit): [Yes] **no**

Select the configuration to use: (1, 2, 3, 4): [1] **1**

Time of day to load the router (YYYYMMDDHHMM) []? **199706261630**

The load timer has been activated.

Boot config>

deactivate

Cancels a scheduled load.

Example 1: Deactivate the time activated load

Boot config>**timedload deactivate**

Deactivate Load Timer Processing...

Do you want to deactivate the load timer? (Yes, No, Quit): [No] **yes**

The load timer has been deactivated.

Boot config>

view

 Displays scheduled load information.

Boot Config> **timedload view**

Time Activated Load Schedule Information...

The router is scheduled to reload as follows.

Date: June 26, 1997

Time: 16:30

The load modules are in bank A.

The configuration is CONFIG 1 in bank A.

Boot config>

Unlock

Use the **unlock** command to allow the device to overwrite the selected configuration that was previously locked.

Syntax:

unlock

Example: Boot config>**unlock**

BankA	Description	Date
IMAGE - NONE		01 Jan 1970 01:03
CONFIG 1 - AVAIL	test config for pubs	01 Jan 1970 00:13
CONFIG 2 - AVAIL *	test config for pubs	01 Jan 1970 01:13
CONFIG 3 - NONE		01 Jan 1970 00:58
CONFIG 4 - AVAIL L		01 Jan 1970 00:26

BankB	Description	Date
IMAGE - ACTIVE		01 Jan 1970 00:01
CONFIG 1 - AVAIL	test config for pubs	01 Jan 1970 00:54
CONFIG 2 - AVAIL		01 Jan 1970 00:01
CONFIG 3 - AVAIL		01 Jan 1970 00:14
CONFIG 4 - ACTIVE *		01 Jan 1970 00:24

Chapter 8. The Configuration Process (CONFIG - Talk 6) and Commands

This chapter describes the CONFIG process and includes the following sections:

- “What is CONFIG?”
- “Config-Only Mode” on page 58
- “Quick Configuration” on page 58
- “Configuring User Access” on page 59
- “Configuring Spare Interfaces” on page 60
- “Resetting Interfaces” on page 63
- “Using System Dumps” on page 66

What is CONFIG?

The Configuration process (CONFIG) is a second-level process of the router user interface. Using CONFIG commands, you can:

- Set or change various configuration parameters
- Add or delete an interface to the hardware configuration
- Enter the Boot CONFIG command mode
- Enter the Quick Configuration mode
- Clear, list, or update configuration information
- Enable or disable console login
- Communicate with third-level processes, including protocol environments

Note: Refer to the chapter “Migrating to a New Code Level” in *2216 Nways Multiaccess Connector Service and Maintenance Manual* for information about migrating to a new code level.

CONFIG lets you display or change the configuration information stored in the router’s nonvolatile configuration memory. Changes to system and protocol parameters do not take effect until you reload the router software. (For more information, refer to the OPCON **reload** command in “Chapter 4. The OPCON Process” on page 29).

Note: You must enter the **write** command to save the changes in the device’s flash memory.

The CONFIG command interface is made up of levels that are called modes. Each mode has its own prompt. For example, the prompt for the TCP/IP protocol is `IP config>`.

If you want to know the process and mode you are communicating with, press **Return** to display the prompt. Some commands in this chapter, such as the **network** and **protocol** commands, allow you to access and exit the various levels in CONFIG. See Table 7 on page 67 for a list of the commands you can issue from the CONFIG process.

Config-Only Mode

Config-Only mode is entered if the configuration file that you are using is empty or no protocols are configured. Config-Only mode can also be entered manually to recover from an invalid configuration that is causing the router to crash during start-up.

Automatic Entry Into Config-Only Mode

Config-Only mode is entered if the router is booting with an empty configuration file or the configuration file contains incomplete configuration data.

The following conditions cause the router to enter Config-Only mode:

- Devices are configured but no protocols are configured.
- Deletion of all router interface information.
- The configuration file is empty.

Manual Entry Into Config-Only Mode

To enter Config-Only mode, do one of the following:

- Reload the router with no configuration.
- Reload the router with no interfaces configured.
- Reload the router with no protocols configured.

See “Chapter 3. Accessing the Firmware from the Command Line Interface” on page 27 for more information.

Quick Configuration

Quick Configuration (Quick Config) provides a minimal set of commands that allow you to configure bridging protocols and routing protocols present in the router load. You can also configure an SNMP community with WRITE_READ_TRAP access. This is useful during initial setup because the configuration program uses SNMP SET commands to transfer the configuration.

Important: At least one network device must be configured before using quick config. To add a device, use the **add device** command at the `config(only)>` or `config>` prompt.

The following table lists the protocols supported by Quick Config.

Table 6. Quick Config Capabilities

ATM Protocols	Bridging Protocols	Routing Protocols
LAN Emulation	STB, SRT, SRB	IP, IPX, DNA IV

Quick Config complements the existing configuration process by offering a shortcut. This shortcut allows you to configure the minimum number of parameters for these bridging protocols and routing protocols without having to exit and enter the different configuration processes. The other parameters are set to selected defaults.

Situations that call for the router to be quickly configured are:

Using the CONFIG (Talk 6) Process

- Blank or corrupted configuration memory, such as when one of the following situations occurs:
 - The router is configured for the first time.
 - Voltage fluctuations caused corruption of the hard file.
- Demonstration purposes, for which the router needs to be quickly configured to demonstrate its capabilities.
- Bench-marking tests to get the tests going without having to learn the router's operating system commands.

Quick Config operates as follows:

- It asks a series of questions with default values.
- It offers a short-cut to the detailed configuration of the normal mode command set.

Quick Config sets a number of default parameters based upon how you answer the configuration questions. What cannot be configured with Quick Config can be configured using Config after exiting Quick Config.

You cannot delete Quick Config information from within Quick Config. However, you can correct information either by exiting and returning to Quick Config, or by entering the **reload** command as a response to some Quick Config questions.

For complete information on using the Quick Config software, see "Appendix A. Quick Configuration Reference" on page 697.

Manual Entry Into Quick Config Mode

You might want to run Quick Config manually to demonstrate the router's capabilities or to reconfigure dynamically to perform benchmark tests without having to learn the router's operating system commands.

To enter Quick Config, type **qconfig** at the Config> prompt.

Exiting from Quick Config Mode

To exit Quick Config, restart by entering **r** from any prompt. Follow the queries until you enter **no** and then enter **q** to quit. The router returns to either the Config (only)> or the Config> prompt.

Configuring User Access

The router configuration process allows for a maximum of 50 user names, passwords, and levels of permission. Each user needs to be assigned a password and level of permission. There are three levels of permission: *Administration*, *Operation*, and *Monitoring*.

For more information, see the **add user** command.

Using the CONFIG (Talk 6) Process

Technical Support Access

If you are the system administrator, when you add a new user for the first time, you are asked if you want to add Technical Support access. If you answer yes, Technical Support is granted the same access privileges that you have as system administrator.

The password for this account is automatically selected by the software and is known by your service representative. This password can be changed using the **change user** command; however, if you do change the password, customer service cannot provide remote support. For additional information on the use of the **change user** command, see “Change” on page 75.

Configuring Spare Interfaces

Occasionally, you may need to configure a new interface along with its bridging and routing protocols without having to restart the device. You can accomplish this by configuring a number of **spare interfaces** on your device. Spare interfaces are useful if:

- You are “hot-plugging” a new adapter into your device.
You can install the adapter, configure it and then activate it without unplugging or restarting the device.
- You are adding dial circuits to your device.
Use spare interfaces to add new V.25bis or ISDN dial circuits on an existing V.25bis or ISDN interface.
- You are adding ATM LAN Emulation clients.
Use spare interfaces to add Token-Ring or Ethernet ATM LAN Emulation clients to an existing ATM interface.
- You are adding virtual networks to an existing ESCON Channel Adapter or Parallel Channel Adapter.

To configure a spare interface:

1. Access the CONFIG process by entering **talk 6**.
2. Configure the number of spare interfaces for the device using the **set spare-interfaces** command.
3. Exit the CONFIG process by pressing **Ctrl-P**.
4. Reload the device.

Example:

```
* talk 6
Config> set spare 2
Config>
*reload
Are you sure you want to reload the gateway? (Yes or [No]) yes
```

When the device reloads, the spare interfaces are installed as null devices.

To use one of the spare interfaces:

1. Insert the new adapter into the adapter slot.

Note: If you are using an ESCON or Parallel channel adapter, you have the ability to define spare interfaces for each of the attached networks without using additional adapters. In this case, you can bypass this step.

Using the CONFIG (Talk 6) Process

2. Access the CONFIG process by entering **talk 6**.
3. Add an interface or a dial circuit using the **add device** command, if necessary.
4. Configure the spare interface by using the **net** command to configure the interface or add ATM LAN Emulation clients.
5. Configure the various protocols and features using the **protocol** and **feature** commands.
6. Exit the CONFIG process by pressing **Ctrl-P**.
7. Access the GWCON process by entering **talk 5**.
8. Bring the new interface online to the network using the **activate** command.

The following example shows how to configure and activate a new dial circuit on which the IP protocol is enabled. The dial circuit and IP protocol configuration are not shown.

Example:

```
*talk 6
Config> add device dial-circuit
Config> net 6
Circuit configuration
Circuit config>

:
Here you would configure the dial circuit

:
Circuit config> exit
Config> protocol ip
IP>

:
Here you would configure the IP protocol on the dial circuit.

:
IP> exit
Config>
*talk 5
+activate 6
```

Restrictions for Spare Interfaces

The **activate** command cannot be used to activate a new interface on the network under the following conditions:

- You have already entered a **delete interface** command. The device must be restarted if **any** interface has been deleted. You cannot delete a spare interface (indicated by **null** in list displays).
- The spare interface is the only interface that enables a protocol or feature. The protocol or feature must already be enabled on an existing interface before it can be used by a spare interface.
- The new spare interface has a header size or trailer size greater than the sizes for other interfaces.
- There is not enough memory to allocate receive buffers for the new interface.

In these cases, you must restart the device to bring the new interface online.

You can configure the following interfaces as spare interfaces, but you cannot activate them on the network using the **activate** command:

- ATM
- SDLC

Using the CONFIG (Talk 6) Process

- SDLC Relay
- V.25bis
- PPP Multilink master and dedicated link nets

You must restart the device to bring these interfaces online.

You can configure the following protocols on spare interfaces, but you cannot activate them on the network using the **activate** command:

- IPv6
- LNM
- OSI/DECnet V
- XTP

Note: When using the configuration program, use the following to work with spare interfaces:

1. Make the configuration changes for the spare interface on the device
2. Enter the **activate** command on the device to bring the spare interface, protocols, and features online
3. Retrieve the configuration using the configuration program
4. Save the retrieved configuration into the configuration program database

There are requirements for certain functions. These are:

APPN	To activate this protocol on a spare interface, you must first activate the interface and then configure the protocol on the activated interface.
Bandwidth Reservation (BRS)	To configure BRS on a spare interface, you must enable BRS on each network interface where Frame Relay circuits will be active before activating the spare interface. After activating the spare interface, you can then use BRS configuration commands to make changes such as adding a traffic class or assigning a protocol to a traffic class.
DECnet IV	To activate this protocol on a spare interface, you must first activate the interface and then configure the protocol on the activated interface. Use the DECnet IV set command to activate the configuration changes.
Frame Relay	<ul style="list-style-type: none">• You cannot activate an FR dial circuit interface unless the dial circuit's base net is already active.• An activate for an FR dial circuit will fail if the frame size, MAC header, or trailer required by the spare interface is larger than other dial circuits already assigned to the base net.• If data compression is not already active in the device, data compression will not work on a spare interface defined for data compression.
BGP	Use the BGP reset neighbor command to activate new neighbors.
IPX	Use the reset command to activate static routes, static services, and filter lists on the spare interface.

Using the CONFIG (Talk 6) Process

PPP	<ul style="list-style-type: none">• If data compression is not already active in the device, data compression does not work on a spare interface defined for data compression.• You cannot activate a spare PPP interface if the device's global buffer is too small to support a 1500-byte PPP MRU.• You cannot activate a PPP dial circuit interface unless the dial circuit's base net is already active.• An activate for a PPP dial circuit will fail if the frame size, MAC header, or trailer required by the spare interface is larger than other dial circuits already assigned to the base net.
Bridging	<ul style="list-style-type: none">• Bridging was not already active.• NetBIOS filters are defined on the spare interface.• The spare interface caused a change to the bridge personality or behavior (for example, adding SR port to pure TB bridge or SR-TB conversion enabled).
IP	Use the reset IP command to bring configuration changes online for access-controls and packet-filters.
Channel Virtual Nets (MPC, LCS, LSA)	The spare interface cannot be activated if its configured subchannels are already in use by or shared with another interface.
WAN Restoral/ WAN Reroute	<p>The spare interface cannot be activated if any of the following conditions exist:</p> <ul style="list-style-type: none">• The spare interface is configured as a WRS primary, and its configured WRS secondary is already a WRS primary or WRR primary or WRR alternate.• The spare interface is configured as a WRS primary, and its configured WRS secondary is already actively restoring some other WRS primary.• The spare interface is configured as a WRS secondary, and its configured WRS primary is already a WRS secondary or WRR primary or WRR alternate.• The spare interface is configured as a WRS secondary, and its configured WRS primary is already actively being restored by some other WRS secondary.• The spare interface is configured as a WRR primary, and its configured WRR alternate is already a WRS primary or WRS secondary or WRR primary or WRR alternate.• The spare interface is configured as a WRR alternate, and its configured WRR primary is already a WRS primary or WRS secondary or WRR alternate.• The spare interface is configured as a WRR alternate, and its configured WRR primary is already actively being rerouted by some other WRR alternate.

Resetting Interfaces

Occasionally, you might need to change the configuration of a network interface along with its bridging and routing protocols without restarting the device. The **reset** command allows you to disable a network interface and then enable it using new interface, bridging and routing configuration parameters.

The interface, protocols and features configuration parameters are changed using the CONFIG process (talk 6) commands. The talk 6 commands affect the contents

Using the CONFIG (Talk 6) Process

of the configuration memory. The configuration changes are activated by issuing the GWCON process (talk 5) **reset** command.

To reset an interface:

1. Access the CONFIG process (talk 6).
2. Use the **net** command and other commands to change configuration parameters.
3. Use the **protocol** and **feature** commands to change the interface-based configuration parameters.
4. Exit the CONFIG process by pressing **Ctrl-P**.
5. Access the GWCON process (talk 5).
6. Use the **reset** command to reset the interface and the protocols and features on the interface.

Example:

```
*talk 6
Config>net 1
PPP Config>

. . . change PPP parameters . . .

PPP Config>exit
Config>protocol ipx
IPX Config>

. . . change IPX parameters on the PPP interface . . .

IPX Config>exit
Config>
*talk 5
+reset 1
Resetting net 1 PPP/0...successful
```

Note: When using the configuration program, do the following to make configuration changes to existing interfaces:

1. Make the configuration changes for the interface on the device
2. Enter the **reset** command to reset interface, protocol and feature parameters
3. Retrieve the configuration using the configuration program
4. Save the retrieved configuration into the configuration program database

Restrictions for Resetting Interfaces

The **reset** command cannot be used to reset a network interface if:

- You have already entered a **delete interface** command. The device must be reloaded if any interface has been deleted.
- You have changed the hardware or data link type. For example, changing the data link type from PPP to Frame Relay.
- You have configured a larger MTU.
- You have configured a routing protocol or bridging on the interface, but that routing protocol or bridging is not currently active in the device.

In these situations, you must reload the device to activate the configuration changes.

You can change the configuration parameters of the following types of interfaces, but you cannot activate the changes using the **reset** command:

Using the CONFIG (Talk 6) Process

- ATM
- PPP Multilink master and dedicated link nets
- ISDN
- X.25
- SDLC
- SDLC Relay
- V.25bis

You must reload the device to activate these configuration changes.

You can change the configuration parameters of the following protocols and features, but you cannot activate the changes using the **reset** command:

- AppleTalk
- Vines
- OSI/DECnet V
- LNM
- XTP
- WAN Restoral
- WAN Reroute

You must reload the device to activate these configuration changes.

There are also requirements for certain functions. They are:

PPP dial circuits	A PPP dial circuit cannot be reset if any of the dial circuit parameters have changed.
Frame Relay dial circuits	A Frame Relay dial circuit cannot be reset if any of the dial circuit parameters have changed.
Compression	Compression requires large header and trailer sizes. Unless compression is already enabled on some other interface, it is likely that the header and trailer sizes will be too small. In this case, compression is disabled automatically on the interface and an ELS message is logged (rather than causing the entire reset interface to fail).
ESCON base net	Resetting the ESCON base net automatically resets all associated virtual nets.
PCA base net	Resetting the PCA base net automatically resets all associated virtual nets.
Channel virtual nets (MPC,LCS, LSA)	Must reset the ESCON or PCA base net in order to reset the following virtual net parameters: Subchannels (adding/deleting/changing/moving), LAN type, LAN number, Block timer, Acknowledgement length.
Bridging	<ul style="list-style-type: none">• Bridging was not already active.• NetBIOS filters are defined on the interface you are resetting.• The reset interface caused a change to the bridge personality or behavior (for example, adding SR port to pure TB bridge or SR-TB conversion enabled).

Using the CONFIG (Talk 6) Process

BGP	Use the BGP reset neighbor command to activate neighbor configuration changes.
APPN	Use the activate_new_config command to activate configuration changes.
IPX	Use the IPX reset command to activate configuration changes for static routes, static services, and filter-lists.
DNA IV	Use the DNA IV set command to activate configuration changes.
SNMP	Use the SNMP revert command to activate configuration changes.

Using System Dumps

A useful tool for debugging problems with the 2216 is the system dump. The dump is a compressed snapshot that the system saves to the hard drive if one is present, or to a remote host on the network .

To configure dumping:

1. Specify which three dump files you will save. See page 97 for more information.
2. Specify whether you want dumping re-enabled after a dump occurs. See page 96 for more information.
3. Enable dumping on the 2216. See page 85 for more information.

You can view the status of system dumping or retrieve a dump from the system. See “System View” on page 101 and “System Retrieve” on page 100, respectively.

Chapter 9. Configuring and Monitoring the CONFIG Process

This chapter describes the CONFIG process configuration and operational commands. It includes the following sections:

- “Entering and Exiting CONFIG”
- “CONFIG Commands”

Entering and Exiting CONFIG

To enter CONFIG from OPCON (*):

1. At the OPCON prompt, enter the **status** command to find the PID of CONFIG. (See page 9 for a sample output of the **status** command.)

```
* status
```

2. Enter the OPCON **talk** command and the PID for CONFIG:

```
* talk 6
```

The console displays the CONFIG prompt (Config>). Now, you can enter CONFIG commands. If the prompt does not appear, press the **Return** key again. To exit CONFIG and return to the OPCON prompt (*), enter the intercept character. (The default is **Ctrl-P**.)

CONFIG Commands

This section describes each of the CONFIG commands. Each command includes a description, syntax requirements, and an example. The CONFIG commands are summarized in Table 7.

After accessing the CONFIG environment, enter the configuration commands at the Config> prompt.

Table 7. CONFIG Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Add	Adds an interface to the router configuration, or a user to the router.
Boot	Enters Boot CONFIG command mode.
Change	Changes a user’s password or a user’s parameter values associated with this interface. Also changes a slot/port of an interface.
Clear	Clears configuration information.
Delete	Deletes an interface from the router configuration or deletes a configured user. Also deletes system dump files.
Disable	Disables login from a remote console,
Enable	Enables login from a remote console, enables modem use
Event	Enters the Event Logging System configuration environment.
Feature	Provides access to configuration commands for independent router features outside the usual protocol and network interface configuration processes.
List	Displays system parameters, hardware configuration, a complete user list.
Load	Lists, adds, or deletes optional software packages.
Network	Enters the configuration environment of the specified network.

CONFIG Commands

Table 7. CONFIG Command Summary (continued)

Command	Function
Patch	Modifies the router's global configuration.
Performance	Provides a snapshot of the main processor utilization statistics.
Protocol	Enters the command environment of the specified protocol.
Qconfig	Initiates the Quick Config process.
Set	Sets system-wide parameters for buffers, host name, inactivity timer, packet size, prompt level, number of spare interfaces, dump parameters, location, and contact person.
System Retrieve	Retrieves dumps
System View	Displays the dump settings and the current dump status. Also displays a summary of the dumps.
Time	Keeps track of system time and displays it on the console.
Unpatch	Restores patch variables to default values.
Update	Updates the current version of the configuration.
Write	Writes the current configuration information to the nonvolatile memory.

Add

Use the **add** command to add an interface to the configuration, or user-access. This command also recreates device records if the configuration is inadvertently lost.

Syntax:

```
add                callback . . .  
                   device  
                   isdn-address . . .  
                   ppp-user  
                   tunnel-profile  
                   user . . .  
                   v25-bis-address
```

Callback

Use the **add callback** command to add, delete, or list information for callback on ISDN.

Add Adds a callback number to the authentication lists.

Delete Deletes a callback number from the authentication list.

Lists Displays the authentication list and other related information.

device *device_type additional-config-info*

With the **add device** command, you must enter the interface device type (*device_type*). You are prompted for additional configuration parameters. This additional information varies by device and platform. Refer to "Accessing Network Interface Configuration and Operating Processes" on page 16 for additional information about device type and configuration parameters.

Note: If you are adding more than one interface, the order in which you add them is important because the router assigns a sequential

CONFIG Commands

interface number to the device when it is added. This interface number is an index number in the device list; it links the device with other protocol configuration information, such as the IP addresses associated with the device. (For more information, refer to the **list devices** command, "List" on page 87.)

All device and protocol configuration information related to network interfaces is stored by interface number. Any changes made to interface numbers will invalidate much of the device configuration information in the protocols.

Example:

```
add device atm
Device Slot #(1-8) [1]? 2
Adding CHARM ATM Adapter device in slot 2 port 1 as interface x
(where x is the interface number assigned)
```

To determine which devices you can add, use the **add devices ?** command.

isdn-address *address-name network-dial-address network-subdial-address*
Adds the local and remote numbers of the ISDN end-points that will be communicating with your router.

address-name

Can be anything (such as a description of the port).

network-dial-address

The telephone number of the local or the destination port.

network-subdial-address

The additional part of the telephone number, such as an extension, that gets interpreted when the interface connects to a PBX; this parameter is optional.

Note: You can use punctuation, such as parentheses and dashes, but the punctuation is not significant (the router uses only the numbers).

```
Example: add isdn-address line 1 local
Assign network dial address [0 - 32 digits]? 1 2345 67
Assign network subdial address [0 - 19 digits]? 98765
```

ppp-user

Adds the user profile of a remote user to the local PPP user data base. You can add up to 500 users. You add a PPP user for each remote router or DIALs client that can connect to the device you are configuring. You must configure PPP users if either of the following conditions exist:

- You are using PPP authentication protocols, PPP encryption, or allowing users to use the dial-out feature. You need to configure a PPP user for either type of encryption - Encryption Control Protocol (ECP) or Microsoft Point-to-Point Encryption (MPPE); however, MPPE does not require the encryption key.
- You want the PPP user data base to be locally stored and managed by the device. If you want PPP user information to be obtained from a RADIUS, TACACS, or TACACS+ server, then you should configure the Authentication feature instead of configuring local PPP users.

Note: MPPE cannot use the RADIUS, TACACS, or TACACS+ server. For MPPE, the PPP user data base must be local.

CONFIG Commands

If ECP has been enabled for the user, you are prompted for the PPP user name, password, IP address, and encryption key .

If the DIALs feature is in the software load, you are asked if this is a DIALs user.

If you are adding a user for a DIALs client, then you are prompted for the hostname, type of route, network mask, connect time, and call-back information.

See “Using a Dial-In Access to LANs (DIALs) Server” in the *Using and Configuring Features* for more information.

A user profile stored locally on the device consists of the following:

Name The userid of the PPP user, used during authentication. See “PPP Authentication Protocols” on page 537.

Password

The password known to the user and the device, used during authentication. It can be up to 31 characters in length, consist of any alphanumeric character, and is case sensitive. See “PPP Authentication Protocols” on page 537 for more information.

Enter again to verify

Enter the password again for verification.

Allow inbound access

Allows inbound access to this user profile.

Valid values: yes, no

Default value: no

Will user be tunneled?

Specifies whether this dial-in user should be tunneled to an LNS destination. If you enter “yes”, you are prompted for information about the LNS.

Valid values: yes, no

Default value: no

Number of days before account expiry

The number of days before the password expires.

Valid values: 0 to 360

Default value: 180

Number of grace logins allowed

The number of login attempts allowed after the password expires.

Valid values: 0 to 100

Default value: 0

Hostname to use when connecting to this peer:

Specifies the local hostname of this LAC that is passed as identification to the LNS during tunnel setup.

Tunnel Server endpoint:

Specifies the IP address of the LNS to which this user is tunneled.

Type of Route

Either “Host Route” or “Net Route.”

A host route is generally applied for single-user access. A net route is generally applied to a network access. A net route allows you to enter a net mask.

IP Address

IP address to be assigned to a user.

A user profile-based IP address to offer to a dial-in client if requested. There are a number of ways for a 2216 to obtain an IP address for a dial-in client. See “IP Control Protocol” on page 543 for more information.

Valid values: any valid IP address

Default value: none

Net-Route Mask

Mask for a network user.

If the dial-in user is connecting to a DIALs-enabled PPP interface, the router automatically adds a temporary static route to that client for the duration of the PPP session. Typically, this static route has a net mask of 255.255.255.255 (the default value), which implies that there is a single IP host at the other end of the PPP link. However, the net mask can be overridden. If configured, this mask is used when adding the temporary route. An example of this is a small router with a single network of hosts that dials into a DIALs-enabled router. The single route to the small office router will be installed automatically based on the user profile, making it unnecessary to configure routing protocols between the two hosts and cutting down on routing traffic overhead over a potentially slow link.

Hostname

Hostname to be sent to the Proxy DHCP server for use by Dynamic DNS. See “Using a Dial-In Access to LANs (DIALs) Server” in *Using and Configuring Features* for more information.

Time-Allotted

The length of time a DIALs user can be connected. This is the total for this session, and should not be confused with an inactivity timer.

Valid Values: 0 to 71 827 788 minutes (0=unlimited)

Default Value: 0

Callback type

Call-back method, either “Roaming” or “Required.” The call-back parameters are used to specify whether the router will call back the user and what number to call back. See “Configuring PPP Callback” on page 541 for additional information.

Set encryption key

Specifies whether ECP encryption is to be enabled for this user/port.

Valid values: yes, no

Default value: no

ECP encryption key

Enter 16-character ECP encryption key.

CONFIG Commands

This parameter is displayed only if PPP Encryption Control Protocol (ECP) has been enabled using the talk 6 PPP Config> **enable ecp** command. MPPE does not require an encryption key. This ECP encryption key is used by the PPP Encryption Control Protocol (ECP). See “Using and Configuring Encryption Protocols” in *Using and Configuring Features*.

Disable user

Allows you to disable a user-profile.

Valid values: yes, no

Default value: no

Example:

```
Config> add ppp-user
Enter name: [ ]? pppusr01
Password:
Enter again to verify:
Allow inbound access for user? (Yes, No): [yes]
Will user be tunneled? (Yes, No): [No]
Number of days before account expiry[0-1000] [0]? 10
Number of grace logins allowed after an expiry[0-100] [0]? 5
IP address: [0.0.0.0]? 1.1.1.1
Set ECP encryption key for this user? (Yes, No): [No] no
Disable user ? (Yes, No): [No]
```

```
      PPP user name: pppusr01
      User IP address: 1.1.1.1
      Virtual Conn: disabled
      Encryption: disabled
      Status: enabled
      Login Attempts: 0
      Login Failures: 0
      Lockout Attempts: 0
      Account expires: Sun 17Feb2036 06:28:16
      Account duration: 10 days 00.00.00
      Password Expiry: <unlimited>
```

User 'pppusr01' has been added

Example:

```
Config> add ppp-user
Enter name: [ ]? tunusr01
Password:
Enter again to verify:
Allow inbound access for user? (Yes, No): [yes]
Will user be tunneled? (Yes, No): [No] yes
Enter hostname to use when connection to this peer: [ ]? host01
Tunnel-Server endpoint address: [0.0.0.0]? 1.1.1.1
```

```
--more--      PPP user name: tunusr01
--more--      Endpoint: 1.1.1.1
--more--      Hostname: host01
```

User 'tunusr01' has been added

Example with ECP encryption:

```
Config>add ppp-user
Enter name: [ ]? ppp_user2
Password:
Enter again to verify:
Allow inbound access for user? (Yes, No): [Yes]
Will user be tunneled? (Yes, No): [No]
Is this a 'DIALs' user? (Yes, No): [Yes]
Type of route? (hostroute, netrout): [hostroute]
Number of days before account expiry[0-1000] [0]?
Number of grace logins allowed after an expiry[0-100] [0]?
IP address: [11.0.0.185]?
Allow virtual connections? (Yes, No): [No]
Give user default time allotted ? (Yes, No): [Yes]
Enable callback for user? (Yes, No): [No]
```

```

Will user be able to dial-out ? (Yes, No): [No]
Set ECP encryption key for this user? (Yes, No): [No] y
Encryption key should be 16 characters long.
Encryption Key (16 characters ) in Hex(0-9, a-f, A-F):
Encryption Key again (16 characters) in Hex(0-9, a-f, A-F):
ECP encryption key is set.
Disable user ? (Yes, No): [No]

```

```

      PPP user name: ppp_user2
      User IP address: 11.0.0.185
      Netroute Mask: 255.255.255.255
      Hostname:          Virtual Conn: disabled
      Time allotted: Box Default
      Callback type: disabled
      Dial-out: disabled
      Encryption: enabled
      Status: enabled
      Login Attempts: 0
      Login Failures: 0
      Lockout Attempts: 0
      Account Expiry:      Password Expiry:
Is information correct? (Yes, No, Quit): [Yes]

User 'ppp_user1' has been added

```

tunnel *tunnel-name*

Gives a tunnel peer access through an IP network to the router. The peer is then authorized to initiate tunneled PPP sessions into the router. To configure a tunnel you must specify:

Name The hostname of the tunnel peer.

Hostname to use when connecting to this peer

The local hostname to use when connecting to this peer. This name is used for identification of the host on the peer.

Set shared secret

Specifies whether a shared secret is to be used.

Shared Secret

The secret shared between the LAC and LNS. It must be exactly the same on both ends of the tunnel.

Enter again to verify

Enter the shared secret again for verification.

Tunnel-Server endpoint address

The IP address of the tunnel peer (LAC or LNS).

Example:

```

Config> add tunnel
Enter name: []? tunne102
Enter hostname to use when connecting to this peer: []? host02
Set shared secret? (Yes, No): [No]? yes
Shared secret for tunnel authentication:
Enter again to verify:
Tunnel-Server endpoint address: [0.0.0.0]? 2.2.2.22

```

```

      Tunnel name: tunnel02
      Endpoint: 2.2.2.22

```

user *user_name*

Gives a user access to the router. You can authorize up to 50 users to access the router. Each *user_name* is eight characters and is case-sensitive.

CONFIG Commands

When the first user is added, console login is automatically enabled. Each user added must be assigned one of the permission levels defined in Table 8.

When users are added, set login authentication to local. Otherwise a remote server must be used.

Table 8. Access Permission

Permission Level	Description
Administrator (A)	Displays configuration and user information, adds/modifies/deletes configuration and user information. The Administrator can access any router function.
Operator (O)	Views router configuration, views statistics, runs potentially disruptive tests, dynamically changes router operation, and restarts the router. Operators cannot modify the permanent router configuration. All actions can be undone with a system restart.
Monitor (M)	Views router configuration and statistics but cannot modify or disrupt the operation of the router.
Tech Support	Allows your service representative to gain access to the router if a password is forgotten. Cannot be assigned to users.

Note: To add a user, you must have administrative permission. You do not have to reinitialize the router after adding a user.

Example:

```
add user John
Enter password:
Enter password again:
Enter permission (A)admin, (O)perations, (M)onitor [A]?
Do you want to add Technical Support access? (Yes or [No]):
```

Enter password

Specifies the access password for the user. Limited to 80 alphanumeric characters and is case-sensitive.

Enter password again

Confirms the access password for the user.

Enter permission

Specifies the permission level for the user: A, O, or M (see Table 8).

v25-bis-address

Adds the local and remote numbers of the V.25bis end-points that communicate with the router. The network *address-name* can be anything, such as a description of the port. You can use any string of up to 23 printable ASCII characters. The *network-dial-address* is the telephone number of the local or destination port. For more information, see “Chapter 46. Using the V.25bis Network Interface” on page 645.

Note: You can use punctuation, such as parentheses and dashes, but the punctuation is not significant (the router uses only the numbers).

```
Example: add v25-bis-address
remote-site baltimore 1-909-555-0983
```

Boot

Use the **boot** command to enter the Boot CONFIG command environment. For Boot CONFIG information, see “Chapter 6. Using BOOT Config to Perform Change Management” on page 41.

Syntax:

boot

Change

Use the **change** command to modify an interface in the configuration, change your own password, or change user information.

Syntax:

```
change                               device . . .
                                         password
                                         ppp_user . . .
                                         tunnel-profile
```

device *device_type*

With the **change device** command you can:

- Change the slot of an existing interface. (Change slot x in interface record n to y where slot y is unoccupied.)
- Change the port of an existing interface. (Change port x in interface record n to y where port y is unoccupied.)
- Swap slots of two existing interfaces. (Swap slot x and slot y in interface records with x or y.)
- Swap ports of two existing interfaces. (Swap port u and slot x in one interface record with port v and slot y in another interface record of the same hardware type.)
- Replace the slot in an existing interface with the slot in another. (Interface configuration for slot x will become interface configuration for slot y. Interface records for slot y will be deleted.)
- Replace the port of one existing interface with the port of another. (Interface configuration for slot x port u will become interface configuration for slot y port v. The interface record for slot y port v will be deleted.)

When the target slot is occupied:

1. If you select the “swap” option, the source and target slots are swapped in all the interface records in which they appear.
2. If you select the “replace” option is selected, the interface configuration for slot x will become the interface configuration for slot y. Interface records for slot y will be deleted.

When the target port is occupied:

1. If you select the “swap” option, the source and target ports can be swapped in their respective interface records if their hardware types in these interface records are identical. For example, 1-port ISDN T1/J1.

CONFIG Commands

- If you select the “replace” option, the interface configuration for slot x port u becomes the interface configuration for slot y port v. The interface record for slot y port v is deleted.

Note: An Ethernet or Token Ring adapter card requires two empty slots if it is installed in slot 3, 4, 7, or 8. Therefore a Token Ring or Ethernet adapter can be installed in slot 3 or 4 (or slot 7 or 8) only if both slots 3 and 4 (or 7 and 8) are unoccupied.

If you try to change the slot of a Token Ring or Ethernet adapter to slot 3 or 4 (or 7 or 8) when both 3 and 4 (or 7 and 8) are not unoccupied, the change is not accepted and a warning message is issued as shown in the example “Change slot 6 on interface 1 to unoccupied slot 8” on page 76.

Example - Change (replace) slot 1 on interface 1 to occupied slot 2:

```
Config>list dev
Ifc 0 CHARM ATM           Slot: 2 Port: 1
Ifc 1 CHARM ATM           Slot: 1 Port: 1

Config>change device
Which configured slot would you like to change? (1, 2) [2]? 1
Which slot would you like to change to? (1-2) [1]? 2

Configuration for slot 2 already exists. You can:
a - abort this operation
r - replace configuration
   (Interface configuration for slot 1 will become interface
   configuration for slot 2. Interface records for slot 2
   will be deleted!)
s - swap configuration (slot 1 will be swapped with slot 2.)
r

Moved slot 2 to slot 1 in 1 intf (port) record...

Config>list dev
Ifc 0 CHARM ATM           Slot: 2 Port: 1
```

Example - Change slot 5 on interface 0 to unoccupied slot 7:

```
Config>list dev
Ifc 0 Token Ring          Slot: 5 Port: 1
Ifc 1 Token Ring          Slot: 6 Port: 1
Ifc 2 Token Ring          Slot: 1 Port: 1
Ifc 3 8 port EIA-232E/V.24 PPP Slot: 2 Port: 0
Ifc 4 8 port EIA-232E/V.24 PPP Slot: 2 Port: 1
Ifc 5 8 port EIA-232E/V.24 PPP Slot: 2 Port: 2
Ifc 6 6 port V.35/V.36 PPP Slot: 3 Port: 0
Ifc 7 6 port V.35/V.36 PPP Slot: 3 Port: 5
Ifc 8 8 port EIA-232E/V.24 PPP Slot: 4 Port: 0

Config>change device
Which configured slot would you like to change? (1, 2, 3, 4, 5, 6) [1]? 5
Change all ports on slot # 5 (Yes or No)? [Yes]: y
Which slot would you like to change to? (1-8) [1]? 7

Changed slot 5 to slot 7 in 1 intf (port) record...

Config>list dev
Ifc 0 Token Ring          Slot: 7 Port: 1
Ifc 1 Token Ring          Slot: 6 Port: 1
Ifc 2 Token Ring          Slot: 1 Port: 1
Ifc 3 8 port EIA-232E/V.24 PPP Slot: 2 Port: 0
Ifc 4 8 port EIA-232E/V.24 PPP Slot: 2 Port: 1
Ifc 5 8 port EIA-232E/V.24 PPP Slot: 2 Port: 2
Ifc 6 6 port V.35/V.36 PPP Slot: 3 Port: 0
Ifc 7 6 port V.35/V.36 PPP Slot: 3 Port: 5
Ifc 8 8 port EIA-232E/V.24 PPP Slot: 4 Port: 0
```

Interface 0 is now changed to slot 7.

Example - Change slot 6 on interface 1 to unoccupied slot 8:

CONFIG Commands

```
Config>change device
Which configured slot would you like to change? (1, 2, 3, 4, 6, 7)[1]? 6
Change all ports on slot # 6 (Yes or No)? [Yes]: y
Which slot would you like to change to? (1-8) [1]? 8
```

Cannot add Token Ring to slot 8.
Slot 7 is occupied so Token Ring cannot be added in slot 8.

Note: See the note on 2 on page 76 for requirements for changing slots 3, 4, 7, and 8 for Token Ring or Ethernet.

Example - Swap slot 6 on interface 1 to occupied slot 1:

```
Config>change device
Which configured slot would you like to change? (1, 2, 3, 4, 6, 7) [1] 6
Change all ports on slot # 6 (Yes or No)? [Yes]: y
Which slot would you like to change to? (1-8) [1]? 1
```

Configuration for slot 1 already exists. You can:
a - abort this operation
r - replace configuration
 (Interface configuration for slot 6 will become interface
 configuration for slot 1. Interface records for slot 1
 will be deleted!)

s - swap configuration (slot 1 will be swapped with slot 6.)
s

Swapped slot 6 with slot 1 in 1 port record...

```
Config>list dev
Ifc 0 Token Ring                Slot: 7 Port: 1
Ifc 1 Token Ring                Slot: 1 Port: 1
Ifc 2 Token Ring                Slot: 6 Port: 1
Ifc 3 8 port EIA-232E/V.24 PPP  Slot: 2 Port: 0
Ifc 4 8 port EIA-232E/V.24 PPP  Slot: 2 Port: 1
Ifc 5 8 port EIA-232E/V.24 PPP  Slot: 2 Port: 2
Ifc 6 6 port V.35/V.36 PPP      Slot: 3 Port: 0
Ifc 7 6 port V.35/V.36 PPP      Slot: 3 Port: 5
Ifc 8 8 port EIA-232E/V.24 PPP  Slot: 4 Port: 0
```

The configurations for interface 2 and interface 1 are swapped.

Example - Slot 1 on interface 1 replaces slot 6, interface 1 is deleted:

```
Config>change device
Which configured slot would you like to change? (1, 2, 3, 4, 6, 7) [1] 6
Change all ports on slot # 6 (Yes or No)? [Yes]: y
Which slot would you like to change to? (1-8) [1]? 1
```

Configuration for slot 1 already exists. You can:
a - abort this operation
r - replace configuration
 (Interface configuration for slot 6 will become interface
 configuration for slot 1. Interface records for slot 1
 will be deleted!)

s - swap configuration (slot 1 will be swapped with slot 6.)
r

Moved slot 6 to slot 1 in 1 intf (port) record...

```
Config>list dev
Ifc 0 Token Ring                Slot: 7 Port: 1
Ifc 1 Token Ring                Slot: 1 Port: 1
Ifc 2 8 port EIA-232E/V.24 PPP  Slot: 2 Port: 0
Ifc 3 8 port EIA-232E/V.24 PPP  Slot: 2 Port: 1
Ifc 4 8 port EIA-232E/V.24 PPP  Slot: 2 Port: 2
Ifc 5 6 port V.35/V.36 PPP      Slot: 3 Port: 0
Ifc 6 6 port V.35/V.36 PPP      Slot: 3 Port: 5
Ifc 7 8 port EIA-232E/V.24 PPP  Slot: 4 Port: 0
```

The slot 6 record replaces the original slot 1 record and the other interfaces are renumbered.

Example - Change slot 2 to unoccupied slot 5:

```
Config>change device
Which configured slot would you like to change? (1, 2, 3, 4, 7) [1]? 2
Change all ports on slot # 2 (Yes or No)? [Yes]: y
Which slot would you like to change to? (1-8) [1]? 5
```

Changed slot 2 to slot 5 in 3 intf (port) records...

CONFIG Commands

```
Config>list dev
Ifc 0 Token Ring           Slot: 7 Port: 1
Ifc 1 Token Ring           Slot: 1 Port: 1
Ifc 2 8 port EIA-232E/V.24 PPP Slot: 5 Port: 0
Ifc 3 8 port EIA-232E/V.24 PPP Slot: 5 Port: 1
Ifc 4 8 port EIA-232E/V.24 PPP Slot: 5 Port: 2
Ifc 5 6 port V.35/V.36 PPP   Slot: 3 Port: 0
Ifc 6 6 port V.35/V.36 PPP   Slot: 3 Port: 5
Ifc 7 8 port EIA-232E/V.24 PPP Slot: 4 Port: 0
```

Interfaces 2, 3 and 4 that were previously configured in slot 2 are now configured in slot 5.

Example - Change port 1 slot 5 to port 0 in unoccupied slot 2:

```
Config>change device
Which configured slot would you like to change? (1, 3, 4, 5, 7) [1]? 5
Change all ports on slot # 5 (Yes or No)? [Yes]: n
Which port would you like to change in slot 5? (0, 1, 2) [0]? 1
Which slot would you like to change to? (1-8) [1]? 2
Which port would you like port 1 in slot 5 to move to in slot2?#(0-7)[0]? 0

Changed slot 5 port 1 to slot 2 port 0...
```

```
Config>list dev
Ifc 0 Token Ring           Slot: 7 Port: 1
Ifc 1 Token Ring           Slot: 1 Port: 1
Ifc 2 8 port EIA-232E/V.24 PPP Slot: 5 Port: 0
Ifc 3 8 port EIA-232E/V.24 PPP Slot: 2 Port: 0
Ifc 4 8 port EIA-232E/V.24 PPP Slot: 5 Port: 2
Ifc 5 6 port V.35/V.36 PPP   Slot: 3 Port: 0
Ifc 6 6 port V.35/V.36 PPP   Slot: 3 Port: 5
Ifc 7 8 port EIA-232E/V.24 PPP Slot: 4 Port: 0
```

Interface 3, which was at slot 5 - port 1, is changed to slot 2 port 0.

Example - Change port 0 slot 2 to port 5 in slot 3 (different hardware types):

```
Config>change device
Which configured slot would you like to change? (1, 2, 3, 4, 5, 7) [1]? 2
Change all ports on slot # 2 (Yes or No)? [Yes]: n
Which port would you like to change in slot 2? (0) [0]? 0
Which slot would you like to change to? (1-8) [1]? 3
Which port would you like port 0 in slot 2 to move to in slot 3? #(0-7) [0] 5

Aborting - source and target slots of different type.
```

Example - Change port 0 slot 2 to port 5 in slot 4 (same hardware types):

```
Config>change device
Which configured slot would you like to change? (1, 2, 3, 4, 5, 7) [1]? 2
Change all ports on slot # 2 (Yes or No)? [Yes]: n
Which port would you like to change in slot 2? (0) [0]? 0
Which slot would you like to change to? (1-8) [1]? 4
Which port would you like port 0 in slot 2 to move to in slot 4? #(0-7)[0] 5

Changed slot 2 port 0 to slot 4 port 5...
```

```
Config>list dev
Ifc 0 Token Ring           Slot: 7 Port: 1
Ifc 1 Token Ring           Slot: 1 Port: 1
Ifc 2 8 port EIA-232E/V.24 PPP Slot: 5 Port: 0
Ifc 3 8 port EIA-232E/V.24 PPP Slot: 4 Port: 5
Ifc 4 8 port EIA-232E/V.24 PPP Slot: 5 Port: 2
Ifc 5 6 port V.35/V.36 PPP   Slot: 3 Port: 0
Ifc 6 6 port V.35/V.36 PPP   Slot: 3 Port: 5
Ifc 7 8 port EIA-232E/V.24 PPP Slot: 4 Port: 0
```

Interface 3 which was at port 0, slot 2 is changed to port 5, slot 4.

Example - Change port 5 slot 4 to port 1 in slot 4 (same slots):

```
Config>change device
Which configured slot would you like to change? (1, 3, 4, 5, 7) [1]? 4
Change all ports on slot # 4 (Yes or No)? [Yes]: n
Which port would you like to change in slot 4? (0, 5) [0]? 5
Which slot would you like to change to? (1-8) [1]? 4
```

CONFIG Commands

Which port would you like port 5 in slot 4 to move to in slot 4? #(0-7) [0] 1

Changed slot 4 port 5 to slot 4 port 1...

```
Config>list dev
Ifc 0 Token Ring                Slot: 7 Port: 1
Ifc 1 Token Ring                Slot: 1 Port: 1
Ifc 2 8 port EIA-232E/V.24 PPP  Slot: 5 Port: 0
Ifc 3 8 port EIA-232E/V.24 PPP  Slot: 4 Port: 1
Ifc 4 8 port EIA-232E/V.24 PPP  Slot: 5 Port: 2
Ifc 5 6 port V.35/V.36 PPP      Slot: 3 Port: 0
Ifc 6 6 port V.35/V.36 PPP      Slot: 3 Port: 5
Ifc 7 8 port EIA-232E/V.24 PPP  Slot: 4 Port: 0
```

Interface 3 is now at port 1, slot 4.

Example - Change (swap) port 1 slot 4 to occupied port 0 in slot 5:

```
Config>change device
Which configured slot would you like to change? (1, 3, 4, 5, 7) [1]? 4
Change all ports on slot # 4 (Yes or No)? [Yes]: n
Which port would you like to change in slot 4? (0, 1) [0]? 1
Which slot would you like to change to? (1-8) [1]? 5
Which port would you like port 1 in slot 4 to move to in slot 5? #(0-7) [0] 0

Configuration for slot 5 (port 0) already exists. You can:
a - abort this operation
r - replace configuration
   (Interface record for slot 4 port 1 will become interface
   configuration for slot 5 port 0. The interface record for
   slot 5 port 0 will be deleted!)
s - swap configuration (slot 5 port 0 will be swapped with slot 4
   port 1.)
s
```

Swapped slot 4 port 1 with slot 5 port 0...

```
Config>list dev
Ifc 0 Token Ring                Slot: 7 Port: 1
Ifc 1 Token Ring                Slot: 1 Port: 1
Ifc 2 8 port EIA-232E/V.24 PPP  Slot: 4 Port: 1
Ifc 3 8 port EIA-232E/V.24 PPP  Slot: 5 Port: 0
Ifc 4 8 port EIA-232E/V.24 PPP  Slot: 5 Port: 2
Ifc 5 6 port V.35/V.36 PPP      Slot: 3 Port: 0
Ifc 6 6 port V.35/V.36 PPP      Slot: 3 Port: 5
Ifc 7 8 port EIA-232E/V.24 PPP  Slot: 4 Port: 0
```

Interface 2 and interface 3 have swapped their port and slot configurations.

Example - Change (replace) port 1 slot 4 to occupied port 0 in slot 5:

```
Config>change device
Which configured slot would you like to change? (1, 3, 4, 5, 7) [1]? 4
Change all ports on slot # 4 (Yes or No)? [Yes]: n
Which port would you like to change in slot 4? (0, 1) [0]? 1
Which slot would you like to change to? (1-8) [1]? 5
Which port would you like port 1 in slot 4 to move to in slot 5? #(0-7) [0] 0

Configuration for slot 5 (port 0) already exists. You can:
a - abort this operation
r - replace configuration
   (Interface configuration for slot 4 port 1 will become interface
   configuration for slot 5 port 0. The interface record for
   slot 5 port 0 will be deleted!)
s - swap configuration (slot 5 port 0 will be swapped with slot 4
   port 1.)
r
```

Moved slot 4 port 1 to slot 5 port 0...

```
Config>list dev
Ifc 0 Token Ring                Slot: 7 Port: 1
Ifc 1 Token Ring                Slot: 1 Port: 1
Ifc 2 8 port EIA-232E/V.24 PPP  Slot: 5 Port: 0
Ifc 3 8 port EIA-232E/V.24 PPP  Slot: 5 Port: 2
Ifc 4 6 port V.35/V.36 PPP      Slot: 3 Port: 0
Ifc 5 6 port V.35/V.36 PPP      Slot: 3 Port: 5
Ifc 6 8 port EIA-232E/V.24 PPP  Slot: 4 Port: 0
```

Interface 2 is configured to slot 5 - port 0. The original interface 3 is deleted and the other interfaces are renumbered.

CONFIG Commands

password

Modifies the password of the user who is now logged in.

Note: To change a user password, you must have administrative permission.

Example:

```
change password
Enter current password:
Enter new password:
Enter new password again:
```

Enter current password

Specifies your current password.

Enter new password

Specifies your new password.

Enter new password again

Specifies your new password again for confirmation. If your confirmation does not match the previous new password, the old password remains in effect.

ppp_user

Changes the information for a specific PPP user.

Syntax:

```
change ppp_user           encryption-key
                               parameters
                               password
```

encryption-key

Changes the encryption key for a PPP user. The following example shows the dialog for changing an encryption key.

Example - Change Encryption key:

```
Config>change ppp_user encryption-key
Enter user name: [ ]? leslie
Enable encryption for this user/port (y/n) [No]:y
Encryption key should be 16 characters long.
Encryption Key (16 characters ) in Hex(0-9, a-f, A-F):
Encryption Key again (16 characters) in Hex(0-9, a-f, A-F):
User 'leslie' has been updated
Config>
```

parameters

Changes all of the ppp-user options for a user. This parameter works similar to the **add ppp_user** except that the values shown within the [] are the current values and the change command does not verify the changes or list them back to you when you are done. See “Add” on page 68 for details about the **add ppp_user** command.

password

Changes the password for the PPP user.

Example - Change password:

```
Config>change ppp_user password
Enter user name: [ ]? sam
Password:
Enter password again:
User 'sam' has been updated
Config>
```

user Modifies the user information that was previously configured with the **add user** command.

Note: To change a user, you must have administrative permission.

Example:

```
change user
User name: []
Change password? (Yes or No)
Change permission? (Yes or [No])
```

tunnel-profile

Changes the configuration for a tunnel peer.

```
Config>change tunnel-profile
Enter name: []? lac.org
Enter hostname to use when connecting to this peer: [lns.org]?
set shared secret? (Yes, No): [No]
Tunnel-Server endpoint address: [11.0.0.1]? 11.0.0.2

profile 'lac.org' has been updated
Config>
```

Clear

Use the **clear** command to delete the router's configuration information from nonvolatile configuration memory.

Attention: Use this command only after calling your service representative.

Syntax:

```
clear
    all
    ap2 (AppleTalk 2)
    arp (ARP)
    asrt (Adaptive Source Route Protocol)
    appn (Advanced Peer-to-Peer Networking)
    atm (Asynchronous Transfer Mode)
    auth (Authentication)
    bgp (Border Gateway Protocol)
    boot
    brs (Bandwidth Reservation)
    callback
    cmprs (Data Compression)
    dls (Data Link Switching)
    device
    dialer-circuit
    dn (DECnet)
    els (Event Logging System Information)
    fr (Frame Relay)
    gsmp (OSI)
    hdlc
    hostname
    ip (IP)
```

CONFIG Commands

| ip-security
| ipv6
| ipx (Novell IPX)
| isdn
| l2tp
| lnm
| mcf
| named-profiles
| nat
| ndp6
| ndr
| osi (OSI)
| ospf (OSPF routing protocol)
| ppp (Point-to-Point)
| prompt
| rip6
| rsvp
| sdlc
| snmp
| srly (SDLC Relay)
| tcp/ip-host
| time (Time of day information)
| tsf (Thin Server)
| user
| v25bis
| vines (Banyan VINES)
| webc (Web server cache)
| wrs (WAN Restoral feature)
| x25
| xtp

To clear a process from nonvolatile configuration memory, enter the **clear** command and the process name. To clear all information from configuration memory, except for device information, use the **clear all** command. To clear all information, including the device information, use the **clear all** command and then the **clear device** command.

The **clear user** command clears all user information except the router console login information. This is left as enabled (if it was configured as enabled) even though the default value is “disabled”.

Notes:

1. To clear user information, you must have administrative permission.
2. There may be other items in the list, depending upon what is included in the software load.

Example: clear els

You are about to clear all Event Logging configuration information
Are you sure you want to do this (Yes or No):

Note: The previous message appears for any parameter configuration you are deleting.

Delete

Use the **delete** command to remove an interface or range of interfaces from the list of devices stored in the configuration, or to remove a user. To use the **delete** command, you must have administrative permission.

Syntax:

```

delete                interface . . .
                    dump-files
                    isdn-address
                    ppp_user . . .
                    tunnel
                    user . . .
                    v25-bis-address
    
```

dump-files

Deletes all of the system dump files from the hard drive .

Note: If you enter this command and a hard drive is not available, you will receive a message indicating that the drive is unavailable.

Example:

```

Config> delete dump-files
Number of existing dump files: 3
Are you sure you want to delete the dump files ? (Yes, No): [No] Yes
Dump files deleted.
    
```

interface [intfc# or intfc#range]

To delete an interface, enter the interface or network number as part of the command. (Only devices that were added with the **add device** command can be deleted.) To obtain the interface number that the router assigns, use the **list device** command.

The delete interface command deletes the device configuration and any protocol information for that interface. However, the router will continue to run the previous configuration until it is reloaded.

If deleting a base ISDN interface or a base ATM interface, all virtual interfaces running on that base net will also be deleted. So, any dial circuits configured on a base ISDN interface will be removed when the ISDN interface is deleted. Also, when deleting an ATM base net, all LAN Emulation Clients running on the base ATM interface will be deleted.

CONFIG Commands

To delete a range of interfaces, specify the first and last interface in the range separated by a hyphen, as shown in the following example:

```
delete interface 13-21
```

You can also enter an interface number or range of interface numbers, when prompted.

isdn-address *address-name*

Removes a previously added ISDN address.

Note: If the *address-name* contains spaces (for example, **remote site XYZ**), you cannot enter the command on one line. Type `delete isdn-address` and press **Return**. Then enter the name when prompted.

ppp_user *user_name*

Deletes a user from the PPP user data base.

tunnel-profile

Deletes a tunnel from the tunnel profile database.

user *user_name*

Removes user access to the router for the specified user.

v25-bis-address *address-name*

Removes a previously added V25bis address.

Note: If the *address-name* contains spaces (for example, **remote site Baltimore**), you cannot enter the command on one line. Type `delete v25-bis-address` and press **Return**. Then enter the name when prompted.

Disable

Use the **disable** command to prevent being prompted for a login from a remote console

You can also use the `disable` command to disable an interface, memory dumping, or rebooting when a serious error occurs.

Syntax:

```
disable                _console-login  
                        _interface . . .  
                        _dump-memory . . .  
                        _reboot-system . . .
```

console-login

Disables the user from being prompted for a user ID and password on the physical console. The default is disabled.

interface *interface#*

Causes the specified interface to be disabled after issuing the **reload** command. The default is enabled.

dump-memory

Disables the dumping of system memory to the installed hard disk when a serious error occurs.

reboot-system

Disables the rebooting of the system when a serious error occurs. This may be desirable if the network service personnel wish to troubleshoot the error on-line. System rebooting cannot be disabled unless memory dumping is also disabled. If you attempt to disable system rebooting while memory dumping is enabled, system rebooting is aborted and the following message is displayed:

```
System reboot not disabled: memory dumping must be disabled first
```

Enable

Use the **enable** command to allow login from a remote console,

Syntax:

```
enable                _console-login
                      _interface . . .
                      _dump-memory . . .
                      _reboot-system . . .
```

console-login

Enables the user to be prompted for a user ID and password on the physical console. This is useful for security situations. If you do not configure any administrative users and you enable this feature, the following message appears:

```
Warning: Console login is disabled until an
administrative user is added.
```

Attention: Before enabling console login, save the configuration with console login disabled. If login authentication is set to a remote server using Radius or Tacacs+ and the router is unable to reach the authentication server, then access to the router is denied. By disabling the console login, a lock-out situation is prevented.

interface interface#

Causes the interface to be enabled after issuing the **reload** command.

dump-memory

This may be desirable so that the state of the unit at the time of the error can be preserved for troubleshooting later. The dump memory function cannot be enabled unless system rebooting is enabled. If you attempt to enable the dump memory function while system rebooting is disabled, the dump memory function is not enabled and the following message is displayed:

```
System memory dump function not enabled: rebooting must be enabled first
```

If you configured system dumping to save the first 3 dump files and 3 dump files already exist the system displays the following message when you enable dump memory:

```
*** System dump cannot be enabled until the   ***
*** existing dump files are deleted.          ***
```

See the **set dump enable-mode** and **set dump save-mode** commands.

CONFIG Commands

Example:

```
Config> enable dump
```

```
Current System Dump Status:  
System dump is currently disabled.  
Number of existing dump files: 0
```

```
Enable system memory dumping? [No]: Yes
```

```
Current System Dump Status:  
System dump is currently enabled.  
Number of existing dump files: 0
```

Note: If you enter this command and a hard drive is not available, you will receive a message indicating that the drive is unavailable.

reboot-system

Enables the rebooting of the system when a serious error occurs.

Event

Use the **event** command to enter the Event Logging System (ELS) environment so that you can define the messages that will appear on the console. Refer to “Chapter 12. Using the Event Logging System (ELS)” on page 123 for information about ELS.

Syntax:

event

Feature

Use the **feature** command to access configuration commands for specific router features outside of the protocol and network interface configuration processes.

Syntax:

feature *[feature# or feature-short-name]*

All 2216 features have commands that are executed by:

- Accessing the configuration process to initially configure and enable the feature, as well as perform later configuration changes.
- Accessing the console process to monitor information about each feature, or make temporary configuration changes.

The procedure for accessing these processes is the same for all features. The following information describes the procedure.

Enter a question mark after the **feature** command to obtain a listing of the features available for your software release.

To access a feature’s configuration prompt, enter the **feature** command followed by the feature number or short name. Table 9 on page 87 lists available feature numbers and names.

Table 9. IBM 2216 Feature Numbers and Names

Feature Number	Feature Short Name	Accesses the following feature configuration process
0	WRS	WAN Restoral/Reroute
1	BRS	Bandwidth Reservation
2	MCF	MAC Filtering
4	VCRM	Virtual Circuit and Resource Management
7	CMPRS	Data Compression
8	NDR	Network Dispatcher
9	DIALs	Dial-In-Access to LANs
10	AUTH	Authentication
11	IPSec	IP Security feature user configuration
12	LAYER	Layer 2 Tunneling Protocol
13	NAT	Network Address Translator user configuration
14	TSF	Thin Server Function

Once you access the configuration prompt for a feature, you can begin entering specific configuration commands for the feature. To return to the CONFIG prompt, enter the **exit** command at the feature's configuration prompt.

List

Use the **list** command to display configuration information for all network interfaces, or configuration information for the router.

Syntax:

```
list configuration
list devices
list isdn-address
list patches . . .
list ppp_users . . .
list tunnel-profile
list users . . .
list v25-bis-address
list vpd
```

devices [*device or devicerange*]

Displays the relationship between an interface number and the hardware interface. You can also use this command to check that a device was added correctly issuing the **add** command.

You can also specify a range of devices to list as shown in the following example:

```
list dev 2-5
Ifc 2 Token Ring          Slot: 2 Port: 1
Ifc 3 Token Ring          Slot: 2 Port: 2
Ifc 4 Ethernet            Slot: 4 Port: 1
Ifc 5 Ethernet            Slot: 4 Port: 2
```

CONFIG Commands

Note: If you do not specify an interface number or a range of interfaces, all interfaces are displayed.

Example: list devices

```
Ifc 0 Token Ring           Slot: 1 Port: 1
Ifc 1 Token Ring           Slot: 1 Port: 2
Ifc 2 Token Ring           Slot: 2 Port: 1
Ifc 3 Token Ring           Slot: 2 Port: 2
Ifc 4 Ethernet             Slot: 4 Port: 1
Ifc 5 Ethernet             Slot: 4 Port: 2
Ifc 6 Ethernet             Slot: 5 Port: 1
Ifc 7 Ethernet             Slot: 5 Port: 2
Ifc 8 Ethernet             Slot: 6 Port: 1
Ifc 9 Ethernet             Slot: 6 Port: 2
Ifc 10 V.35/V.36 Frame Relay Slot: 8 Port: 0
Ifc 11 V.35/V.36 X.25      Slot: 8 Port: 1
Ifc 12 V.35/V.36 PPP       Slot: 8 Port: 2
Ifc 13 V.35/V.36 PPP       Slot: 8 Port: 3
Ifc 14 V.35/V.36 PPP       Slot: 8 Port: 4
Ifc 15 V.35/V.36 PPP       Slot: 8 Port: 5
```

Note: The number of receive buffers noted are exceptions from the receive buffer defaults. The **set receive buffers** command is discussed under "Set" on page 95.

configuration

Displays configuration information about the router.

Example: list configuration

```
Hostname: [none]
Maximum packet size: [autoconfigured]
Maximum number of global buffers: [autoconfigured]
Number of spare interfaces: 0
Console inactivity timer (minutes): 0
Physical console login: disabled
System rebooting on error: disabled
System memory dumping: disabled
Contact person for this node: [none]
Location of this node: [none]

Configurable Protocols:
Num Name Protocol
0 IP DOD-IP
3 ARP Address Resolution
4 DN DNA Phase IV
6 VIN Banyan Vines
7 IPX NetWare IPX
8 OSI ISO CLNP/ISIS/ISIS
9 DVM Distance Vector Multicast Routing Protocol
10 BGP Border Gateway Protocol
11 SNMP Simple Network Management Protocol
12 OSPF Open SPF-Based Routing Protocol
20 SDLC SDLC/HDLC-Relay
22 AP2 AppleTalk Phase 2
23 ASRT Adaptive Source Routing Transparent Enhanced Bridge
24 HST TCP/IP Host Services
25 LNM LAN Network Manager
26 DLS Data Link Switching
27 XTP X.25 Transport Protocol
28 APPN Advanced Peer-to-Peer Networking [HPR]
29 NHRP Next Hop Routing Protocol
30 APPN Advanced Peer-to-Peer Networking [ISR]

Configurable Features:
Num Name Feature
0 WRS WAN Restoral
1 BRS Bandwidth Reservation
2 MCF MAC Filtering
6 QOS Quality of Service
7 CMPRS Data Compression Subsystem
8 NDR Network Dispatching Router
10 AUTH Authentication
14 TSF Thin Server Function

26176 bytes of configuration memory free
```

isdn-address

Displays the current ISDN address configurations.

```
Example: list isdn-address
Address assigned name   Network Address   Network Subdial Address
-----
remote site XYZ        1 2345 67        98765
```

patches

Displays the values of patch variables that have been entered using the **patch** command.

Example:

```
list patches
Patched variable      Value
-----
ping-size              60
ping-ttl               59
ip-default-ttl        60
ethernet-security     3
rip-static-suppress   3
```

ppp_users

Lists specific PPP user profile parameters.

Example: List of PPP users when DIALs is not in the software load

```
Config> list ppp_users
List (Name, Verb, User, Addr, Encr):

    PPP User Name: joe
    User IP Address: Interface Default
    Encryption: Not Enabled
```

Example: List of PPP users when DIALs is in the software load

```
Config> list ppp_users
List (Name, Verb, User, Addr, Call, Time, Dial, Encr):

    PPP User Name: joe
    User IP Address: Interface Default
    Net-Route Mask: 255.255.255.255
    Hostname: <undefined>
    Time-Allotted: Box Default
    Call-Back Type: Not Enabled
    Dial-Out: Not Enabled
    Encryption: Not Enabled
```

When you enter **list ppp_users**, the software will prompt you to enter one of the following:

Name List all of the names in the database.

Verb List verbose information about each user. List all information pertaining to each user profile.

User List verbose information about a single user.

Addr (address)

List IP address information for each user, including IP Address, net mask and hostname.

Call (callback)

List callback information for each user, including the type of callback and number.

Time List time allowed configured for each user.

Encr (encryption)

List whether encryption is enabled for each user.

tunnel-profile

Displays the tunnel-profile parameters.

Example:

CONFIG Commands

```
Config>list tunnel-profile
Endpoint Tunnel name Hostname
11.0.0.192 tac lns
1 TUNNEL record displayed.
Config>
```

Tunnel Name

Specifies the configured name for the peer.

Server Endpoint

The IP address of the peer.

Type Specifies the type of peer connection.

Medium

Specifies the protocol that the tunnel is using.

Local Host Name

Specifies the name configured for use when connecting to the peer.

users Displays the users configured to access the system.

Example:

```
list users
USER          PERMISSION
joe           operations
mary         administrative
peter        monitor
```

v25-bis-address

Displays the current V25bis address configurations. The V25bis address configuration consists of the network address and network address name for a local port (serial line interface) or destination port. The network address is the telephone number of the local or destination port. The network address name can be anything, such as the description of the port. See "Chapter 46. Using the V.25bis Network Interface" on page 645 for more information.

```
Example:
list v25-bis-address
Address assigned name      Network Address
-----
v25-1                     8982800
v25-2                     8980001
delaware                  1-666-555-4444
```

vpd Displays the hardware and software vital product data.

Load

Use the **load** command to list packages in the software load that are available but not configured, or packages that are configured in the software load. The **load** command is also used to add or delete a software package.

Syntax:

```
load          add package packagename
                delete package packagename
                list . . .
```

The software is divided into multiple load modules. These load modules are grouped into software packages. Some of these software packages are optional because, although they are shipped with the product, they are not automatically loaded.

Software packages containing encryption are available from the 2216 Web server accessible using the Internet.

To load and run optional software packages:

1. Add the package using the **load add** command.
2. Reboot. This action loads the optional software into the device's memory.
3. Configure the optional software.
4. Save the configuration.
5. Reboot the device. This action enables the software with the new configuration.

add package *packagename*

Adds a software package to the software. The *packagename* is the name of the package of load modules you want to include in the software.

Example: load add package appn

delete package *packagename*

Removes a software package from the software. The *packagename* is the name of the package of load modules you want to remove from the software.

Example: load delete package appn

list Lists either the packages in the software load that are available but not configured, or the packages that are configured in the software load. You can specify one of the following:

available

Lists the software packages in the current software load that are not configured.

configured

Lists the software packages in the current software load that are configured.

Network

Use the **network** command to enter the network interface configuration environment for supported networks. Enter the interface or network number as part of the command. (To obtain the interface number, use the CONFIG **list device** command.) The appropriate configuration prompt (for example, TKR Config>) will be displayed. See the network interface configuration chapters in this book for complete information on configuring your types of network interfaces.

Syntax:

network *interface#*

Notes:

1. If you change a user-configurable parameter, you must **reload** the router for the change to take effect. To do so, enter the **reload** command at the OPCON prompt (*).
2. Not all network interfaces are user-configurable. For interfaces that you cannot configure, you receive the message: That network is not configurable.

ip-default-ttl *#_of_packets*

The TTL used in packets that are originated by the router. The default is 64.

Note: It is preferable to set this parameter with the **set ttl** IP configuration command. (See the “Set” section of the “Using and Configuring IP” chapter of *Protocol Configuration and Monitoring Reference Volume 1* .) This patch variable remains for compatibility with configurations from older releases.

ip-mtu *bytes*

This parameter limits the IP MTU size to the specified value. When this parameter is set, the IP MTU size on a given network interface is set to the lesser of the ip-mtu value and the largest value that network interface’s configured frame size can accommodate.

Inm-link-via-tbport *new value*

Allows LNM to link to a token-ring over an Ethernet transparent bridge (TB) port.

When set to 1, the LNM link is allowed.

When set to 0, the default, the LNM link is not allowed.

more-lines *#_of_lines*

The number of lines to display on the console when listing the IP routing table, which uses a “more pipe” (!).

mosheap-lowmark *new value*

This parameter specifies the percentage of free MOS heap memory, at which the device notifies the operator that an out-of-memory error is imminent. This notification allows the operator to take action to free up MOS heap memory before the device receives an error and stops.

When the operator receives notification, the operator can reconfigure the router and then reboot, minimizing the outage to the network. Specifying 0 for this parameter suppresses this warning.

Valid Values: 0 to 100

Default Value: 10

ospf-import-rate *rate*

Number of routes imported per second.

ping-size *bytes*

The size of the data portion (that is, excluding IP and ICMP headers) of the ICMP PING packet that is sent via the IP>**ping** command. Default: 56 bytes. (The size of the PING data can also be entered as a parameter of the **ping** command as described in the “Ping” section of the “Monitoring IP” chapter of *Protocol Configuration and Monitoring Reference Volume 1* .)

ping-ttl *seconds*

The TTL (time-to-live) sent in PINGs by the IP>**ping** command. Default: 64. (The TTL can also be entered as a parameter of the **ping** command as described in the “Ping” section of the “Monitoring IP” chapter of *Protocol Configuration and Monitoring Reference Volume 1* .)

ppp-echo *new value*

When set to 1, the device will not send PPP Echo Requests on any PPP interface. PPP Echo Requests are sent to remote devices as part of PPP maintenance to ensure the remote device is operational. Consider enabling this variable when running PPP on a slow line and using that line to

CONFIG Commands

transmit large data packets such that the PPP maintenance packets are not exchanged often enough to keep the PPP interface up.

relax-jate

Relaxes JATE ISDN restriction.

rip-static-suppress *new value*

When set to a non-zero value, static routes will not be advertised by RIP over a given interface unless the IP config> **enable send static** command is given for the interface. This changes the semantics of the **enable send static** command. When rip-static-suppress is equal to 0 (the default), the list of the routes advertised via RIP is the union of those specified by the interface's RIP flags.

Note: You must specify the complete name of the patch variable that you want to change. You cannot use an abbreviated syntax for the patch name.

Performance

Use the **performance** command at the GWCON> prompt (+) to enter the configuration environment for performance. See "Chapter 14. Configuring and Monitoring Performance" on page 195 for more information.

Protocol

Use the **protocol** command at the Config> prompt to enter the configuration environment for the protocol software installed in the router.

Syntax:

protocol *[prot# or prot_name]*

The **protocol** command followed by the desired protocol number *or* short name lets you enter a protocol's command environment. After you enter this command, the prompt of the specified protocol appears. From the prompt, you can enter commands specific to that protocol. To return to Config>, enter the **exit** command.

Notes:

1. To see the names and numbers of the protocols in your software load, at the Config> prompt, enter **list configuration**.
2. When you change a user-configurable parameter, you must restart the router for the change to take effect. To do so, enter the **reload** command at the OPCODE prompt (*).

The changes you make through CONFIG are kept in a configuration database in nonvolatile memory and are recalled when you restart the router.

Qconfig

Use the **qconfig** command to initiate Quick Config. Quick Config allows you to configure parameters for bridging and routing protocols without entering separate configuration environments.

Syntax:

qconfig

Note: For complete information on using the Quick Config software provided with your router, see “Appendix A. Quick Configuration Reference” on page 697.

Set

Use the **set** command to configure various system-wide parameters.

Syntax:

```

set                contact-person . . .
                    data-link . . .
                    down-notify . . .
                    dump enable-mode
                    dump save-mode
                    global-buffers
                    hostname
                    inactivity-timer
                    input-low-water
                    location . . .
                    logging level
                    packet-size
                    prompt-level
                    receive-buffers
                    spare-interfaces

```

contact-person *sysContact*

Sets the name or identification of the contact person for this managed SNMP node. There is a limit of 80 characters for the *sysContact* name length.

This variable is for information purposes only and has no effect on router operation. It is useful for SNMP management identification of the system.

data-link *type interface#*

Select the data link type for a serial interface or a dial circuit interface. The *type* can be one of:

- FRAME-RELAY
- PPP
- SDLC
- SRLY
- V25BIS
- X25

Notes:

1. PPP, SDLC, and Frame Relay are the only data-links supported on dial circuit interfaces. X.25 is supported on ISDN BRI D-channel only.
2. All data-link types can be used on the 8-port EIA 232E adapter, 6-port V.35/V.36 adapter, and the 8-port X.21 adapter except for V.25bis which can only be used with the EIA 232E adapter.

CONFIG Commands

Interface# is the number of the interface you are configuring.

down-notify interface# # of seconds

Allows the user to specify the number of seconds before declaring an interface as being down. The normal maintenance packet interval is 3 seconds, and it takes four maintenance failures to declare the interface as down.

The **set down-notify** command is used primarily when tunneling LLC traffic over an IP network using OSPF. If an interface goes down, OSPF cannot detect it fast enough because of the length of time that it takes for an interface to be declared down. Therefore, LLC sessions would begin to timeout. You can set the down-notify timer to a lower value, allowing OSPF to sense that an interface is down quicker. This enables an alternate route to be chosen more quickly, which will prevent the LLC sessions from timing out.

Note: If the **set down-notify** command is executed on one end of a serial link, the same command must be performed at the other end of the link or the link may not come up and stay up.

Interface#

The number of the interface you are configuring.

of seconds

The down notification time value that specifies the maximum time that will elapse before a down interface is marked as such. Large values will cause the router to ignore transient connection problems, and smaller values will cause the router to react more quickly. The range of values is 1 to 300 seconds and the default is 0, which sets the 3-second period. Setting the down notification time to 0 will restore the default time for that interface.

The **list devices** command will show the down notification time setting for any interface that has the default value overridden.

dump enable-mode

Specifies whether dumping is enabled following the next system dump. If you configure the save mode (see the **set dump save-mode** command) to save the first three dumps and the system has already created the third dump file, dumping is disabled regardless of your specification. At the time the system creates the third dump file, you will receive the following message:

```
Active Dump Detected.  
Dump Compression in Progress, please be patient ...  
  
*** System dumping is being DISABLED because dumping is ***  
*** configured to save the 3 initial dumps, but 3          ***  
*** dump files already exist.                               ***
```

Example:

```
Config> set dump enable-mode
```

```
Current System Dump Settings:  
  Disable System Dump following the next system dump.  
  Save the last 3 (most recent) dump files.
```

```
Do you want to change system dump enable-mode to  
re-enable System Dump following the next system dump ? (Yes, No): [No] Yes
```

```
Current System Dump Settings:
```

Re-enable System Dump following the next system dump.
Save the last 3 (most recent) dump files.

Current System Dump Status:
System dump is currently enabled.
Number of existing dump files: 2

Default value: disable

Note: Dumping is enabled with the **enable dump-memory** command.

dump save-mode

Specifies whether to save the first three (initial) system dump files or the last three (most recent). See the **dump enable-mode** for a consideration for using recent mode as opposed to initial mode.

Example:

```
Config> set dump save-mode
```

Current System Dump Settings:
Re-enable System Dump following the next system dump.
Save the last 3 (most recent) dump files.

Do you want to change system dump save-mode to
save the first (initial) dump files ? (Yes, No): [No] Yes

Current System Dump Settings:
Re-enable System Dump following the next system dump.
Save the first 3 (initial) dump files, then disable system dump.

Current System Dump Status:
System dump is currently enabled.
Number of existing dump files: 2

Default value: recent

global-buffers *max#*

Sets the maximum number of global packet buffers, which are the packet buffers used for locally originated packets. The default is to autoconfigure for the maximum number of buffers (up to 1000). To restore the default, set the value to 0. To display the setting for global-buffers, use the **list configuration** command.

hostname *name*

Adds or changes the router name. The router name is for identification only; it does not affect any router addresses. The *name* must be less than 78 characters and is case sensitive.

inactivity-timer *#_of_min*

Changes the setting of the Inactivity Timer. The Inactivity Timer logs out a user if the remote or physical console is inactive for the period of time specified in this command. This command affects only consoles that require login. The default setting of 0 turns the inactivity timer off, indicating that no logoff is performed, no matter how long a console remains inactive.

input-low-water *interface# low_ #_of_receive_buffers*

Allows you to configure the value of the low number of receive buffers, or packets, on a per-interface basis, thus overriding the default values.

The memory allocation strategy changes to conserve buffers when the number of free buffers is equal to or less than the low or low-water mark value. When a packet is received, and the current value of the interface is less than the low water value, then that packet is eligible for flow control (dropping).

CONFIG Commands

The range of values is 1 to 255. The default is both platform and device specific. Setting the value to 0 restores the autoconfigured default.

Interface# is the number of the interface you are configuring.
Low_#_of_receive_buffers is the low water value.

Lowering the value will make it less likely that packets from this interface will be dropped when sent on congested networks. However, lowering the value may negatively affect performance if it drops packets to the extent that the receive queue is frequently empty. Raising the value has the opposite effect.

Type the **QUEUE** or **BUFFER** command at the GWCON prompt (+) to show the low setting.

location *sysLocation*

Sets the physical location of an SNMP node. There is a limit of 80 characters for the *sysLocation* name length. This variable is for information purposes only and has no effect on router operation. It is useful for SNMP management identification of the system.

logging level

Controls the output of messages that have not yet been converted to the ELS. (Refer to for more information about the ELS.) The logging level is recorded in the configuration. When the router is powered on or restarted, the logging level takes effect and determines message output. The default logging level is 76. Logging level 0 equates to no logging level.

Example: set logging level 76

packet-size *max_packet_size_in_bytes*

Establishes or changes the maximum size for global buffers and receive buffers. If you specify a value of 0 as the maximum packet size, the size of receive buffers for an interface is based on that interface's configured packet size and the packet size of global buffers are autoconfigured. If you specify a non-zero value, the configured value is used as the global buffer packet size and any interfaces that have a configured packet size that is larger than the maximum packet size will use the maximum packet size for their receive buffers. A value of 0 (for autoconfigure) is the default.

Attention: Use this command only under direct instructions from your service representative. **Never** use it to reduce packet size – **only** to increase it.

prompt-level *user-defined-name*

Adds a user-defined name as a prefix to all operator prompts, replacing the hostname.

The user-defined-name can be any combination of characters, numbers, and spaces up to 80 characters. Special characters may be used to request additional functions as described in Table 10 on page 99.

Example:

```
set prompt
What is the new MOS prompt [y]? AnyHost 99
AnyHost 99 Config>
```

Table 10. Additional Functions Provided by the Set Prompt Level Command

Special Characters	Function Provided by the Set Prompt Level Command
\$n	Displays the hostname. This is useful when you want the hostname included in the prompt. For example: Config> set prompt What is the new MOS prompt [y]? \$n hostname:: Config>
\$t	Displays the time. For example: Config> set prompt. What is the new MOS prompt [y]? \$t 02:51:08[GMT-300] Config>
\$d	Displays the current date-month-year. For example: Config> set prompt. What is the new MOS prompt [y]? \$d 26-Feb-1997 Config>
\$v	Displays the software VPD information in the following format: program-product-name Feature xxxx Vx Rx.x PTFx RPQx
\$e	Erases one character <i>after</i> this combination within the user-defined prompt.
\$h	Erases one character <i>before</i> this combination within the user-defined prompt.
\$_	Adds a carriage return to the user-defined prompt.
\$\$	Displays the \$.
<p>Note: You can combine these commands. For example:</p> <pre>Config> set prompt What is the new MOS prompt [y]? \$n::\$d hostname::26-Feb-1997 Config></pre>	

receive-buffers interface# max#

Adjusts the number of private receive buffers for most interfaces.

The range is 5 to 1000.

Note: This command is not applicable for ISDN Primary Rate Interfaces and 10/100 Mbps Ethernet interfaces. For ISDN PRI, the number of receive buffers is fixed at 5 per B-channel, 115 for T1 and 150 for E1. When in channelized mode, the PRI gets 5 receive buffers per configured timeslot.

(On some devices, the maximum value is restricted further, as shown in Table 11 on page 100.) To restore the default, set the value to 0. The **set receive-buffers** command can be used to increase the receive performance of an interface. In addition, this command can be used to reduce flow control drops when the router is forwarding many packets from a fast interface to a slow interface. The effect of this command is visible on the GWCON **buffer** command.

CONFIG Commands

Attention: Use the **set receive-buffer** command only under direct instructions from your service representative.

Table 11. Default and Maximum Settings for Interfaces

Interface	Default	Maximum
ATM	80*	1000
10 Mbps Ethernet	40*	1000
10/100 Mbps Ethernet	64*	1000
Serial	24	250
TKR	40*	1000
FDDI	80	80
HSSI	60*	1000
ESCON	1000	1000
PCA	1000	1000

* This is the default value for the 2216-400. For Network Utility, the default value is 1000

spare-interfaces *n*

Defines *n*, the number of spare interfaces, for this device. See “Configuring Spare Interfaces” on page 60 for additional information.

System Retrieve

Use the **system retrieve** command to retrieve one or more memory image files from the installed hard drive after a serious error has occurred.

Syntax:

system retrieve

Uses TFTP to send selected memory image files to a remote host. The system will prompt you for the remote host’s IP address and file names.

If there are no dump files, you will receive the following message:

No dump files exist to retrieve

Example:

```
Config> system retrieve
```

```
Current System Dump Settings:
```

```
Re-enable System Dump following the next system dump.
```

```
Save the first 3 (initial) dump files, then disable system dump.
```

```
3 dump files currently exist.
```

```
Do you want to see a summary of the dump files ? (Yes, No): [No] No
```

```
Destination IP address [0.0.0.0]? 9.9.9.1
```

```
Filename: core0.cmp
```

```
Dump Date: Tue May 05 14:38:59 1998
```

```
Do you want to retrieve this file ? (Yes, No): [No] Yes
```

```
Fully qualified destination path/file name [/tmp/dump0.cmp]?
```

```
The memory image file is 19.3 Mb long.
```

```
Proceed? [No]: Yes
```

```
Sending memory image file by tftp
```

```
TFTP transfer of /hd0/core0.cmp complete, size=20331888 status: OK
```

```
tftp transfer completed successfully.
```

```
Filename: core1.cmp
```



```
Dump Date: Wed May 06 07:53:51 1998
Do you want to retrieve this file ? (Yes, No): [No]
Filename: core2.cmp
Dump Date: Wed May 06 09:14:55 1998
Do you want to retrieve this file ? (Yes, No): [No]
```

System View

Use the **system view** command to display the current system dump settings and the status of the system dumps, including how many dump files exist. You can also display a summary of the dump files.

Syntax:

```
system view
```

Example:

```
Config> system view

Current System Dump Settings:
  Re-enable System Dump following the next system dump.
  Save the first 3 (initial) dump files, then disable system dump.

Current System Dump Status:
  System dump is currently enabled.
  Number of existing dump files: 2

Do you want to see a summary of the dump files ? (Yes, No): [No] Yes
-----
Filename: core0.cmp

Dump Date: Tue May 05 14:38:59 1998

Fatal messages:
  Data St. Excp Reading 0x6c6966b1 at 0x3090fca4 in thread MOSDBG (0x304d54)

CMVC Build: cc_144b
Builder: build
Build Name: LML.1d
Retain Name: MAS.DF1
Product Number: 2216-MAS
Build Date: Wed May 6 11:47:03 1998

-----
Filename: core1.cmp

Dump Date: Wed May 06 07:53:51 1998

Fatal messages:
  Data St. Excp Reading 0x6c6966b1 at 0x3090fca4 in thread MOSDBG (0x304d54)

CMVC Build: cc_144b
Builder: build
Build Name: LML.1d
Retain Name: MAS.DF1
Product Number: 2216-MAS
Build Date: Wed May 6 11:47:03 1998
```

CONFIG Commands

Time

Use the **time** command to set the 2216 system clock and date, and to display the values on the user console. These values can then be used to time-stamp ELS messages.

Note: The 2216 has a hardware clock that maintains the date and time after router reinitialization.

Syntax:

```
time                host . . .  
                    list  
                    offset  
                    set . . .  
                    sync . . .
```

host *IP_address*

Sets the IP address of the RFC 868-compliant host that will be used as the time source. This is the address of a host which will respond to an empty datagram on UDP port 37 with a datagram containing the current time.

list Displays all configured time-related parameters. This includes the current time (if set) and the source of the time (operator or IP address from which time was last received).

```
Example: time list  
05:20:27 Wednesday December 7, 1994  
Set by: operator  
Time Host: 131.210.4.1  
Sync Interval: 10 seconds GMT  
Offset: -300 minutes
```

offset *minutes*

Defines the time zone, in minutes, offset from GMT (Greenwich Mean Time). Note that values west of GMT are negative. For example, EST is 5 hours earlier than GMT, so the command would be **time offset -300**.

Valid values: -720 to 720

Default value: 0

set *<year month date hour minute second>*

Prompts you to set the current time. If you do not specify the entire time in the command, you are prompted for the remaining values. You can change the date as shown in the following example.

```
Example: time set  
year [1996] 1997  
month [12]?  
date [6]? 7  
hour [11]? 12  
minute [3]?  
second [2]?
```

sync *seconds*

Sets the period, in seconds, at which the router will poll the time host for the current time.

Unpatch

Use the **unpatch** command to restore the values of the patch variables entered with the **patch** command to their default values. See the **patch** command in “Patch” on page 92 for details.

Syntax:

unpatch *variable_name*

Note: You *must* specify the long name of the patch variable to be restored.

Update

Use the **update** command to update the configuration memory when you receive a new software load.

Syntax:

update *_version-of-SRAM*

Follow the instructions on the release notice sent with the software. The **update** command is the last command that you enter when loading new software. After you enter this command, the console displays a message indicating configuration memory is being updated.

Write

Use the **write** command to save a configuration to the device before reloading.

Syntax:

write

If you fail to issue the write command and try to reload the device, you will be asked if you want to save the configuration. The configuration is saved in the next CONFIG on the hard disk in the bank you are currently using.

Chapter 10. The Operating/Monitoring Process (GWCON - Talk 5) and Commands

This chapter describes the GWCON process and includes the following sections:

- “What is GWCON?”
- “Entering and Exiting GWCON”
- “GWCON Commands”

What is GWCON?

The Gateway Console (monitoring) process, GWCON (also referred to as CGWCON), is a second-level process of the router user interface.

Using GWCON commands, you can:

- List the protocols and interfaces currently configured in the router.
- Display memory and network statistics.
- Set current Event Logging System (ELS) parameters.
- Test a specified network interface.
- Communicate with third-level processes, including protocol environments.
- Enable and disable interfaces.

The GWCON command interface is made up of levels called modes. Each mode has its own prompt. For example, the prompt for the IP protocol is IP>.

If you want to know the process and mode you are communicating with, press **Return** to display the prompt. Some commands in this chapter, such as the **network** and **protocol** commands, allow you to access the various modes in GWCON.

Entering and Exiting GWCON

To enter the GWCON command environment from OPCON and obtain the GWCON prompt enter the **talk 5**

```
* talk 5
```

The console displays the GWCON prompt (+). If the prompt does not appear, press **Return**. Now, you can enter GWCON commands.

To return to OPCON, enter the OPCON intercept character. (The default is **Ctrl-P**.)

GWCON Commands

This section contains the GWCON commands. Each command includes a description, syntax requirements, and an example. The GWCON commands are summarized in Table 12 on page 106.

To use the GWCON commands, access the GWCON process by entering **talk 5** and enter the GWCON commands at the (+) prompt.

GWCON Process

Table 12. GWCON Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Activate	Enables a newly configured spare interface.
Buffer	Displays information about packet buffers assigned to each interface.
Clear	Clears network statistics.
Configuration	Lists status of the current protocols and interfaces.
Disable	Takes the specified interface or slot off line.
Enable	Enables all interfaces of an adapter.
Error	Displays error counts.
Event	Enters the Event Logging System environment.
Feature	Provides access to console commands for independent router features outside the usual protocol and network interface console processes.
Interface	Displays network hardware statistics or statistics for the specified interface.
Memory	Displays memory, buffer, and packet data.
Network	Enters the console environment of the specified network.
Performance	Provides a snapshot of the main processor utilization statistics.
Protocol	Enters the command environment of the specified protocol.
Queue	Displays buffer statistics for a specified interface.
Reset	Disables the specified interface and then re-enables it using new interface, protocol and feature configuration parameters.
Statistics	Displays statistics for a specified interface.
Test	Enables a disabled interface or tests the specified interface.
Uptime	Displays time statistics for the router.

Activate

Use the **activate** command to enable a spare interface on this device. See “Configuring Spare Interfaces” on page 60 for more information.

Syntax:

activate *interface#*

Buffer

Use the **buffer** command to display information about packet buffers assigned to each interface or range of interfaces.

Note: Each buffer on a device is the same size and is dynamically built. Buffers vary in size from one device to another.

To display information about one interface only, enter the interface or network number as part of the command. To obtain the interface number, use the GWCON **configuration** command.

Syntax:

buffer [*network# or range_of_network#*]

To display information about multiple interfaces, specify the *range_of_network#* (or a combination of *network#* and *range_of_network#*). For example, specifying **buffer 0 3 25-50** displays the information for nets 0, 3, and 25 through 50.

Example:**buffer**

Nt	Interface	Input Buffers:				Buffer sizes:					
		Req	Alloc	Low	Curr	Hdr	Wrap	Data	Trail	Total	Bytes Alloc
0	TKR/0	20	20	7	0	109	92	2052	7	2260	45200
1	PPP/0	20	20	7	20	109	92	2052	7	2260	45200
2	PPP/1	10	10	4	0	108	92	2048	0	2248	22480

Nt Network interface number associated with the software.

Interface

Type of interface.

Input Buffers:

Req Number of buffers requested.

Alloc Number of buffers allocated.

Low Low water mark (flow control).

Curr Current number of buffers on this device. The value will be 0 if the device is disabled. When a packet is received, if the value of *Curr* is below *Low*, then the packet is eligible for flow control. (See the **queue** command for conditions.)

Buffer Sizes:

Hdr Sum of the maximum hardware, MAC, and data link headers.

Wrap Allowance given for MAC, LLC, or Network layer headers due to protocol wrapping.

Data Maximum data link layer packet size.

Trail Sum of the largest MAC and hardware trailers.

Total Overall size of each packet buffer.

Bytes Alloc

Amount of buffer memory for this device. This value is determined by multiplying the values of *Alloc* x *Total*.

Clear

Use the **clear** command to delete statistical information about one or all of the router's network interfaces. This command is useful when tracking changes in large counters. Using this command does not save space or speed up the router.

Enter the interface (or net) number as part of the command. To get the interface number, use the GWCON **configuration** command.

Syntax:

clear *interface# or range_of_interface#*

To clear information about multiple interfaces, specify the *range_of_network#* (or a combination of *interface#* and *range_of_interface#*). For example, specifying **clear 0 3 25-50** clears the information for nets 0, 3, and 25 through 50.

GWCON Process Configuration

Use the **configuration** command to display information about the protocols and network interfaces. The output is displayed in three sections, the first section lists the router identification, software version, boot ROM version, and the state of the auto-boot switch. The second and third sections list the protocol and interface information.

Syntax:

configuration

To display information about multiple interfaces, specify the *range_of_network#* (or a combination of *network#* and *range_of_network#*). For example, specifying **configuration 0 3 25-50** displays the information for nets 0, 3, and 25 through 50.

Example:

configuration

Multiprotocol Access Services

2216-MAS Feature 2822 V3.2 Mod 0 PTF 0 RPQ 0 MAS.EF9 cc4_2a

```
Num Name Protocol
0 IP DOD-IP
3 ARP Address Resolution
4 DN DNA Phase IV
6 VIN Banyan Vines
7 IPX NetWare IPX
10 BGP Border Gateway Protocol
11 SNMP Simple Network Management Protocol
12 OSPF Open SPF-Based Routing Protocol
22 AP2 AppleTalk Phase 2
23 ASRT Adaptive Source Routing Transparent Enhanced Bridge
26 DLS Data Link Switching
27 XTP X.25 Transport Protocol
28 APPN Advanced Peer-to-Peer Networking [HPR]
30 APPN Advanced Peer-to-Peer Networking [ISR]
```

```
Num Name Feature
2 MCF MAC Filtering
```

```
16 Networks:
Net Interface MAC/Data-Link Hardware State
0 TKR/0 Token-Ring/802.5 Token-Ring Up
1 TKR/1 Token-Ring/802.5 Token-Ring Up
2 TKR/2 Token-Ring/802.5 Token-Ring Up
3 TKR/3 Token-Ring/802.5 Token-Ring Up
4 Eth/0 Ethernet/IEEE 802.3 Ethernet Up
5 Eth/1 Ethernet/IEEE 802.3 Ethernet Up
6 Eth/2 Ethernet/IEEE 802.3 Ethernet Up
7 Eth/3 Ethernet/IEEE 802.3 Ethernet Up
8 Eth/4 Ethernet/IEEE 802.3 Ethernet Up
9 Eth/5 Ethernet/IEEE 802.3 Ethernet Up
10 FR/0 Frame Relay V.35/V.36 Up
11 X25/0 X.25 V.35/V.36 Up
12 PPP/0 Point to Point V.35/V.36 Up
13 PPP/1 Point to Point V.35/V.36 Up
14 PPP/2 Point to Point V.35/V.36 Up
15 PPP/3 Point to Point V.35/V.36 Up
```

- The first line gives the product name.
- The second line lists the program/product number, Feature Number, Version, Release, PTF and RPQ information.
- The remaining lines list the configured protocols, followed by the configured features.

The following information is displayed for protocols:

Num Number that is associated with the protocol.

Name Abbreviated name of the protocol.

Protocol

Full name of the protocol.

The following information is displayed for features:

Num Number associated with the feature.

Name Abbreviated name of the feature.

Feature

Full name of the feature.

The following information is displayed for networks:

Net Network number that the software assigns to the interface. Networks are numbered starting at 0. These numbers correspond to the interface numbers discussed under the CONFIG process.

Interface

Name of the interface and instance of this type of interface.

MAC/Data Link

Type of MAC/Data link configured for the interface.

Hardware

Specific kind of interface by hardware type.

State Current state of the network interface.

Testing

Indicates that the interface is undergoing a self-test. Occurs when the router is first started, when a problem is detected on the interface, or when the **test command** is used. (The **enable slot** command can also be used to initiate a self-test of all interfaces on an adapter.)

When an interface is operational, the interface periodically sends out maintenance packets and/or checks the physical state of the port or line to ensure that the interface is still functioning correctly. If the maintenance fails, the interface is declared down and a self-test is scheduled to run in 5 seconds. If a self-test fails, the interface transitions to the down state and the interval until the next self-test is increased up to a maximum of 2 minutes. If the self-test is successful, the network is declared up.

Up Indicates the interface is operational.

Down Indicates that the interface is not operational and has failed a self-test. The network will periodically transition to the testing state to determine if the interface can become operational again.

Disabled

Indicates that the interface is disabled. An interface can be disabled by the following methods:

- An interface can be configured as disabled using the CONFIG **disable** command. Each time the router is reinitialized, the interface's initial state will be disabled. It will remain in the disabled state until an action is taken to enable it.

GWCON Process

- An interface can be disabled using the GWCON **disable** command. This method is temporary because the interface will revert to its configured state (enabled or disabled) when the router is reinitialized.
- The network manager can disable the interface through SNMP. This method is temporary because the interface will revert to its configured state (enabled or disabled) when the router is reinitialized.

When an interface is disabled, it remains disabled until one of the following methods is used to enable it:

- The GWCON **test** command is used to start a self-test of the interface.
- The GWCON **enable slot** command is used to start a self-test on all interfaces on an adapter.
- The network manager initiates a self-test of the interface through SNMP.

WAN Reroute also can change the state of a disabled interface. If an interface is configured as an alternate interface for WAN Reroute and its configured state is disabled, WAN Reroute will start a self-test of the interface when the primary interface goes down. When the primary interface is operational and stable again, WAN Reroute puts the alternate interface back to its configured state. Refer to The WAN Reroute Feature in *Using and Configuring Features* for more information.

Available

Indicates that the interface has been configured as a secondary WAN Restoral interface and it is available to back up the primary interface.

Not Present

Indicates that the interface's adapter is not plugged in.

Not Present is also used as the state for a null device. Spare interfaces are displayed as null devices until they are activated.

HW Mismatch

Indicates that the configured adapter type does not match the adapter type that is actually present in the slot.

HW Failure

Indicates that there is an unrecoverable hardware error for the interface's hardware.

Diagnostics

Indicates that hardware diagnostics are running.

Disable

Use the **disable** command to take a network interface or slot off-line, making the interface or slot unavailable. This command immediately disables the interface or slot. You are not prompted to confirm, and no verification message displays. If you disable an interface or slot with this command, it remains disabled until you use the GWCON **test** command or an OPCON **reload** command to enable it.

GWCON Process

were detected to prevent their being deliverable to a higher-layer protocol. The packets may have been discarded to free buffer space.

Input Errors

Number of packets that were found to be defective at the data link.

Input Unk Proto

Number of packets received for an unknown protocol.

Input Flow Drop

Number of packets received that are flow controlled on output.

Output Discards

Number of packets that the router chose to discard rather than transmit due to flow control.

Output Errors

Number of output errors, such as attempts to send over a network that is down or over a network that went down during transmission.

Note: The sum of the discarded output packets is not the same as input flow drops over all networks. Discarded output may indicate locally originated packets.

Event

Use the **event** command to access the Event Logging System (ELS) console environment. This environment is used to set up temporary message filters for troubleshooting purposes. All changes made in the ELS console environment will take effect immediately, but will go away when the router is reinitialized. See “Chapter 12. Using the Event Logging System (ELS)” on page 123 for information about the Event Logging System and its commands. Use the **exit** command to return to the GWCON process.

Syntax:

event

Feature

Use the **feature** command to access console commands for specific 2216 features outside of the protocol and network interface console processes.

Enter a question mark after the **feature** command to obtain a listing of the features available for your software release.

To access that feature’s console prompt, enter the **feature** command at the GWCON prompt followed by the feature number or short name. Table 9 on page 87 lists available feature numbers and names.

Once you access the prompt for that feature, you can begin entering specific commands to monitor that feature. To return to the GWCON prompt, enter the **exit** command at the feature’s console prompt.

Syntax:

feature *feature# or feature-short-name*

Interface

Use the **interface** command to display statistical information about the network interfaces (for example, Ethernet or Token-Ring). This command can be used without a qualifier to provide a summary of all the interfaces (shown in the following output) or with a qualifier to reveal detailed information about one specific interface.

Descriptions of detailed output for each type of interface are provided in the specific interface *Monitoring* chapters found in this guide. To obtain the interface number, use the GWCON **configuration** command.

Syntax:

interface *[interface# or range_of_interface#]*

To display information about multiple interfaces, specify the *range_of_network#* (or a combination of *interface#* and *range_of_interface#*). For example, specifying **interface 0 3 25-50** displays the information for nets 0, 3, and 25 through 50.

Example: interface

Nt	Nt'	Interface	Slot-Port	Self-Test Passed	Self-Test Failed	Maintenance Failed
0	0	TKR/0	Slot: 1 Port: 1	1	0	0
1	1	TKR/1	Slot: 1 Port: 2	2	1	0
2	2	TKR/2	Slot: 2 Port: 1	2	1	0
3	3	TKR/3	Slot: 2 Port: 2	2	1	0
4	4	Eth/0	Slot: 4 Port: 1	1	0	0
5	5	Eth/1	Slot: 4 Port: 2	1	0	0
6	6	Eth/2	Slot: 5 Port: 1	1	0	0
7	7	Eth/3	Slot: 5 Port: 2	3	2	2
8	8	Eth/4	Slot: 6 Port: 1	1	0	0
9	9	Eth/5	Slot: 6 Port: 2	5	4	1
10	10	FR/0	Slot: 8 Port: 0	2	1	0
11	11	X25/0	Slot: 8 Port: 1	1	0	0
12	12	PPP/0	Slot: 8 Port: 2	2	1	0
13	13	PPP/1	Slot: 8 Port: 3	1	0	0
14	14	PPP/2	Slot: 8 Port: 4	1	0	0
15	15	PPP/3	Slot: 8 Port: 5	1	0	0

Note: The display varies depending on the device.

Nt Global interface number.

Nt' Reserved for dial circuit use. Interface number of the physical network interface that the dial circuit uses.

Interface

Interface name.

Slot-Port

Slot number and port number of the interface.

Self-Test Passed

Number of times self-test succeeded (state of interface changes from down to up).

Self-Test Failed

Number of times self-test failed (state of interface changes from up to down).

Maintenance Failed

Number of maintenance failures.

Memory

Use the **memory** command to display the current CPU memory usage in bytes, the number of buffers, and the packet sizes.

To use this command, free memory must be available. The number of free packet buffers may drop to zero, resulting in the loss of some incoming packets; however, this does not adversely affect router operations. The number of free buffers should remain constant when the router is idle. If it does not, contact your service representative.

Syntax:

memory

Example:

```

memory
Physical installed memory:      16 MB
Total routing (heap) memory:   12 MB
Routing memory in use:        13 %

                Total  Reserve  Never   Perm   Temp   Prev
                Alloc  Alloc   Alloc  Alloc  Alloc  Alloc
Heap memory    12231155  26488 10687312 1438487 104924  432

Number of global buffers: Total = 300, Free = 300, Fair = 77, Low = 60
Global buff size: Data = 2048, Hdr = 17, Wrap = 72, Trail = 65, Total = 2208
    
```

Physical installed memory

The total amount of physical RAM installed in the router.

Total routing memory

The amount of memory available to the routing function, not including that allocated to the base operating system, system extensions, or options such as APPN. This is also called "heap" memory, and matches the "Total" heap memory size given in bytes shortly thereafter.

Routing memory in use

The percentage of total routing memory that is currently being used by the routing function. Heap memory currently in use is counted under the following headings **Perm Alloc** and **Temp Alloc**.

Heap memory:

Amount of memory used to dynamically allocate data structures.

Total Total amount of space available for allocation for memory.

Reserve

Minimum amount of memory needed by the currently configured protocols and features.

Never Alloc

Memory that has never been allocated.

Perm Alloc

Memory requested permanently by router tasks.

Temp Alloc

Memory allocated temporarily to router tasks.

Prev Alloc

Memory allocated temporarily and returned.

Number of global buffers:

Total Total number of global buffers in the system.

Free	Number of global buffers available.
Fair	Fair number of buffers for each interface. (See “Low”.)
Low	The number of free buffers at which the allocation strategy changes to conserve buffers. If the value of <i>Free</i> is less than <i>Low</i> , then buffers will not be placed on any queue that has more than the <i>Fair</i> number of buffers in it.
Global buff size:	Global buffer size.
Data	Maximum data link packet size of any interface.
Header	Sum of the maximum hardware, MAC, and data link headers.
Wrap	Allowance given for MAC, LLC, or Network layer headers due to protocol wrapping.
Trailer	Sum of the largest MAC and hardware trailers.
Total	Overall size of each packet buffer

Network

Use the **network** command to enter the console environment for supported networks, such as X.25 networks. This command obtains the console prompt for the specified interface. From the prompt, you can display statistical information, such as the routing information fields for Token-Ring networks.

Syntax:

```
network                interface#
```

At the GWCON prompt (+), enter the **configuration** command to see the protocols and networks for which the router is configured. See “Configuration” on page 108 for more information on the configuration command.

Enter **interface** at the + prompt for a display of the networks for which the router is configured.

Enter the GWCON **network** command and the number of the interface you want to monitor or change. For example:

```
+network 3
X.25>
```

In the example, the X.25> prompt is displayed. You can then view information about the X.25 interface by entering the X.25 operating commands.

After identifying the interface number of the interface you want to monitor, for interface-specific information, see the corresponding monitoring chapter in this manual for the specified network or link-layer interface. Console support is offered for the following network and link-layer interfaces:

- Ethernet
- Frame Relay
- PPP
- SDLC
- SDLC Relay (SRLY)

GWCON Process

- Token-Ring
- V.25bis
- X.25
- ATM
- ISDN
- Dial-In
- Multilink PPP (MP)
- Layer-2-Tunneling

Performance

Use the **performance** command at the Config> prompt to enter the monitoring environment for performance. See “Chapter 14. Configuring and Monitoring Performance” on page 195 for more information.

Protocol

Use the **protocol** command to communicate with the router software that implements the network protocols installed in your router. The **protocol** command accesses a protocol's command environment. After you enter this command, the prompt of the specified protocol appears. From the prompt, you can enter commands that are specific to that protocol.

Syntax:

protocol *prot#*

Enter the protocol number or short name as part of the command. To obtain the protocol number or short name, enter the CONFIG command environment (Config>), and then enter the **list configuration** command. See “Accessing the Configuration Process, CONFIG (Talk 6)” on page 14 for instructions on accessing Config>. To return to GWCON, enter **exit**.

See the corresponding monitoring chapter in this manual or in the *Protocol Configuration and Monitoring Reference* for information on a specific protocol's console commands.

Queue

Use the **queue** command to display statistics about the length of input and output queues on the specified interfaces. Information about input and output queues provided by the queue command includes:

- The total number of buffers allocated
- The low-level buffer value
- The number of buffers currently active on the interface.

Syntax:

queue *interface#or range_of_interface#*

To display information about multiple interfaces, specify the *range_of_network#* (or a combination of *interface#* and *range_of_interface#*). For example, specifying **queue 0 3 25-50** displays the information for nets 0, 3, and 25 through 50.

To display information about one interface only, enter the interface or network number as part of the command. To obtain the interface number, use the **GWCON configuration** command.

Example:

```
queue
      Input Queue      Output Queue
Nt Interface  Alloc Low Curr      Fair Curr
0 Eth/0       30  10  30      30   1
1 PPP/0       24   4  24       4   0
2 FR/0        24   4  24       5   0
```

Nt Network interface number associated with the software.

Interface

Type of interface.

Input Queue:

Alloc Number of buffers allocated to this device.

Low Low water mark for flow control on this device.

Curr Current number of buffers on this device. The value will be 0 if the device is disabled.

Output Queue:

Fair Fair level for the length of the output queue on this device.

Curr Number of packets currently waiting to be transmitted on this device. For locally originated packets, the eligibility discard depends on the global low water mark described in the **memory** command.

The router attempts to keep at least the Low value packets available for receiving over an interface. If a packet is received and the value of Curr is less than Low, then the packet will be subject to flow control. If a buffer subject to flow control is to be queued on this device and the Curr level is greater than Fair, then the buffer is dropped instead of queued. The dropped buffer is displayed in the Output Discards column of the **error** command. It will also generate ELS event GW.036 or GW.057.

Due to the scheduling algorithms of the router, the dynamic numbers of Curr (particularly the Input Queue Curr) may not be fully representative of typical values during packet forwarding. The console code runs only when the input queues have been drained. Thus, Input Queue Curr will generally be nonzero only when those packets are waiting on slow transmit queues.

Reset

Use the **reset** command to disable the specified interface and then re-enable it using new interface, protocol and feature configuration parameters. See "Resetting Interfaces" on page 63 for more information.

Syntax:

```
reset interface#
```

Statistics

Use the **statistics** command to display statistical information about the network software, such as the configuration of the networks in the router.

GWCON Process

Syntax:

statistics *interface#or range_of_interface#*

To display information about multiple interfaces, specify the *range_of_network#* (or a combination of *interface#* and *range_of_interface#*). For example, specifying **statistics 0 3 25-50** displays the information for nets 0, 3, and 25 through 50.

To display information about one interface only, enter the interface or network number as part of the command. To obtain the interface number, use the GWCON **configuration** command.

Example:

```
statistics
  Nt Interface      Unicast  Multicast  Bytes  Packets  Bytes
  0 Eth/0           Pkts Rcv  Pkts Rcv  Received Trans  Trans
  1 PPP/0           0       0       0      0        0       0
  2 PPP/1           0       0       0      0        0       0
```

Nt Network interface number associated with the software.

Interface

Type of interface.

Unicast Pkts Rcv

Number of non-multicast, non-broadcast specifically-addressed packets at the MAC layer.

Multicast Pkts Rcv

Number of multicast or broadcast packets received.

Bytes Received

Number of bytes received at this interface at the MAC layer.

Packets Trans

Number of packets of unicast, multicast, or broadcast type transmitted.

Bytes Trans

Number of bytes transmitted at the MAC layer.

Test

Use the **test** command to verify the state of an interface or to enable an interface that was previously disabled with the **disable** command. If the interface is enabled and passing traffic, the **test** command will remove the interface from the network and run self-diagnostic tests on the interface.

Syntax:

test *interface#*

Note: For this command to work, you must enter the **complete** name of the command followed by the interface number.

Enter the interface or network number as part of the command. To obtain the interface number, use the GWCON **configuration** command. For example, when testing starts, the console displays the following message:

```
Testing net 0 TKR/0...
```

GWCON Process

When testing completes or fails, or when GWCON times out (after 30 seconds), the following possible messages are displayed:

```
Testing net 0 Eth/0 ...successful
Testing net 0 Eth/0 ...failed
Testing net 0 Eth/0 ...still testing
```

Some interfaces may take more than 30 seconds before testing is done.

Note: If the interface you are testing is configured as an alternate WAN Reroute interface, you are prompted:

- If you want to enable the interface's primary-alternate pairings if WAN Reroute is currently disabled for the alternate interface.
If you answer *yes*, the same action occurs as when you enter the **t 5 enable alternate-circuit** WAN reroute command described in Configuring and Monitoring WAN Restoral in *Using and Configuring Features*.
- If you want to test the interface.
Normally an alternate WAN Reroute interface is disabled until it is needed to back up its corresponding primary interface. If you answer *yes*, a self-test is started for the interface. If you answer *no*, a self-test does not occur.

See The WAN Reroute Feature, Using WAN Restoral, and Configuring and Monitoring WAN Restoral in the *Using and Configuring Features* for additional information.

Uptime

Use the **uptime** command to display time statistics about the router, including the following:

- Number of restarts.
- Number of known crashes.
- Whether the router was last reloaded or restarted.
- Time elapsed since the last reload.
- Time elapsed since the last restart.

Syntax:

uptime

GWCON Process

Chapter 11. The Messaging (MONITR - Talk 2) Process

This chapter explains how to collect and display messages. (Refer to “Chapter 12. Using the Event Logging System (ELS)” on page 123 for information about ELS and message formats. Refer also to the *IBM Nways Event Logging System Messages Guide* for a description of each message. This chapter includes the following sections:

- “What is Messaging (MONITR)?”
- “Commands Affecting Messaging”
- “Entering and Exiting the Messaging (MONITR) Process”
- “Receiving Messages”

What is Messaging (MONITR)?

The MONITR process provides a view of activity inside the router and the networks. MONITR also displays logging messages from the software.

Commands Affecting Messaging

The following commands affect the messaging process:

- OPCON commands:
 - **divert** temporarily diverts output to a different device.
 - **flush** causes the software to discard the messages it collects.
 - **halt** reverses the action of the divert command.
 - **talk** displays message output.
- CONFIG **set logging disposition** command sets the initial device to which the software sends its output.

Entering and Exiting the Messaging (MONITR) Process

To enter the messaging process from OPCON enter the **talk 2** command.

The console displays the messages the software has accumulated.

To exit messaging and return to OPCON, enter the OPCON intercept character (the default is **Ctrl-P**).

Receiving Messages

To receive messages at your console, enter the messaging process as described in the previous section. The software then displays all the messages it has recorded since it was last invoked. While you are connected to the messaging process, it displays all messages as they arrive.

Use the OPCON **divert** and **halt** commands to view software messages while you are doing something else with the router. Permitted devices divert output to TTY0 (the local console), TTY1, or TTY2 (the remote consoles).

Chapter 12. Using the Event Logging System (ELS)

This chapter describes the Event Logging System (ELS). The ELS continually logs all events, filtering them according to parameters that you select. A combination of operational counters and the ELS provides information for monitoring the health and activity of the system. The information is divided into the following sections:

- “What is ELS?”
- “Entering and Exiting the ELS Configuration Environment” on page 124
- “Event Logging Concepts” on page 124
- “Using ELS” on page 127
- “Using ELS to Troubleshoot a Problem” on page 129
- “Using and Configuring ELS Remote Logging” on page 131
- “Using ELS Message Buffering” on page 139

What is ELS?

ELS is a monitoring system and an integral part of the router operating system. ELS manages the messages logged as a result of router activity. Use ELS commands to set up a configuration that sorts out only those messages you feel are important. You can then display the messages on the console terminal screen, log them to a remote workstation, or send the messages to a network management station using Simple Network Management Protocol (SNMP) traps.

The ELS system and the operational counters are the best troubleshooting tools you have to isolate problems in the router. A quick scan of the event messages will tell you whether the router has a problem and where to start looking for it.

In the ELS configuration environment, the commands are used to establish a default configuration. This default configuration does not take effect until the router reinitializes.

Occasionally, it is helpful to temporarily view messages using parameters other than was set up in the ELS configuration environment, without having to reinitialize the router. The ELS operating and monitoring environment is used to:

- Temporarily change the default ELS display settings
 - Changes made in the ELS console environment take effect immediately
 - Changes made in the operating/monitoring environment are not stored in nonvolatile configuration storage.
- View statistical information regarding ELS uses of dynamic RAM

Note: Specific ELS messages are described in the *IBM Nways Event Logging System Messages Guide*.

ELS is a subprocess that you access from the OPCON process.

Entering and Exiting the ELS Configuration Environment

The ELS configuration environment (available from the CONFIG process) is characterized by the ELS Config> prompt. Commands entered at this prompt create the ELS default state that takes effect after you restart the router. These commands are described in greater detail later in this chapter.

Configuration commands that have subsystem, group, or event as a parameter are executed in the following order:

- Subsystem
- Group
- Event

To set a basic ELS configuration, enter the **display subsystem all standard** command at the ELS Config> prompt. This command configures the ELS to display messages from all subsystems with the STANDARD logging level (that is, all errors and unusual informational comments).

Note: The router does not have a default ELS configuration. You must enter the ELS configuration environment and set the default state.

To enter the ELS configuration environment from OPCON:

1. Enter the **talk 6** command. The console displays the CONFIG prompt (Config>). If the prompt does not appear when you first enter CONFIG, press **Return**.
2. At the CONFIG prompt, enter the following command to access ELS:

```
Config> eve
```

The console displays the ELS configuration prompt (ELS config>). Now, you can enter ELS configuration commands.

To leave the ELS configuration environment, enter the **exit** command.

Event Logging Concepts

This section describes how events are logged and how to interpret messages. Also described are the concepts of subsystem, event number, and logging level. A large part of ELS function is based on commands that accept the subsystem, event number, and logging level as parameters.

Causes of Events

Events occur continuously while the router is operating. They can be caused by any of the following reasons:

- System activity
- Status changes
- Service requests
- Data transmission and reception
- Data and internal errors

When an event occurs, ELS receives data from the system that identifies the source and nature of the event. Then ELS generates a message that uses the data received as part of the message.

Interpreting a Message

This section describes how to interpret a message generated by ELS. Figure 4 shows the message contents.

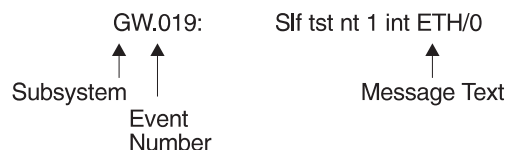


Figure 4. Message Generated by an Event

The information illustrated in Figure 4 as well as the ELS logging level information displayed with the **list subsystem** command is as follows:

Subsystem

Subsystem is a predefined short name for a router component, such as a protocol or interface. In Figure 4, **GW** identifies the subsystem through which this event occurred.

Other examples of subsystems include IP, TKR, and X25. On a particular router, the actual subsystems present depend on the hardware and software configured for that router. You can use the **list subsystem** command described in this chapter to see a list of the subsystems on your router.

Enter the subsystem as a parameter to an ELS command when you want the command to affect the entire subsystem. For example, the ELS command **display subsystem GW** causes all events (except the events with 'debug' logging level) that occur through the GW subsystem to be displayed.

Event Number

Event Number is a predefined, unique, arbitrary number assigned to each message within a subsystem. In Figure 4, **019** is the event number within the GW subsystem. You can see a list of all the events within a subsystem by using the **list subsystem** command, where *subsystem* is the short name for the subsystem.

The event number always appears with a subsystem identifier, separated by a period. For example: **GW.019**. The subsystem and event number together identify an *individual* event. They are entered as a parameter to certain ELS commands. When you want a command to affect only the specified event, enter the subsystem and event number as a parameter for the ELS command.

Logging Level

Logging level is a predefined setting that classifies each message by the type of event that generated it. Use the **list subsystem** ELS console command to display the setting of the logging level. Table 13 on page 126 lists the logging levels and types. ERROR, INFO, TRACE, STANDARD, and ALL are aggregates of other logging level types. STANDARD is the recommended default.

Using ELS

Table 13. Logging Levels

Logging Level	Type
UI ERROR	Unusual internal errors
CI ERROR	Common internal errors
UE ERROR	Unusual external errors
CE ERROR	Common external errors
ERROR	Includes all error levels above
UINFO	Unusual informational comment
CINFO	Common informational comment
INFO	Includes all comment levels above
STANDARD	Includes all error levels and all informational comment levels (default)
PTRACE	Per packet trace
UTRACE	Unusual operation Trace message
CTRACE	Common operation Trace message
TRACE	Includes all trace levels above
DEBUG	Message for debugging
ALL	Includes all logging levels

The logging level setting affects the operation of the following commands:

- **Display subsystem**
- **Nodisplay subsystem**
- **Trap subsystem**
- **Notrap subsystem**
- **Remote subsystem**
- **Noremote subsystem**

The logging level is set for a particular command when you specify it as a parameter to one of the above commands. For example:

```
display subsystem TKR ERROR
```

Including the logging level on the command line modifies the **display** command so that whenever an event with a logging level of either UI-ERROR or CI-ERROR occurs through subsystem TKR, the console displays the resulting message.

You cannot specify the logging level for operations affecting groups or events.

Message Text

Message Text appears in short form. In Figure 4 on page 125, S1f tst nt 1 int ETH/0 is the message generated by this event. Variables, such as *source_address* or *network*, are replaced with actual data when the message displays on the console.

The variable *error_code* is referred to by some of the Event Logging System message descriptions (usually preceded by *rsn* or *reason*). They indicate the type of packet error detected. Table 14 describes the error or packet completion codes. Packet completion codes indicate the disposition of the packets received by the router.

Table 14. Packet Completion Codes (Error Codes)

Code	Meaning
0	Packet successfully queued for output

Table 14. Packet Completion Codes (Error Codes) (continued)

Code	Meaning
1	Random, unidentified error
2	Packet not queued for output due to flow control reasons
3	Packet not queued because network is down
4	Packet not queued to avoid looping or bad broadcast
5	Packet not queued because destination host is down (only on networks where this can be detected)

ELS displays network information as follows:

```
nt 1 int Eth/0 (or ) network 1, interface Eth/0,
```

where:

- 1 is the network number (each network on the router is numbered sequentially from zero).
- 0 is the unit number (the interfaces of each hardware type are numbered sequentially from zero).

Ethernet and 802.5 hardware addresses appear as a long hexadecimal number.

IP (Internet Protocol) addresses are printed as 4 decimal bytes separated by periods, such as 18.123.0.16.

Groups

Groups are user-defined collections of events that are given a name, the group name. Like the subsystem, subsystem and event number, and logging level, use the group name as a parameter to ELS commands. However, there are no predefined group names. You must create a group before you can specify its name on the command line.

To create a group, use the **add** configuration command, specify the name you want to call the group, and then specify the events you want to be part of the group. The events you add to the group can be from different subsystems and have different logging levels.

After creating a group, use the group name to manipulate the events in the group as a whole. For example, to turn off display of all messages from events that have been added to a group named `grouptwo`, include the group name on the command line, as follows:

```
nodisplay group grouptwo
```

To delete a group, use the **delete** command.

Using ELS

To use ELS effectively, do the following:

- Know what you want before using the ELS system. Clearly define the problem or events that you want to see before using the MONITR process.
- Execute the command **nodisplay subsystem all all** to turn off all ELS messages.
- Turn on only those messages that relate to the problem you are experiencing.

Using ELS

- Use the *IBM Nways Event Logging System Messages Guide* to determine which messages are not normal.

When initially viewing ELS from the MONITR process, you will see a considerable amount of information. Because the router cannot buffer and display every packet under moderate to heavy loads the buffers are flushed. When this occurs the following message is displayed:

```
xx messages flushed
```

The router does not save these messages. When this message appears, tailor the ELS output to display only that information that is important to the current task you are monitoring, or use the advanced ELS commands to establish a message buffer. See “Using ELS Message Buffering” on page 139.

Managing ELS Message Rotation

It is also important to note that the ELS messages continually rotate through the router’s buffers. To stop and restart the displaying of ELS messages, use the following key combinations:

Ctrl-S to pause scrolling

Ctrl-Q to resume scrolling

Ctrl-P to go back to the last process

You may also want to capture the ELS output to a file. You can do this by starting a script file or log file from your location when Telneting to a router. You can also do this by attaching a PC to the router’s console port and starting a log file from within the terminal emulation package. This information is needed to help Customer Service diagnose a problem.

Capturing ELS Output Using a Telnet Connection on a UNIX Host

Use a Telnet connection on an AIX or UNIX host to capture the ELS messages on your screen to a file on the host. Before beginning, set up ELS for the messages you want to capture using the ELS console commands in “Chapter 13. Configuring and Monitoring the Event Logging System (ELS)” on page 143.

To capture the ELS output to a file on an AIX or UNIX host, follow these steps:

1. From the host, enter **telnet** *router_ip_addr* | **tee** *local_file_name*
router_ip_addr is the IP address of the router
local_file_name is the name of the file on the host where you want the ELS messages to be saved.

The **tee** command displays the ELS messages on your screen and, at the same time, copies them to the local file.

2. From the OPCON prompt (*), enter **t 2**. This accesses the MONITR process, which is the process that displays ELS messages on your screen. Depending on which ELS messages you configured, you should see ELS messages appearing on the screen.

As long as you are in the MONITR process, all ELS messages will be written to the local file. When you exit the MONITR process (by entering **Ctrl-P**) or terminate the Telnet session, the logging of messages to the local file will stop.

You can also use remote logging instead of capturing ELS output on a UNIX Host. For more information about remote logging, see “Using and Configuring ELS Remote Logging” on page 131.

Configuring ELS So Event Messages Are Sent In SNMP Traps

ELS can be configured so that event messages are sent to a network management workstation in an SNMP enterprise-specific trap. These traps are useful for reporting status and diagnostic results, and are often used for remote monitoring of a 2216. When ELS is configured appropriately, an SNMP trap will be generated each time the selected event occurs. For more information about SNMP, see *Protocol Configuration and Monitoring Reference*.

To tell ELS that a specific event should be activated to be sent as an SNMP trap, at the ELS config> prompt or at the ELS> prompt, using IP as an example, type:

```
trap event ip.007
```

Note: If you are at the ELS config> prompt, you will need to reboot.

To enable the ELS enterprise-specific trap, follow these steps:

1. At the SNMP config> prompt, using **public** as an example, type:

```
SNMP config> add address public <network manager IP address>
SNMP config> enable trap enterprise public
SNMP config> set community access read_trap public
```

Note: You need to reboot to activate these changes.

2. Enable your network management station to receive and properly display the enterprise-specific traps.

Follow these steps to trap groups, subsystems, and events.

Using ELS to Troubleshoot a Problem

If you are trying to troubleshoot a particular problem, display the messages related to the problem. For example, if experiencing a problem with bridging, turn on the bridging messages:

```
display subsystem srt all
display subsystem br all
```

Initially, because of the rapid pace of messages scrolling across the screen, you may want to record the numbers you see and look them up in the *Event Logging System Messages Guide* manual. Once you become familiar with different types of messages being displayed for a particular protocol, you can turn on and turn off only those messages that contain the information that you require to troubleshoot a problem. The following sections list specific ELS examples. Keep in mind that different problems may require different steps.

ELS Example 1

You are interested in looking at the frequency of polling on a Token-Ring interface, and finding out whether the polls are successful.

Using ELS

```
ELS> nodisplay subsystem all all
ELS> display subsystem tkr all
Ctrl-P
* t 2
```

As the messages begin to scroll by, look for ELS message tkr.031.

ELS Example 2

SRB bridging is not working.

1. Check the configuration.
2. Use the GWCON bridging console to verify that the bridging interfaces are enabled.

3. Enter:

```
* t 6
config> event
ELS config> nodisplay subsystem all all
ELS config> display subsystem srb all
ELS config> exit
config> Ctrl-P
```

4. Restart the routing subsystem. When the subsystem has restarted, enter the following:

```
* t 2
```

ELS Example 3

Router cannot communicate with an IPX server on an Ethernet.

1. Enter the **talk** command and the PID for GWCON.

```
* talk 5
```

The console displays the GWCON prompt (+). If the prompt does not appear when you first enter GWCON, press **Return**.

2. At the GWCON prompt (+), enter **IPX** to access the IPX console prompt (IPX>).
3. At the IPX console prompt, enter the **slist** command to verify that the server is listed. (See the section on monitoring IPX in the *Protocol Configuration and Monitoring Reference* for information on the **slist** command.)
4. Check the IPX configuration.
5. Enter the following:

```
* t 5
+ event
ELS> nodisplay subsystem all all
ELS> display subsystem IPX all
ELS> display subsystem eth all
ELS> Ctrl-P
* t 2
```

As the messages begin to scroll by, look for ELS message eth.001. This indicates that the server has a bad Ethernet type field.

Using and Configuring ELS Remote Logging

The remotely-logged ELS message contains all of the information that is contained in ELS messages found in the monitor queue, as viewed under talk 2, and also contains additional information as shown in Figure 5.

Date/Time	IP address assigned by the user	Sequence Number used for detecting missing messages	Local Name assigned by the user	ELS Subsystem Name, & Formatted message
Nov 20 12:13:47	5.1.1.1	Msg [0444] from	** IBM/2216 **	:els: ARP.011 Del ent ...

Figure 5. Syslog Message Description

Note the following differences in the remote log display:

- The month and day of month in addition to the time, which is always displayed as the time-of-day.
- An IP address, which is the user-specified source IP address. If a DNS server resolves the source IP address to a hostname, then the hostname will be displayed instead of the IP address.
- A Sequence number is added to the message by the source device to assist in detecting dropped messages. See “Remote Logging Output” on page 135 for an explanation of dropped messages. When the sequence number of the message reaches 9999, the next sequence number is 0001.
- A “Local Name” for the source router, to assist in distinguishing between messages from multiple sources. If you do not configure a local name, this field is blank.

Syslog Facility and Level

Remotely-logged ELS messages are transmitted over the network in UDP packets with the destination port number in the UDP header always equal to 514, the syslog port. To receive and process the UDP packets, the *syslog daemon* (*syslogd*) must be running in the remote workstation that is receiving and logging the ELS messages. See “Remote Workstation Configuration” for details.

Although it is not displayed in the remotely-logged ELS message, every ELS message sent on the network in a UDP packet must be assigned a *syslog_facility* and a *syslog_level*. The syslog daemon uses the combination of facility and level to determine where to route the message. Typically, you want the ELS messages to be written to one or more files in the remote host. Other options include displaying the message on the console, sending the message to one or more users, or sending the message to another workstation.

The commands you use to specify the *syslog_facility* and *syslog_level* values, along with other remote-logging related console commands, are described in “ELS Monitoring Commands” on page 165 and “ELS Configuration Commands” on page 143. Review these commands before reading through the next section.

Remote Workstation Configuration

The following configuration assumes that a single 2216 is remote-logging to a single remote workstation. You can configure multiple 2216s to remote-log to the same

Using ELS

remote workstation. However, a particular 2216 can log to one and only one remote workstation. The operating system used in this example is AIX 4.2. Your environment may be slightly different. For more information on syslog, refer to the documentation for your operating system.

To perform the configuration on an AIX workstation, you must log in as **root**. To configure the workstation:

1. Create or edit a `syslog.conf` file to specify where ELS messages with particular `syslog_facility` and `syslog_level` values are to be written. See the bottom of Figure 6 on page 133 for an example of how to specify the message destination. Note that the full pathname of the log files must be specified. The default location for the syslog configuration file is `/etc/syslog.conf`.
2. Create the files for logging syslog messages that you specified in the `syslog.conf` file.
3. Start the syslog daemon by entering **syslogd**. To start the syslog daemon from SRC (System Resource Controller), enter **startsrc -s syslogd**. If the pathname of the configuration file is not `/etc/syslog.conf`, then enter **syslogd -f *pathname***. To start the syslog daemon in debug mode, enter **syslogd -d**.

Note: Running multiple instances of the syslog daemon is not supported.

4. If the syslog daemon is already running when you create or modify the `syslog.conf` file, it must be restarted so that the daemon reinitializes the configuration from `syslog.conf`.
5. Verify the setup by using the **logger** command as follows:

```
logger -p user.alert THIS IS A TEST MESSAGE (user.alert)
logger -p news.info THIS IS A TEST MESSAGE (news.info)
```

If the setup is correct, `THIS IS A TEST MESSAGE...` will be written to the files specified in `syslog.conf`.


```

# @(#)34      1.9 src/bos/etc/syslog/syslog.conf, cmdnet, bos411, 9428A410j 6/13/93 14:52:39
#
# COMPONENT_NAME: (CMDNET) Network commands.
#
# FUNCTIONS:
#
# ORIGINS: 27
#
# (C) COPYRIGHT International Business Machines Corp. 1988, 1989
# All Rights Reserved
# Licensed Materials - Property of IBM
#
# US Government Users Restricted Rights - Use, duplication or
# disclosure restricted by GSA ADP Schedule Contract with IBM Corp.
#
# /etc/syslog.conf - control output of syslogd
#
# Each line must consist of two parts:-
#
# 1) A selector to determine the message priorities to which the
#    line applies
# 2) An action.
#
# The two fields must be separated by one or more tabs or spaces.
#
# format:
#
# <msg_src_list>          <destination>
#
# where <msg_src_list> is a semicolon separated list of <facility>.<priority>
# where:
#
# <facility> is:
#   * - all (except mark)
#   kern,user,mail,daemon, auth, syslog, lpr, news, uucp, cron, authpriv, local0 - local7
#
# <priority or level> is one of (from high to low):
#   emerg,alert,crit,err(or),warn(ing),notice,info,debug
#   (meaning all messages of this priority or higher)
#
# <destination> is:
#   /filename - log to this file
#   username[,username2...] - write to user(s)
#   @hostname - send to syslogd on this machine
#   * - send to all logged in users
#
# example:
# "mail messages, at debug or higher, go to Log file. File must exist."
# "all facilities, at debug and higher, go to console"
# "all facilities, at crit or higher, go to all users"
# mail.debug          /usr/spool/mqueue/syslog
# *.debug             /dev/console
# *.crit              *
#
#   syslog messages with facility / priority values of LOG_USER,   LOG_ALERT
user.alert           /tmp/syslog_user_alert
#
#   syslog messages with facility / priority values of LOG_NEWS,  LOG_INFO
news.info            /tmp/syslog_news_info

```

Figure 6. *syslog.conf* Configuration File

Configuring the 2216 for Remote Logging

To configure a 2216:

1. In talk 6, configure the remote-logging facility as shown in Figure 7 on page 134. The IP address specified as the *source-ip-addr* should be an IP address that is configured in the 2216 for easier identification when the IP address or the hostname is shown in the remotely-logged ELS message. You should also verify that this IP address resolves quickly into a hostname by the name server or that

Using ELS

the name server at least responds quickly with “address not found.” To determine whether this happens, issue the **host** command on your workstation as follows:

```
workstation> host 5.1.1.1
host: address 5.1.1.1 NOT FOUND
workstation>
```

If the response takes more than 1 second, select an IP address which resolves more quickly.

2. In talk 6 configure events and subsystems for remote-logging, as shown in Figure 8 on page 135.
3. Write the configuration and reload the 2216.

```
ELS config>set remote source-ip-addr 5.1.1.1
Source IP Addr = 5.1.1.1

ELS config>set remote remote-ip-addr 192.9.200.1
Remote Log IP Addr = 192.9.200.1

ELS config>set remote local-id ** IBM/2216 **
Remote Log Local ID = ** IBM/2216 **

ELS config>set remote no-msgs-in-buffer 100
Number of messages in Remote Log Buffer must be 100-512
Number of Messages in Remote Buffer = 100

ELS config><B>set remote facility log_news
Default Syslog Facility = LOG_NEWS

ELS config>set remote level log_info
Default Syslog Level = LOG_INFO

ELS config>set remote on
Remote Logging is ON

ELS config>list remote

----- Remote Log Status -----

Remote Logging is ON
Source IP Address = 5.1.1.1
Remote Log IP Address = 192.9.200.1
Default Syslog Facility = LOG_NEWS
Default Syslog Priority Level = LOG_INFO
Number of Messages in Remote Log = 100
Remote Logging Local ID = ** IBM / 2216 **
ELS config>
```

Figure 7. Configuring the 2216 for Remote Logging

```

ELS config>display sub snmp all
ELS config>remote sub snmp all log_news log_info

ELS config>display event srt.017
ELS config>remote event srt.017 log_news log_info

ELS config>display event stp.016
ELS config>remote event stp.016 log_user log_info

ELS config>display event stp.026
ELS config>remote event stp.026 log_news log_info

ELS config>display event stp.024
ELS config>remote event stp.024 log_news log_info

ELS config>display event ip.068
ELS config>remote event ip.068 log_news log_info

ELS config>display event ip.058
ELS config>remote event ip.058 log_news log_info

ELS config>display event ip.022
ELS config>remote event ip.022 log_news log_info

ELS config>display event gw.022
ELS config>remote event gw.22 log_news log_info

ELS config>display event arp.011
ELS config>remote event arp.011 log_user log_alert

ELS config>display event arp.002
ELS config>remote event arp.022 log_user log_alert

ELS config>list status
Subsystem:      SNMP
Disp levels:   ERROR INFO TRACE
Trap levels:   none
Trace levels:  none
Remote levels: ERROR INFO TRACE
               Syslog Facility/Level: LOG_NEWS LOG_INFO

Event   Display Trap   Trace   Remote
SRT.017 On      Unset   Unset   On
               Syslog Facility/Level: LOG_NEWS LOG_INFO
STP.016 On      Unset   Unset   On
               Syslog Facility/Level: LOG_NEWS LOG_INFO
STP.026 On      Unset   Unset   On
               Syslog Facility/Level: LOG_NEWS LOG_INFO
STP.024 On      Unset   Unset   On
               Syslog Facility/Level: LOG_NEWS LOG_INFO
IP.068  On      Unset   Unset   On
               Syslog Facility/Level: LOG_NEWS LOG_INFO
IP.058  On      Unset   Unset   On
               Syslog Facility/Level: LOG_NEWS LOG_INFO
IP.022  On      Unset   Unset   On
               Syslog Facility/Level: LOG_NEWS LOG_INFO
GW.022  On      Unset   Unset   On
               Syslog Facility/Level: LOG_NEWS LOG_INFO
ARP.011 On      Unset   Unset   On
               Syslog Facility/Level: LOG_USER LOG_ALERT
ARP.002 On      Unset   Unset   On
               Syslog Facility/Level: LOG_USER LOG_ALERT

```

Figure 8. Configuring Subsystems and Events for Remote Logging

Remote Logging Output

Figure 9 on page 136 shows a sample from the `/tmp/syslog_news_info` file. Notice that the first message has a sequence number of 310. This means that the first 309 ELS messages were not sent from the source 2216. There are several reasons for this:

- The remote-logging facility had not completed initialization when the messages were first passed to ELS

Using ELS

- A route from the source 2216 to the remote workstation was not in the routing table
- The interface for the outbound UDP packet containing the ELS messages was not in the “Up” state

Notice in **1** that messages 311-313 did not get remote-logged. This is because an ARP request was outstanding and until the ARP response is received, all but the first packet is dropped in the source 2216. Additionally, the ARP cache is cleared at a user-configured refresh rate, and a new ARP request is issued. To determine when this is occurring, you can remote log events ARP.002 and ARP.011 in addition to the primary ELS events of interest. Figure 11 on page 137 shows ARP events logged to the `syslog_user_alert` file that account for events 445 and 446, which were indicated as missing in Figure 9.

```
Nov 20 12:03:16 worksta01 root: THIS IS A TEST MESSAGE (news.info)
Nov 20 12:08:48 5.1.1.1 Msg [0310] from ** IBM / 2216 **: els: IP.022: add nt 192.9.200.0 int 192.9.200.20
nt 0 int Eth/0

1 ( messages 311, 312, and 313 did not get remote-logged due to ARP request outstanding - see
explanation in the text)

2 (messages 314 and 315 were logged to a separate
file - see explanation in the text)

Nov 20 12:08:48 5.1.1.1 Msg [0316] from ** IBM / 2216 **: els: IP.068: routing cache cleared
Nov 20 12:08:48 5.1.1.1 Msg [0317] from ** IBM / 2216 **: els: IP.022: add nt 5.0.0.0 int 5.1.1.1 nt 5 int Eth/4
Nov 20 12:08:48 5.1.1.1 Msg [0318] from ** IBM / 2216 **: els: SRT.017: Enabling SRT on port 5 nt 5 int Eth/4

(message 319 was logged to a separate file)

Nov 20 12:08:48 5.1.1.1 Msg [0320] from ** IBM / 2216 **: els: IP.068: routing cache cleared

(120 messages not shown)

Nov 20 12:13:33 5.1.1.1 Msg [0441] from ** IBM / 2216 **: els: GW.022: Nt fld slf tst nt 3 int Eth/3
Nov 20 12:13:33 5.1.1.1 Msg [0442] from ** IBM / 2216 **: els: GW.022: Nt fld slf tst nt 6 int Eth/5
Nov 20 12:13:38 5.1.1.1 Msg [0443] from ** IBM / 2216 **: els: GW.022: Nt fld slf tst nt 11 int ISDN/0

(messages 444 and 447 were logged to a separate file)

(messages 445 and 446 did not get remote-logged due to ARP request outstanding)

Nov 20 12:13:50 5.1.1.1 Msg [0448] from ** IBM / 2216 **: els: GW.022: Nt fld slf tst nt 4 int PPP/0
Nov 20 12:13:50 5.1.1.1 Msg [0449] from ** IBM / 2216 **: els: IP.068: routing cache cleared
Nov 20 12:13:50 5.1.1.1 Msg [0450] from ** IBM / 2216 **: els: IP.058: del nt 4.0.0.0 rt via 0.0.0.4 nt 4 int PPP/0
```

Figure 9. Sample Contents from Syslog News Info File

If the initial ELS messages that are generated during and immediately after booting are of particular interest, then it is recommended that these messages also be displayed in the monitor queue, which is viewed with talk 2. Figure 10 on page 137 shows the talk 2 output including the initial messages that did not get remote-logged. Note that there is a message in the talk 2 output that indicates that the remote-logging facility is available. This does not indicate that a route exists to the remote workstation, nor that the associated interface is in the “Up” state. It simply provides a reference point before which no messages can be successfully remote-logged.

Also notice that you can account for the messages that were missing (indicated in Figure 9 with **2**) in the talk 2 output.

```

12:08:17 SNMP.024: generic trc (P2) at snmp_mg.c(766): Now 0 trap destinations
12:08:17 SNMP.012: comm public added
12:08:17 SNMP.012: comm public added
12:08:27 SNMP.022: ext err (Z1) at snmp_resconf.c(322): add_router_if_info(): sr
rdrec failed

12:08:27 SNMP.022: ext err (Z1) at snmp_resconf.c(322): add_router_if_info(): sr
rdrec failed

12:08:27 SNMP.028: err (E2) at snmp_moh.c(1583) : Duplicate
12:08:27 SNMP.028: err (E2) at snmp_moh.c(1583) : Duplicate
12:08:28 GW.022: Nt fld slf tst nt 13 int PPP/3
12:08:28 IP.022: add nt 4.0.0.0 int 4.1.1.1 nt 4 int PPP/0

    ( 297 messages not shown )

12:08:43 GW.022: Nt fld slf tst nt 12 int PPP/2
12:08:43 GW.022: Nt fld slf tst nt 13 int PPP/3
12:08:48 IP.022: add nt 192.9.200.0 int 192.9.200.20 nt 0 int Eth/0
12:08:48 SRT.017: Enabling SRT on port 1 nt 0 int Eth/0
12:08:48 STP.016: Select as root TB-1, det topol chg
12:08:48 STP.026: Root TB-1, strt hello tmr
12:08:48 ARP.002: Pkt in 1 1 800 nt 0 int Eth/0
12:08:48 ARP.002: Pkt in 2 1 800 nt 0 int Eth/0
12:08:48 IP.068: routing cache cleared

    ( 126 messages not shown )

12:13:38 GW.022: Nt fld slf tst nt 11 int ISDN/0
12:13:47 ARP.011: Del ent 1 3 nt 0 int Eth/0
12:13:47 ARP.011: Del ent 1 3 nt 0 int Eth/0
12:13:47 ARP.002: Pkt in 1 1 800 nt 5 int Eth/4
12:13:47 ARP.002: Pkt in 2 1 800 nt 0 int Eth/0
12:13:50 GW.022: Nt fld slf tst nt 4 int PPP/0

    Corresponding Sequence
    Numbers in
    Remote-Logging Files :

    [0310] first message logged
    -- not logged (ARP request) --
    -- not logged (ARP request)--
    -- not logged (ARP request)--
    [0314]
    [0315]
    [0316]

    [0443]
    [0444]
    -- not logged (ARP request) --
    -- not logged (ARP request)--
    [0447]
    [0448]

```

Figure 10. Output from Talk 2

You can use the timestamp, which appears in both the remote-logging output file and the talk 2 output, to determine when the first ELS message is successfully remote-logged. To use the timestamp for this purpose, configure ELS such that the timestamp in the monitor queue displays the time-of-day.

Also notice in Figure 9 on page 136 that messages 311-313 did not get remote-logged. This is because an ARP request was outstanding and until the ARP response is received, all but the first packet is dropped in the source IBM 2216. The ARP cache is cleared at a user-configured refresh rate, and the device issues a new ARP request. To determine when ARP requests are occurring, events ARP.002 and ARP.011 can be remote-logged, in addition to the ELS events of interest. Figure 11 shows ARP events logged to the *syslog_user_alert* file that account for events 445 and 446, which were indicated as missing in Figure 9 on page 136 .

```

Nov 20 12:02:53 worksta01 root: THIS IS A TEST MESSAGE (user.alert)
Nov 20 12:08:48 5.1.1.1 Msg [0314] from ** IBM / 2216 **: els: ARP.002: Pkt in 1 1 800 nt 0 int Eth/0
Nov 20 12:08:48 5.1.1.1 Msg [0315] from ** IBM / 2216 **: els: ARP.002: Pkt in 2 1 800 nt 0 int Eth/0
Nov 20 12:08:48 5.1.1.1 Msg [0319] from ** IBM / 2216 **: els: ARP.002: Pkt in 2 1 800 nt 0 int Eth/0
Nov 20 12:13:47 5.1.1.1 Msg [0444] from ** IBM / 2216 **: els: ARP.011: Del ent 1 3 nt 0 int Eth/0
Nov 20 12:13:47 5.1.1.1 Msg [0447] from ** IBM / 2216 **: els: ARP.002: Pkt in 2 1 800 nt 0 int Eth/0

```

Figure 11. Sample Contents from Syslog_user_alert File

You can prevent the loss of ELS messages caused by this ARP sequence by establishing a static relationship between the IP address and the MAC address. The basic steps are outlined below and are illustrated in Figure 12 on page 138.

1. In talk 5, “ping” the remote workstation’s IP address
2. In talk 5, determine the interface (net) number used to send messages to the remote-workstation’s IP address
3. Use the net number from the previous step to determine the associated MAC address

Using ELS

4. In talk 6, add an ARP entry to establish a static IP address to MAC address relationship

```
*t 5
+p ip

IP>ping 192.9.200.1
PING 192.9.200.20 -> 192.9.200.1: 56 data bytes, ttl=64, every 1 sec.
56 data bytes from 192.9.200.1: icmp_seq=0. ttl=64. time=0. ms
----192.9.200.1 PING Statistics----
1 packets transmitted, 1 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms

IP>dump

  Type  Dest net          Mask          Cost   Age      Next hop(s)
  .
  Dir*  192.9.200.0      FFFFFFF0      1      102305   Eth/0
  .
IP>exit
+int

Net  Net'  Interface  Slot-Port          Self-Test  Self-Test  Maintenance
0    0     Eth/0     Slot: 1  Port: 1          Passed    Failed     Failed
                                1          0             0

+p arp
ARP>dump
Network number to dump [0]? 0
Hardware Address      IP Address      Refresh
02-60-8C-2D-69-5D   192.9.200.1    2

Ctrl-P
*t 6
config>p arp
ARP config>add entry
Interface Number [0]? 0
Protocol [IP]? IP
IP Address [0.0.0.0]? 192.9.200.1
Mac Address []? 02608C2D695D
ARP config> list entry

Mac address translation configuration

IF #      Prot #  Protocol -> Mac address
0         0      192.9.200.1 -> 02608C2D695D
ARP config>exit
Config>write

Ctrl-P

*reload
Are you sure you want to reload the gateway? (Yes or [No]): Yes

(after reload, static ARP entry is active)
```

Figure 12. Example of Setting Up a Static ARP Entry

Additional Considerations

ELS Messages Containing IP Addresses

ELS messages containing an IP address which matches the IP address of the remote workstation will not be remote-logged, even if configured for remote-logging, and may appear under talk 2. These messages are discarded instead of being remote-logged in order to prevent excessive UDP packets from being sent on the network.

Duplicate Logging

If a facility value is repeated in *syslog.conf*, for example:

```

user.debug      /tmp/syslog_user_debug
user.alert      /tmp/syslog_user_alert

```

The syslog daemon will log *user.debug* messages only to the */tmp/syslog_user_debug* file while *user.alert* messages will be logged to both the */tmp/syslog_user_debug* file and the */tmp/syslog_user_alert* file. This is consistent with the syslog design that logs the more severe conditions in multiple places.

To prevent this duplicate logging, it is recommended that different facility values be specified in the *syslog.conf* file. A total of 19 facility values are available.

Recurring Sequence Numbers in Syslog Output Files

Depending upon the configuration of your network, it is possible for duplicate UDP packets containing ELS messages to arrive at the remote host. It is also possible for the packets to arrive in a different order than they were transmitted. An example of this phenomenon is shown in Figure 13. Notice that the messages with sequence numbers 628 through 633 are logged twice. Also notice that after the first occurrence of sequence number 0630, sequence number 0629 occurs again, followed by the second occurrence of 0630.

```

Apr 01 10:48:33 0.0.0.0 Msg [0628] from: RA22: : els: IPX.018: SAP gen rply sent nt 5 int TKR/1, 1 pkts
Apr 01 10:48:33 0.0.0.0 Msg [0628] from: RA22: : els: IPX.018: SAP gen rply sent nt 5 int TKR/1, 1 pkts
Apr 01 10:49:08 0.0.0.0 Msg [0629] from: RA22: : els: IPX.037: RIP resp sent nt 0 int TKR/0, 1 pkts
Apr 01 10:49:08 0.0.0.0 Msg [0630] from: RA22: : els: IPX.018: SAP gen rply sent nt 0 int TKR/0, 1 pkts
Apr 01 10:49:08 0.0.0.0 Msg [0629] from: RA22: : els: IPX.037: RIP resp sent nt 0 int TKR/0, 1 pkts
Apr 01 10:49:08 0.0.0.0 Msg [0630] from: RA22: : els: IPX.018: SAP gen rply sent nt 0 int TKR/0, 1 pkts
Apr 01 10:49:33 0.0.0.0 Msg [0631] from: RA22: : els: IPX.037: RIP resp sent nt 5 int TKR/1, 1 pkts
Apr 01 10:49:33 0.0.0.0 Msg [0631] from: RA22: : els: IPX.037: RIP resp sent nt 5 int TKR/1, 1 pkts
Apr 01 10:49:33 0.0.0.0 Msg [0632] from: RA22: : els: IPX.018: SAP gen rply sent nt 5 int TKR/1, 1 pkts
Apr 01 10:49:33 0.0.0.0 Msg [0632] from: RA22: : els: IPX.018: SAP gen rply sent nt 5 int TKR/1, 1 pkts
Apr 01 10:50:08 0.0.0.0 Msg [0633] from: RA22: : els: IPX.037: RIP resp sent nt 0 int TKR/0, 1 pkts
Apr 01 10:50:08 0.0.0.0 Msg [0633] from: RA22: : els: IPX.037: RIP resp sent nt 0 int TKR/0, 1 pkts

```

Figure 13. Example of Recurring Sequence Numbers in Syslog Output

Because neither Syslog nor UDP has the ability to handle duplicate or out of sequence packets, it is important to recognize the possibility of duplicate sequence numbers occurring.

Using ELS Message Buffering

Message buffering is an advanced feature of ELS that can help you with problem determination. You can set up defaults that ELS will use for message buffering or change how messages are buffered while the router is operating. Message buffering can minimize the information lost because messages have wrapped in the default message buffers. Message buffering is accessible through the **advanced** configuration or monitoring command. It enables you to:

- Specify whether buffering is active.
- Specify what events are written to the message buffer.
- Stop buffering and free the memory allocated for buffering.
- Display the status of the message buffer.
- Specify an event that stops message buffering and what action the system takes when the event occurs.

Using ELS

- Send a formatted version of the buffer to a file at a remote server.
- View a specific number or all of the ELS messages in the buffer.
- Write the buffer to a hard drive if a hard drive is present.
- Read a file that contains a formatted ELS message buffer from the hard drive , if a hard drive is present.
- Send a file that contains a formatted ELS message buffer from the hard drive , if a hard drive is present.

For specifics about the commands, see “ELS Message Buffering Configuration Commands” on page 161 and “ELS Message Buffering Monitoring Commands” on page 188 .

Figure 14 on page 141 is an example of configuring ELS message buffering.

MOS Operator Control

*t 5 :Enter t 5 at the * prompt.

CGW Operator Console

+ev :Enter ev at the + prompt.

Event Logging System user console

ELS>a :Enter a for advanced at the ELS prompt.

Advanced ELS Console

ELS Advanced>li s :Enter li s to list status at the > prompt.

-----Advanced ELS Configuration-----

Logging Status: OFF Wrap Mode: ON Logging Buffer Size: 0 KB

Stop-Event: NONE Stop-String: NONE

Additional Stop-Action: NONE

-----Run-Time Status-----

Has Stop Condition Occurred? NO Messages currently in buffer: 0

ELS Advanced>s b :Enter s b to set buffer size.

Enter buffer size of 0 KB or between 148 and 593 KB 148 ?

Buffer size set to 148 KB

ELS Advanced>s s e gw.26 :Enter s s e to set stop event eg. gw.26

Stop Event "GW.026" has been set

ELS Advanced>ex :Enter ex to exit Advanced to list gw.26

ELS>list ev gw.26

Level: C-TRACE

Message: Mnt nt %n int %s/%d

Active: Count: 742

ELS>a :Enter a to get back to advanced.

Advanced ELS Console

ELS Advanced>s s s Mnt nt 5 :Enter s s s to set the stop string.

Stop String set to "Mnt nt 5"

ELS Advanced>s s a ? :Enter s s a ? to query available stop actions.

NONE

APPN-DUMP :Only available if APPN active and in the load image.

SYSTEM-DUMP

ELS Advanced>s s a s :Enter s s a s to set SYSTEM-DUMP stop action.

Stop Action has been set to SYSTEM-DUMP

ELS Advanced>s w off to :Enter s w on to set wrap mode off.

Advanced Wrap Mode set to OFF.

ELS Advanced>log sub gw all :Enter to enable the whole gw subsystem

ELS Advanced>s l on :Enter s l on to start the logging process.

Advanced Logging set to ON.

ELS Advanced>li s :Enter to list status of logging.

-----Advanced ELS Configuration-----

Logging Status: OFF Wrap Mode: OFF Logging Buffer Size: 148 KB

Stop-Event: GW.026 Stop-String: Mnt nt 5

Additional Stop-Action: SYSTEM-DUMP

-----Run-Time Status-----

Has Stop Condition Occurred? YES Messages currently in buffer: 7

ELS Advanced>v a n :Enter to view all messages in buffer. For this trivial example any viewing command suffices.

```

1 10:52:10 GW.026: Mnt nt 0 int Eth/0
2 10:52:10 GW.026: Mnt nt 5 int Eth/1->This triggers stop action
3 10:52:14 GW.026: Mnt nt 0 int Eth/0 Note that 5 more events
4 10:52:14 GW.026: Mnt nt 5 int Eth/1 get logged before
5 10:52:18 GW.026: Mnt nt 0 int Eth/0 logging stops and
6 10:52:18 GW.026: Mnt nt 5 int Eth/1 the stop action occurs.
7 10:52:22 GW.026: Mnt nt 0 int Eth/0

```

Bughlt: Dump initiated by ELS Stop Action.

BUGHLT+80; Dump initiated by ELS Stop Action.

Note:

In reality if the stop action is the SYSTEM-DUMP you will not be able to list the final status as above nor view the buffer because

Chapter 13. Configuring and Monitoring the Event Logging System (ELS)

This chapter describes how to configure events logged by ELS and how to use the ELS commands. The information includes the following sections:

- “Accessing the ELS Configuration Environment”
- “ELS Configuration Commands”
- “Entering and Exiting the ELS Operating Environment” on page 164
- “ELS Monitoring Commands” on page 165

For more information on the Event Logging System and how to interpret ELS event messages, refer to “Chapter 12. Using the Event Logging System (ELS)” on page 123.

Accessing the ELS Configuration Environment

The ELS configuration environment is characterized by the ELS `config>` prompt. Commands entered at this prompt are described “Chapter 13. Configuring and Monitoring the Event Logging System (ELS)”.

To enter the ELS configuration environment:

1. Enter **talk 6**.

The monitoring displays the `Config>` prompt. If the prompt does not appear, press **Return**.

2. At the `Config>` prompt, enter the following command to access ELS:

```
event
```

The monitoring displays the ELS configuration prompt (`ELS config>`). Now, you can enter ELS configuration commands.

To leave the ELS configuration environment, enter the **exit** command.

ELS Configuration Commands

Table 15 summarizes the ELS configuration commands. The remainder of this section describes each one in detail. After accessing the ELS configuration environment, you can enter ELS Configuration commands at the ELS `Config>` prompt.

Table 15. ELS Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Add	Adds an event to an existing group or creates a new group.
Advanced	Places you in the advanced configuration environment in which you can configure message buffering.
Clear	Clears all ELS configuration information.
Default	Resets the display or trap setting of an event, group, or subsystem.

ELS Configuration Commands (Talk 6)

Table 15. ELS Configuration Command Summary (continued)

Command	Function
Delete	Deletes an event number from an existing group or deletes an entire group.
Display	Enables message display on the console monitor.
Filter	Filter ELS messages based upon the net number.
List	Lists information on ELS settings and messages.
Nodisplay	Disables message display on the console.
Noremote	Disables remote logging to a remote workstation.
Notrace	Controls disablement of packet trace events.
Notrap	Keeps messages from being sent out in SNMP traps.
Remote	Allows messages to be logged to a remote workstation.
Set	Sets the pin parameter and the timestamp feature options.
Trace	Controls enablement of packet trace events.
Trap	Allows messages to be sent to a network management workstation in SNMP traps.
View	Allows viewing of traced packets.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Add

Use the **add** command to add an individual event to an existing group or to create a new group. Group names must start with a letter and are case sensitive. You cannot append an entire subsystem to a group.

Syntax:

add *group_name subsystem.event_number*

Note: If the specified group does not exist, the following prompt asks you to confirm the creation of a new group:

Group not found. Create new group? (yes or no)

Advanced

Use the **advanced** command to enter the advanced configuration environment. In this environment you configure message buffering.

Syntax:

advanced

Clear

Use the **clear** command to clear all of the ELS configuration information.

Syntax:

clear

Example:

clear

You are about to clear all ELS configuration information
Are you sure you want to do this (Yes or No):

Default

Resets the display or trap setting of an event, group, or subsystem back to a disabled state.

Syntax:

```
default                display
                        trap
                        remote
```

display *event OR group OR subsystem*

Controls the output of the display of messages to the monitoring.

trap *event OR group OR subsystem*

Controls the generation of traps to the network management station.

remote *event OR group OR subsystem*

Controls the generation of traps to the remote station.

Delete

Use the **delete** command to delete an event number from an existing group or to delete the entire group. If the specified event is the last event to be deleted in a group, you will be notified. If *all* is specified instead of *subsystem.event_number*, a prompt asks you to confirm the deletion of the entire group.

Syntax:

```
delete                group_name subsystem.event_number
```

Display

Use the **display** command to enable message displaying on the monitoring monitor for specific events, a range of events for a subsystem, groups, or subsystems.

Syntax:

```
display                event . . .
                        group . . .
                        range . . .
                        subsystem . . .
```

event *subsystem.event#*

Displays messages of the specified event (*subsystem.event#*).

group *groupname*

Displays messages of a specified group (*groupname*).

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event in the specified event range.

Displays a range of messages for the specified subsystem.

Example:

ELS Configuration Commands (Talk 6)

```
display range gw 19 22
```

Displays events gw.19, gw.20, gw.21, and gw.22.

subsystem *subsystemname*

Displays messages associated with the specified subsystem. To find out which subsystems are on the router, type **list subsystems**.

Note: Although ELS supports all subsystems on the router, not all devices support all subsystems. See *Event Logging System Messages Guide* for a list of currently supported subsystems.

Filter

Use the **filter** command to access the filter configuration command environment. See “ELS Net Filter Configuration Commands” on page 158 for complete command details.

Syntax:

```
filter net
```

List

Use the **list** command to get updated information regarding ELS settings and listings of selected messages.

Syntax:

```
list all  
filter-status  
groups  
pin  
remote-log status  
status  
subsystem . . .  
subsystems all  
trace-status
```

all Lists information from all the **list** categories.

filter-status

Lists ELS net number filters.

groups

Lists the user-defined group names and contents.

pin

Lists the current number of ELS event messages sent in SNMP traps (per second).

remote-log status

Lists the current values of remote logging options.

Example:

ELS Configuration Commands (Talk 6)

list r

```
Remote Logging is ON
Source IP Address = 192.67.38.2
Remote Log IP Address = 192.9.200.1
Default Syslog Facility = LOG_DAEMON
Default Syslog Priority Level = LOG_CRIT
Number of Messages in Remote Log = 256
Remote Logging Local ID = MYHOSTNAME
```

status Lists the subsystems, groups, and events that have been modified by the **display**, **nodisplay**, **trap**, **notrap**, **trace**, **notrace**, **remote**, and **noremove** commands.

Example:

list status

```
Subsystem:          TKR
Disp Levels:        STANDARD
Trap levels:         none
Trace levels:        none
Remote levels:       ERROR INFO TRACE
Syslog Facility/Level: LOG_USER LOG_INFO

Group      Disp  Trap  Trace  Remote
Mygroup    Unset Unset Unset   On
                        Syslog Facility/Level: LOG_DAEMON LOG_CRIT

Event      Disp  Trap  Trace  Remote
IP.007     Unset Unset Unset   On
                        Syslog Facility/Level: LOG_CRON LOG_NOTICE
```

Note: Not only is remote logging enabled, but the display includes the Syslog Facility/Level values for each subsystem, group, and event. Ranges of events are listed as individual events.

subsystem

Lists names, events, and descriptions of all subsystems.

(Example output from a **list subsystem** command can be found beginning on page 169.)

subsystem *subsystem*

Lists all events in a specified subsystem.

Example:

list subsystem gw

Event	Level	Message
GW.001	ALWAYS	Copyright 1984 Mass Institute of Technology
GW.002	ALWAYS	Portable CGW %s Rel %s strtd
GW.003	ALWAYS	Unus pkt len %d nt %d int %s/%d
GW.004	ALWAYS	Sys %s q adv alloc %d excd %d
GW.005	ALWAYS	Bffrs: %d avail %d idle fair %d low %d
GW.006	C-INFO	Pkt frm nt %d int %s/%d for uninit prt, disc
GW.007	C-INFO	Ip err %x nt %d int %s/%d
GW.008	U-INFO	Ip ovfl nt %d int %s/%d, disc
GW.009	UI-ERROR	Nt dwn ip rstrt nt %d int %s/%d
GW.010	UI-ERROR	Ip q len %d no ip buf nt %d int %s/%d
GW.011	U-INFO	Op err %x hst %wo nt %d int %s/%d
GW.012	U-INFO	Op err cnt excd hst %wo nt %d int %s/%d
GW.013	U-INFO	Rtrns cnt excd hst %wo nt %d int %s/%d
GW.014	UI-ERROR	Nt dwn op rstrt nt %d int %s/%d
GW.015	UI-ERROR	Nt dwn to hst %wo nt %d int %s/%d
GW.016	U-INFO	Op ovfl to hst %wo nt %d int %s/%d
GW.017	UE-ERROR	Intfc hdw mssng nt %d int %s/%d
GW.018	U-TRACE	Strt nt slf tst nt %d int %s/%d
GW.019	C-INFO	Slf tst nt %d int %s/%d
GW.020	U-TRACE	Nt pss slf tst nt %d int %s/%d
GW.021	UE-ERROR	Nt up nt %d int %s/%d
GW.022	U-TRACE	Nt fld slf tst nt %d int %s/%d

subsystems all

Lists all events in all subsystems.

ELS Configuration Commands (Talk 6)

trace-status

Displays information on the status of packet tracing, including configuration and run-time information.

Example:

```
list trace-status
```

```
----- Configuration -----  
Trace Status:ON  Wrap Mode:ON  Decode Packets:ON  HD Shadowing:ON  
RAM Trace Buffer Size:100000  Maximum Trace Buffer File Size:10000000  
Max Packet Bytes Trace:256  Default Packet Bytes Traced:100  
Trace File Record Size:2048  Stop Trace Event: TCP.013  
Maximum Hours to HD Shadow: 1
```

Nodisplay

Use the **nodisplay** command to select and turn off messages displaying on the console.

Syntax:

```
nodisplay      event. . .  
                group . . .  
                range . . .  
                subsystem . . .
```

event *subsystem.event#*

Suppresses the displaying of a specified event (*subsystem.event#*).

group *groupname*

Suppresses the displaying of messages that were previously added to the specified group (*groupname*).

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Suppresses the displaying of a range of messages for the specified subsystem.

Example:

```
nodisplay range gw 19 22
```

Suppresses the display of events gw.19, gw.20, gw.21, and gw.22.

subsystem *subsystemname*

Suppresses the displaying of messages associated with the specified subsystem.

Noremote

Use the **noremote** command to suppress the logging of events to a remote workstation based on event number, group, range of events, or subsystem.

Note: With the **noremote** command, there is usually no need to specify a *syslog_facility* and *syslog_level*, such as there is with the **remote** command. However, for **noremote subsystem** command, there exists the option of selectively suppressing specific message levels (for example, “error” only or “trace” only) rather than turning them all off. (If you do not specify any

ELS Configuration Commands (Talk 6)

particular message level, “all” is assumed). Additionally, with the **noremove subsystem** command, you can set a *syslog_facility* and *syslog_level* for any remaining message levels that have not been turned off.

Syntax:

noremove *event* . . .
group . . .
range . . .
subsystem . . .

event *subsystem.event#*

Suppresses the remote logging of messages for the specified event.

group *group.name*

Suppresses the remote logging of messages that were previously added to the specified group (*group.name*).

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Suppresses the remote logging of a range of messages for the specified subsystem.

Example:

```
noremove range gw 19 22
```

Suppresses the remote logging of events gw.019, gw.020, gw.021, and gw.022

subsystem *subsystem.name [syslog_facility syslog_level]*

Suppresses the remote logging of messages associated with the specified subsystem (*subsystem.name*).

Example 1:

```
noremove subsystem tkr
```

Suppresses the remote logging of all “tkr” messages.

Example 2:

```
ELS config> noremove subsystem tkr info
ELS config> SYSLOG FACILITY[LOG_USER]?
ELS config> SYSLOG LEVEL[LOG_INFO]?
```

In this example, “LOG_USER” and “LOG_INFO” were the values last picked for subsystem TKR. The command specified turns off the remote logging for subsystem TKR only for messages coded for “info”. Because *syslog_facility* and *syslog_level* was not specified, the software prompts for *syslog_facility* and *syslog_level*. If you enter another value at the prompts, that value will replace *syslog_facility* and *syslog_level* for the remaining remote-logged messages for the TKR subsystem.

Use the **list all** or **list status** commands to display what you have set with the **noremove** and **remove** commands.

For more information about *syslog_facility* and *syslog_level* see “Remote” on page 151 .

ELS Configuration Commands (Talk 6)

Notrace

Disables packet trace for the specified event/range/subsystem/group.

Syntax:

```
notrace                event . . .  
                        group . . .  
                        range . . .  
                        subsystem . . .
```

event *subsystem.event#*

Suppresses the sending of packet trace data for the specified event#

group *groupname*

Suppresses the sending of packet trace data that was previously added to the specified group (*groupname*).

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Disables the sending of packet trace data for a range of messages for the specified subsystem.

Example:

```
trace range gw 19 22
```

Suppresses the sending of packet trace data for events gw.19, gw.20, gw.21, and gw.22.

subsystem *subsystemname*

Suppresses the sending of packet trace data for the specified subsystem (*subsystemname*).

Notrap

Use the **notrap** command to select and turn off messages so that they are no longer sent to a network management workstation in SNMP traps.

Syntax:

```
notrap                event . . .  
                        group . . .  
                        range . . .  
                        subsystem . . .
```

event *subsystem.event#*

Suppresses the sending of the specified message in an SNMP trap (*subsystem.event#*).

group *groupname*

Suppresses the sending of messages in SNMP traps that were previously added to the specified group (*groupname*).

range *subsystemname first_event_number last_event_number*

ELS Configuration Commands (Talk 6)

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Suppresses the sending of messages for the events in the specified range for the specified subsystem in SNMP traps.

Example:

```
notrap range gw 19 22
```

Suppresses the sending of messages for events gw.19, gw.20, gw.21, and gw.22 in SNMP traps.

subsystem *subsystemname*

Suppresses the sending of messages in SNMP traps that are associated with the specified subsystem.

Remote

Use the **remote** command to select the events to be logged to a remote workstation by event number, range of events, group, or subsystem.

Syntax:

```
remote          event . . .  
                  range . . .  
                  group . . .  
                  subsystem . . .
```

event *subsystem.event# syslog_facility syslog_level*

Causes the specified event to be logged remotely.

Syslog facility and level values are used by the syslog daemon in the remote workstation to determine where to log the messages. This value overrides the default values that are set with the **set facility** and **set level** commands.

syslog_facility

```
log_auth  
log_authpriv  
log_cron  
log_daemon  
log_kern  
log_lpr  
log_mail  
log_news  
log_syslog  
log_user  
log_uucp  
log_local0-7
```

syslog_level

```
log_emerg  
log_alert
```

ELS Configuration Commands (Talk 6)

log_crit
log_err
log_warning
log_notice
log_info
log_debug

These values do NOT have any particular association with any daemons on the IBM 2216. They are merely identifiers which are used by the syslog daemon on the remote workstation.

range *subsystemname first_event_number last_event_number syslog_facility syslog_level*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Causes the events in the specified range for the specified subsystem to be remotely logged based on the *syslog_facility* and *syslog_level* values. See “the remote event command” on page 151.

Example:

```
remote range gw 19 22 log_user log_info
```

Causes the event gw.19, gw.20, gw.21, and gw.22 to be logged remotely on the *syslog_facility* value of log_user and the *syslog_level* value of log_info.

group *group.name syslog_facility syslog_level*

Allows events belonging to the specified group to be logged remotely based on the *syslog_facility* and *syslog_level* values. See “the remote event command” on page 151.

subsystem *subsystem.name message_level syslog_facility syslog_level*

Where *subsystem.name* is the name of the subsystem and *message_level* is the level of messages selected in the subsystem.

Causes the events within the specified *subsystem.name* whose *message_level* agrees with the specified *message_level* to be logged remotely at the files based on the *syslog_facility* and *syslog_level* values. See “the remote event command” on page 151.

Message_level is a value such as “ALL,” “ERROR,” “INFO,” or “TRACE” . See “Logging Level” on page 125. The value specified in the **remote** command must agree with the value as coded on the particular event within the subsystem, or that event within the subsystem will not be remotely logged.

Example:

```
remote subsystem TKR all log_user log_info
```

In the above example, all messages in subsystem TKR (“all” includes any messages coded for “error,” “info,” or “trace”) will be logged remotely based on log_user and log_info values at the remote host.

Use the **list all** or **list status** commands to display what you have set with the **noremove** and **remote** commands.

Set

Use the **set** command to set the maximum number of tags per second, the timestamp feature, or to set tracing options.

Syntax:

```
set                pin . . .
                    remote-logging . . .
                    timestamp . . .
                    trace . . .
```

pin *max_traps*

Use the **set pin** command to set the pin parameter to the maximum number of traps that can be sent on a per-second basis. Internally, the pin resets every tenth of a second. (One tenth of the number (*max_traps*) is sent every tenth of a second.)

remote-logging

Use the **set remote-logging** command to configure remote logging options. When these options are configured from the monitoring environment, the changes take effect immediately, and return to their previously configured settings when the device is rebooted.

Syntax:

```
set remote-logging  on
                    off
                    facility . . .
                    level . . .
                    no-msgs
                    remote_ip_addr . . .
                    source_ip_addr ...
                    local_id
```

on Turns remote logging on. Remote logging is now enabled to allow any messages selected by the **remote** command to be actively logged.

off Turns remote logging off. All messages selected by the 'remote' command will be prevented from being logged.

facility

Specifies a value that, in combination with the *level* value, is used by the syslog daemon in the remote workstation to determine where to log messages. This value is used for all remotely-logged ELS messages unless you specify a different value for a particular ELS event, range, group, or subsystem with the **remote** command.

These are all possible syslog facility values:

```
log_auth
log_authpriv
log_cron
log_daemon
```

ELS Configuration Commands (Talk 6)

log_kern
log_lpr
log_mail
log_news
log_syslog
log_user
log_uucp
log_local0-7

level Specifies a value that, in conjunction with the *facility* value, is used by the syslog daemon in the remote workstation to determine where to log messages. This value is used for all remotely-logged ELS messages unless you specify a different value for a particular ELS event, range, group, or subsystem with the **remote** command.

These are all possible syslog level values:

log_emerg
log_alert
log_crit
log_err
log_warning
log_notice
log_info
log_debug

no-msgs

Specifies the number of messages in the buffer for the remote log before log wraps.

remote_ip_addr

This is an ip address of the form xxx.xxx.xxx.xxx where xxx can be any integer 0 to 255. It represents the ip address of the remote host where the log files reside.

source_ip_addr

This is an ip address of the form xxx.xxx.xxx.xxx where xxx can be any integer 0 to 255.

You should use an IP address that is configured in the 2216 for easier identification when the IP address or the hostname is shown in the remotely-logged ELS message. You should also verify that this IP address is quickly resolved to a hostname by the name server, or at least that the name server responds quickly with "address not found."

To determine that the IP address resolves properly enter the **host** command on your workstation as shown:

```
workstation>host 5.1.1.1  
host: address 5.1.1.1 NOT FOUND  
workstation>
```

If the response takes more than 1 second, select an IP address that resolves more quickly.

local_id

This is any character string of up to 32 characters, which is

ELS Configuration Commands (Talk 6)

included in the logged message at the remote file and can help identify which machine logged the message.

timestamp [**timeofday** or **uptime** or **off**]

Allows you to turn on message timestamping so that either the time of day or uptime (number of hours, minutes, and seconds, but no date, since the router was last initialized) appears next to each message. Set timestamp can also be turned off.

Use the **set timestamp** command to enable one of the following timestamp options.

timeofday

Adds an HH:MM:SS prefix to each ELS message indicating the time of the occurrence during a 24-hour day.

uptime

Adds an HH:MM:SS prefix to each ELS message indicating the time of the occurrence during a 100-hour cycle. After 100 hours of uptime, the uptime counter returns to zero to begin another 100-hour cycle.

off Turns off the ELS timestamp prefix.

trace Use the **set trace** command to configure tracing options. If you configure tracing options from the monitoring environment, the changes take effect immediately. They return to their previously configured settings when the device is rebooted.

Note: Tracing should be used only under the direction of trained support personnel. Tracing, especially when used with disk-shadowing enabled, uses device resources and can impact overall performance and throughput.

Syntax:

set trace decode
default-bytes-per-pkt
disk-shadowing
max-bytes-per-pkt
memory-trace-buffer-size
off
on
reset
stop-event
wrap-mode

decode *off/on*

Turns packet decoding on or off. Packet decoding is not supported by all components.

default-bytes-per-pkt *bytes*

Sets the default number of bytes traced. This value is used if a value is not specified by the component doing the tracing.

ELS Configuration Commands (Talk 6)

disk-shadowing [[off or on] or record-size or time-limit or delete-file or max-file-size]

Turns disk shadowing on or off, sets the maximum trace file size, or sets the maximum time for disk-shadowing traces.

[off or on]

Turns disk shadowing on or off. If disk shadowing is enabled, trace records are copied to the hard disk. Once a traced record is copied to the hard disk, it can no longer be viewed from the monitoring.

Note: Disk shadowing should be set to OFF whenever the WRITE, TFTP software, RETRIEVE system dump, or COPY software commands are issued.

disk-shadowing delete-file

Deletes the trace file.

disk-shadowing max-file-size *Mbytes*

Sets the maximum file size for the trace file.

Valid Values: 1 Mbyte to 16 Mbytes

Default Value: 10 Mbytes

disk-shadowing record-size *bytes*

Sets the record size for trace file records:

Valid Values 1024, 2048, or 4096 bytes

Default 2048 bytes

Notes:

1. If a trace file already exists, "Cannot change Record Size without first deleting the existing Trace File" is displayed and record size is not changed.
2. If you configure a record size and a trace file already exists, the trace will use the record size of the existing file.

disk-shadowing time-limit *hours*

Sets the maximum time for disk-shadowing of traces:

Valid Values 1 - 72 hours

Default 24 hours

Note: Disk shadowing stops (tracing continues) after this time has elapsed. The actual time is reset to 0 when disk shadowing is turned on again.

max-bytes-per-pkt *bytes*

Sets the maximum number of bytes traced for each packet.

memory-trace-buffer-size *bytes*

Sets the size, in bytes, of the RAM trace buffer.

Valid Values: 0, $\geq 10,000$

Default Value: 0

off Disables packet tracing.

on Enables packet tracing.

ELS Configuration Commands (Talk 6)

reset Clears the trace buffer and resets all associated counters.

stop-event *event id*

Stops tracing when an event (event id) occurs. Enter either an ELS event id (for example: TCP.013) or "None". "None" is the default. Tracing stops only if the display of the particular ELS event is enabled.

When a stop-event occurs, an entry is written to the trace buffer. The **view** command for this trace entry will display "Tracing stopped due to ELS Event Id: TCP.013".

After tracing stops due to a stop-event, you must re-enable tracing with the **set trace on** command. (A restart will also re-enable tracing if enabled from the ELS Config> prompt.)

wrap-mode [**off** or **on**]

Turns the trace buffer wrap mode on or off. If wrap mode is on and the trace buffer is full, previous trace records will be overwritten by new trace records as necessary to continue tracing.

Trace

Enables packet trace for the specified event/range/subsystem/group. When the **trace** command is used from the ELS Config> prompt, the changes become part of the configuration, and a reboot is required to activate the changes.

Syntax:

```
trace                event . . .  
                    group . . .  
                    range . . .  
                    subsystem . . .
```

event *subsystem.event#*

Causes the specified trace event (*subsystem.event#*) to be displayed on the system monitoring.

group *groupname*

Allows trace events that were previously added to the specified group to be displayed on the router monitoring.

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Causes the trace events in the specified range for the specified subsystem to be displayed on the system monitoring.

Example:

```
trace range gw 19 22
```

Causes the trace events gw.19, gw.20, gw.21, and gw.22 to be displayed on the system monitoring.

ELS Configuration Commands (Talk 6)

subsystem *subsystemname*

Allows trace events associated with the specified subsystem to be displayed on the router monitoring.

Trap

Use the **trap** command to select the message to be sent to the remote SNMP network management workstation. A remote SNMP network management workstation is an IP host in the network acting as an SNMP manager.

Syntax:

```
trap                event . . .  
                    group . . .  
                    range . . .  
                    subsystem . . .
```

event *subsystem.event#*

Causes the specified message (*subsystem.event#*) to be sent to a network management workstation in an SNMP trap.

group *groupname*

Allows messages that were previously added to the specified group to be sent to a network management workstation in an SNMP trap.

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Causes the messages that are in the specified range for the specified subsystem to be sent to a network management workstation in an SNMP trap.

Example:

```
trap range gw 19 22
```

Causes the messages in events gw.19, gw.20, gw.21, and gw.22 to be sent to a network management workstation in an SNMP trap.

subsystem *subsystemname*

Allows messages associated with the specified subsystem to be sent to a management station in an SNMP trap.

Note: Messages for the IP, ICMP, ARP and UDP subsystems cannot be sent in SNMP traps because these areas are or may be used in the process of sending the SNMP trap. This could lead to an infinite loop of traffic putting an undue strain on the router.

ELS Net Filter Configuration Commands

ELS net filters give you the capability of looking only at ELS messages with certain net numbers and discarding other ELS messages.

When you create a filter, you specify the subsystem, event, or range of events to which the filter applies. You also specify the queue (for example, "DISPLAY",

ELS Configuration Commands (Talk 6)

“TRAP”, “TRACE”, or “REMOTE-LOGGING”). Finally, you specify the net number (or range of net numbers) that you want to filter.

When you enable the filter, messages that have been turned on by the ELS commands are subject to filtering. The filter allows only messages with the specified net numbers. The filter causes the device to discard messages that do not contain the specified net numbers.

By reducing the number of ELS messages sent, you can more easily locate messages for the interfaces in which you are interested.

This section describes the commands to configure the ELS net filters. To configure these filters, enter the **filter net** command at the ELS> prompt. Then, enter the configuration commands at the ELS Filter net> prompt.

Table 16. ELS Net Filter Configuration Commands

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Create	Creates a filter and assigns it a number. A maximum of 64 filters is allowed.
Delete	Deletes a specified filter number or all filters.
Disable	Disables a specified filter number or all filters.
Enable	Enables a specified filter number or all filters.
List	Lists a specified filter number or all filters.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Create

Use the **create** command to create an ELS net filter.

Syntax:

```
create queue                event event_name net#_start net#_end  
                             _range event_range net#_start net#_end  
                             subsystem subsystem_name net#_start net#_end
```

queue The queue for which you are setting the filter. The valid queues are:

- Display
- Trace
- Trap
- Remote

event *event_name net#_start net#_end*

Specifies the event and net numbers that you are filtering.

If you specify *net#_start* and *net#_end* as the same number, you are filtering on a single net number.

The command **create trap event GW.009 2 10** filters traps for message GW.009 for net numbers 2 through 10.

range *event_range net#_start net#_end*

Specifies the range of ELS messages and net numbers that you are filtering.

ELS Configuration Commands (Talk 6)

If you specify *net#_start* and *net#_end* as the same number, you are filtering on a single net number.

The command **create remote range ipx 19 22 3 6** filters all ipx messages beginning with IPX.019 and ending with IPX.022 for net numbers 3 through 6 for remote logging.

subsystem *subsystem_name net#_start net#_end*

Specifies the subsystem and net numbers that you are filtering.

If you specify *net#_start* and *net#_end* as the same number, you are filtering on a single net number.

The command **create display subsys ip 1 1**, filters all ELS messages for the ip subsystem that contain net number 1 to the display. All other ip subsystem messages are discarded.

Delete

Use the **delete** command to delete a specific ELS filter or all ELS filters.

Syntax:

```
delete                all
                        filter filter#
```

all Deletes all currently configured filters.

filter *filter#*

Deletes the filter specified by *filter#*. Use the **list** command to obtain the number for the filter you want to delete.

Disable

Use the **disable** command to disable a specific ELS filter or all ELS filters.

Syntax:

```
disable               all
                        filter filter#
```

all Disables all currently configured filters.

filter *filter#*

Disables the filter specified by *filter#*. Use the **list** command to obtain the number for the filter you want to disable.

Enable

Use the **enable** command to enable a specific ELS filter or all ELS filters.

Syntax:

```
enable                all
                        filter filter#
```

all Enables all currently configured filters.

filter *filter#*

Enables the filter specified by *filter#*. Use the **list** command to obtain the number for the filter you want to enable.

List

Use the **list** command to list a specific ELS filter or all ELS filters.

Syntax:

```
list                all
                    filter filter#

all                Lists all currently configured filters.
filter             Lists the filter specified by filter#.
```

ELS Message Buffering Configuration Commands

Table 17 describes the commands available at the ELS Config Advanced> prompt.

Table 17. ELS Message Buffering Configuration Commands

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Displays the configuration settings for message buffering.
Log	Enables logging of selected messages to the message buffer.
Nolog	Turns off logging of selected messages to the message buffer.
Set	Sets the size of the message buffer, the wrapping mode, whether logging occurs, which event will end message buffering, and what the system does when message buffering is stopped by an event.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

List

Use the **list** command to list the ELS message buffering configuration.

Syntax:

```
list                status
```

Example:

```
ELS Config Advanced> list status
-----Configuration-----
Logging Status:  OFF   Wrap Mode:  ON   Logging Buffer Size:  8500   Kbytes
Stop-Event:     APPN.2   Stop-String:  netdn for intf 6
Additional Stop-Action:  NONE
```

See “Set” on page 163 for a description of the commands that change the values in the display.

Log

Use the **log** command to select which messages will be logged to the message buffer.

Syntax:

```
log                event
                    group
```

ELS Configuration Commands (Talk 6)

range

subsystem

event *subsystem.event#*

Causes the specified message (*subsystem.event#*) to be logged to the message buffer.

group *groupname*

Allows messages that were previously added to the specified group to be logged to the message buffer.

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Causes the messages that are in the specified range for the specified subsystem to be logged to the message buffer.

Example:

```
log range gw 19 22
```

Causes the messages in events gw.19, gw.20, gw.21, and gw.22 to be logged to the message buffer.

subsystem *subsystemname*

Allows messages associated with the specified subsystem to be logged to the message buffer.

Nolog

Use the **nolog** command to remove messages from the defined list of messages that are logged to the message buffer.

Syntax:

nolog

event

group

range

subsystem

event *subsystem.event#*

Causes the specified message (*subsystem.event#*) not to be logged to the message buffer.

group *groupname*

Allows messages that were previously added to the specified group not to be logged to the message buffer.

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Causes the messages that are in the specified range for the specified subsystem not to be logged to the message buffer.

Example:

```
log range gw 19 22
```

ELS Configuration Commands (Talk 6)

Causes the messages in events gw.19, gw.20, gw.21, and gw.22 not to be logged to the message buffer.

subsystem *subsystemname*

Allows messages associated with the specified subsystem not to be logged to the message buffer.

Set

Use the **set** command to configure various ELS message buffering options.

Syntax:

```
set                buffer-size Kbytes  
                   logging [on or off]  
                   stop action . . .  
                   stop event subsystem.event#  
                   stop string text  
                   wrap on or off]
```

buffer-size *Kbytes*

Specifies the size, in kilobytes, of the message buffer that the system should allocate. The **mem** command displays this memory as “Never Alloc.” Setting this value too high could prevent the router from operating correctly after a reboot because of insufficient memory for protocols and features.

Valid values: 0 KB to 80% of the memory available on the router.

Default value: 0 (no message buffering)

Note: You must allocate a buffer with this command before you can set logging on.

logging [on or off]

Specifies whether message buffering will occur. This command will not take affect until you allocate a buffer using the **set buffer-size** command. The default is off.

stop action [appn-dump or disk-offload or none or system-dump]

Specifies the additional action the system takes when the “stop event” (and if specified, the “stop string”) occurs. The actions are:

appn-dump

Dumps the APPN protocol, if it is active. The APPN dump will indicate that the dump was taken as the result of a stop action.

disk-offload

Writes a formatted version of the buffer to a file on the hard drive . If the file already exists, the new file replaces it. You can then use the **tftp file** monitoring command to send the file to a remote host.

none No other action is taken after logging stops.

system-dump

Dumps the entire system. The system dump will indicate that the dump was taken as the result of a stop action.

Default value: none

ELS Configuration Commands (Talk 6)

stop event [*subsystem.event#* or **none**]

Specifies the event (*subsystem.event#*) that stops logging. If you have specified a stop string, the text in the stop string must also match. When the stop event occurs:

1. The next five ELS messages are logged.
2. Logging stops.
3. The system performs the specified “stop action.”

Logging remains stopped until the next time you issue the **set logging on** command or reboot the router.

If you do not specify the stop event when you enter the command, the system prompts you to enter the stop event. Specifying **none** disables the stop event function.

Default value: none

stop string *text* or **none**

Specifies the string to be used in conjunction with the “stop event” to stop logging. If you have not specified a stop event, the system ignores the “stop string.”

Text can be any ASCII string up to 32 characters in length. If you do not specify *text* when you enter the command, the system will prompt you for the string. Entering **none** clears the “stop string.”

Default value: none

wrap [**on** or **off**]

Specifies whether to stop the log when the buffer is full (off) or to log the new messages at the beginning of the buffer (on).

Default value: off

Entering and Exiting the ELS Operating Environment

The ELS monitoring environment (available from the GWCON process) is characterized by the ELS> prompt. Commands entered at this prompt modify the current ELS parameter settings. These commands are described “Chapter 13. Configuring and Monitoring the Event Logging System (ELS)” on page 143.

To enter the ELS monitoring environment from OPCON:

1. Enter the **talk 5** command.

* ta1k 5

The monitoring displays the GWCON prompt (+). If the prompt does not appear when you first enter GWCON, press **Return**.

2. At the GWCON prompt, enter the following command to access ELS:

+ event

The monitoring displays the ELS monitoring prompt (ELS>). Now, you can enter ELS monitoring commands.

To leave the ELS monitoring environment, enter the **exit** command.

ELS Monitoring Commands

This section summarizes and then explains all the ELS monitoring commands. After accessing the ELS Monitoring environment, you can enter ELS monitoring commands at the ELS> prompt.

Table 18. ELS Monitoring Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Advanced	Places you in the advanced configuration environment in which you can configure message buffering.
Clear	Resets to zero the counts of messages associated with specified events, groups, or subsystems.
Display	Enables message display on the console.
Exit	Exits the ELS console process and returns the user to GWCON.
Filter	Filter ELS messages based upon the net number.
List	Lists information on ELS settings and messages.
Nodisplay	Disables message display on the console.
Noremote	Disables remote logging to file at remote workstation.
Notrace	Disables trace event display on the console.
Notrap	Keeps messages from being sent out in SNMP traps to the network management workstation.
Packet-trace	Provides an enhanced central environment for setting and listing active packet tracing parameters.
Remote	Allows messages to be logged at a file on a remote workstation.
Remove	Frees up memory by erasing stored information.
Restore	Clears current settings and reloads initial ELS configuration.
Retrieve	Reloads the saved ELS configuration.
Save	Stores the current configuration.
Set	Sets the pin parameter and the timestamp feature.
Statistics	Displays available subsystems and pertinent statistics.
Trace	Enables trace event display on the console.
Trap	Allows messages to be sent to a network management workstation in SNMP traps.
View	Allows viewing of traced packets.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Advanced

Use the **advanced** command to enter the advanced monitoring environment. In this environment you change message buffering operation.

Syntax:

advanced

Clear

Use the **clear** command to reset to zero the counts of the display, trace, trap, or remote commands as they relate to specific events, groups or subsystems.

ELS Monitoring Commands (Talk 5)

- The currently active bank (bank A or bank B on the hard disk)
- Bank A on the hard disk
- Bank B on the hard disk
- The trace file stored in the Network Subdirectory (if there is no active bank)

Syntax:

```
files trace tftp           active-bank ...  
                                bank-a ...  
                                bank-b ...  
                                net-subdir ...
```

You are prompted for the *remote server IP address* and the *remote path/file name*.

active-bank

Retrieves the traces file from the currently active bank

bank-a

Retrieves the trace file from bank A.

bank-b

Retrieves the trace file from bank B.

net-subdir

Retrieves the trace file stored in the Network Subdirectory (if there is no active bank).

Filter

Use the **filter** command to access the filter configuration command environment. See “ELS Net Filter Monitoring Commands” on page 186 for complete command details.

Syntax:

```
filter                       net
```

List

Use the **list** command to get updated information regarding ELS settings and to get listings of selected messages.

Syntax:

```
list                          all  
                                active . . .  
                                event . . .  
                                filter-status  
                                groups . . .  
                                pin  
                                remote-log status  
                                subsystem . . .
```

ELS Monitoring Commands (Talk 5)

`_trace-status`

all Lists all subsystems, defined groups, enabled subsystems, enabled events, and pins.

active *subsystem.name*

Displays the events that are active for a specific subsystem and the count of the occurrence of the messages.

Example:

```
list active ip
EventActiveCount
IP.00789354
ETH.009D10
Subsystem X25: no event active
```

If Remote logging is turned on, those events displayed as active for a subsystem will have an “R” next to their name.

event *subsystem.event#*

Displays the logging level, the message, and the count of the specified event.

Example:

```
list event ip.007
Level: p-TRACE
Message: source_ip_address -> destination_ip_address
Active: Count: 84182
```

If Remote-logging had been activated for this event, and the *syslog_facility* and *syslog_level* values were *log_daemon* and *log_crit*, the last lines would look like:

```
Active: R count:84182
Syslog Facility: log_daemon Syslog Level: log_crit
```

filter-status

Lists ELS net number filters.

groups *group.name*

Displays the user-defined group names.

pin Lists the current number of ELS event messages sent per second in SNMP traps. This is a threshold value that can be used to reduce the amount of SNMP trap traffic.

Example:

```
list pin
Pin: 100 events/second
```

remote-log status

Lists the current values of the remote logging options set in the **set remote-logging** command.

Example:

```
list r
Remote Logging is On
Source Ip Address = 192.9.200.8
Remote Log IP Address = 192.9.200.1
Default Syslog Facility = LOG_USER
Default Syslog Priority Level = LOG_INFO
Number of Messages in Remote Log = 256
Remote Logging Local ID = SPHINX
```

ELS Monitoring Commands (Talk 5)

subsystem *subsystem.name*

Lists event names, the total number of events that have occurred, and their descriptions.

Note: Although ELS supports all subsystems on the router, not all devices support all subsystems. See *ELS Messages* for a list of currently supported subsystems.

subsystem *subsystem.name*

Lists all events, logging levels, and messages for the specified subsystem.

Example:

```
list subsystem eth
```

```
Event      Level      Message
ETH.001    P-TRACE    brd rcv unkwn type packet_type source_Ethernet_address ->
            destination_Ethernet_address nt network
ETH.002    UE-ERROR    rcv unkwn typ packet_type source_Ethernet_address ->
            destination_Ethernet_address nt network
ETH.010    C-INFO     LLC unk SAP_DSAP source_Ethernet_address ->
            destination_Ethernet_address nt network
```

subsystem all

Lists all events, logging levels, and messages for every event that has occurred on the router.

trace-status

Displays information on the status of packettracing, including configuration and run-time information.

Example:

```
list trace-status
```

```
----- Configuration -----
Trace Status:ON  Wrap Mode:ON  Decode Packets:ON  HD Shadowing:ON
RAM Trace Buffer Size:100000  Maximum Trace Buffer File Size:10000000
Max Packet Bytes Traced:256  Default Packet Bytes Traced:100
Trace File Record Size:2048  Stop Trace Event: TCP.013
Maximum Hours to HD Shadow: 1
----- Run-time Status -----
Packets in RAM Trace Buffer:1  Free Trace Buffer Memory:99958
Trace Errors:0  First Packet:1  Last Packet:1
Trace Records Stored on HD:8  Trace Buffer File Size:16560
HD-Shadowing Time Exceeded? NO  Elapsed Time: 0 hr, 0 min, 10 sec
Has Stop Trace Event Occurred? NO
```

- “Trace Status” in the LIST TRACE-STATUS display will indicate OFF when STOP-ON-EVENT action occurs.
- “HD Shadowing” in the LIST TRACE-STATUS display will indicate OFF when STOP-ON-EVENT action occurs or when Time Limit is exceeded.
- “Trace Buffer File Size” will display “<wrapped>” when a wraparound has occurred in the trace file.
- If disk-shadowing time limit is exceeded, but there has not been a trace record written since the time expired, then “HD-Shadowing Time Exceeded? NO <Next trace will turn it OFF>” will be displayed. When the next trace record has been written, then “HD-Shadowing Time Exceeded? YES” will be displayed.

ELS Config>**LIST TRACE** command under **talk 6** displays information similar to the following:

```
----- Configuration -----
Trace Status:ON  Wrap Mode:ON  Decode Packets:ON  HD Shadowing:ON
RAM Trace Buffer Size:100000  Maximum Trace Buffer File Size:10000000
Max Packet Bytes Traced:256  Default Packet Bytes Traced:100
Trace File Record Size:2048  Stop Trace Event: TCP.013
Maximum Hours to HD Shadow: 1
```

ELS Monitoring Commands (Talk 5)

Nodisplay

Use the **nodisplay** command to select and turn off messages displaying on the console.

Syntax:

```
nodisplay          event . . .  
                   group . . .  
                   range . . .  
                   subsystem . . .
```

event *subsystem.event#*

Suppresses the displaying of messages for the specified event.

group *group.name*

Suppresses the displaying of messages that were previously added to the specified group (*group.name*).

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Suppresses the displaying of a range of messages for the specified subsystem.

Example:

```
nodisplay range gw 19 22
```

Suppresses the display of events gw.19, gw.20, gw.21, and gw.22.

subsystem *subsystem.name*

Suppresses the displaying of messages associated with the specified subsystem (*logging level*).

Noremote

Use the **noremote** command to select and turn off messages logging to a remote workstation.

Syntax:

```
noremote          event . . .  
                   group . . .  
                   range . . .  
                   subsystem . . .
```

event *subsystem.event#*

Suppresses the remote logging of messages for the specified event.

group *group.name*

Suppresses the remote logging of messages that were previously added to the specified group (*group.name*).

range *subsystemname first_event_number last_event_number*

ELS Monitoring Commands (Talk 5)

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Suppresses the remote logging of a range of messages for the specified subsystem.

Example:

```
noremote range gw 19 22
```

Suppresses the remote logging of events gw.19, gw.20, gw.21, and g.22

subsystem *subsystem.name*

Suppresses the remote logging of messages associated with the specified subsystem (*logging level*).

Example:

```
noremote subsystem tkr
```

Note: With Noremote, there is no need to specify a Syslog Facility and Level, such as there is with Remote.

Use the **list event** and **list active** commands to verify what you set with the **remote** and **noremote** commands.

Notrace

Use the **notrace** command to stop display of selected trace events at the monitoring.

Syntax:

```
notrace          event . . .  
                  group . . .  
                  range . . .  
                  subsystem . . .
```

event *subsystem.event#*

Suppresses the display of the specified tracing event.

group *groupname*

Suppresses the display of tracing events related to the specified group (*groupname*).

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Disables the sending of packet trace data for a range of messages for the specified subsystem.

Example:

```
notrace range gw 19 22
```

Suppresses the sending of packet trace data for events gw.19, gw.20, gw.21, and gw.22.

ELS Monitoring Commands (Talk 5)

subsystem *subsystemname* [*logging-level*]

Suppresses the display of tracing events that are associated with the specified subsystem and logging level. If you do not specify a *logging-level* you suppress tracing for all logging levels for the subsystem.

Example:

```
notrace subsystem fr1 error
notrace subsystem fr1
```

Notrap

Use the **notrap** command to select and turn off messages so that they are no longer sent to a network management workstation in SNMP traps.

Syntax:

```
notrap event . . .
          group . . .
          range . . .
          subsystem . . .
```

event *subsystem.event#*

Suppresses the sending of the specified message in an SNMP trap (*subsystem.event#*).

group *groupname*

Suppresses the sending of messages in SNMP traps that were previously added to the specified group (*groupname*).

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Suppresses the sending of messages for the events in the specified range for the specified subsystem in SNMP traps.

Example:

```
notrap range gw 19 22
```

Suppresses the sending of messages for events gw.19, gw.20, gw.21, and gw.22 in SNMP traps.

subsystem *subsystemname* [*logging-level*]

Suppresses the sending of messages in SNMP traps that are associated with the specified subsystem and logging level. If you do not specify a *logging-level* you suppress trapping for all logging levels for the subsystem.

Example:

```
notrap subsystem tkr error
```

Packet Trace

Use the **packet-trace** command to display/enable/disable packet tracing information for various subsystems. This command provides function similar to the **Trace** command.

ELS Monitoring Commands (Talk 5)

These values do NOT have any particular association with any daemons on the IBM 2216. They are merely identifiers which are used by the syslog daemon on the remote workstation.

Example:

```
remote event gw.019 log_user log_info
```

group *group.name syslog_facility syslog_level*

Allows events belonging to the specified group to be logged remotely based on the *syslog_facility* and *syslog_level* values. See “the remote event command” on page 173.

range *subsystemname first_event_number last_event_number syslog_facility syslog_level*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Causes the events in the specified range for the specified subsystem to be remotely logged based on the *syslog_facility* and *syslog_level*. See “the remote event command” on page 173.

Example:

```
remote range gw 19 22 log_user log_info
```

Causes the event gw.19, gw.20, gw.21, and gw.22 to be logged remotely to the files specified by the *syslog_facility* value of log_user and the *syslog_level* value of log_info.

subsystem *subsystem.name message_level syslog_facility syslog_level*

Where *subsystem.name* is the name of the subsystem and *message_level* is the level of messages selected in the subsystem.

Causes the events within the specified *subsystem.name* whose *message_level* agrees with the specified *message_level* to be logged remotely based on the *syslog_facility* and *syslog_level*. See “the remote event command” on page 173.

Message_level is a value such as “ALL,” “ERROR,” “INFO,” or “TRACE” . See “Logging Level” on page 125. The value specified in the **remote** command must agree with the value as coded on the particular event within the subsystem, or that event within the subsystem will not be remotely logged.

Example:

```
remote subsystem TKR all log_user log_info
```

In the above example, all messages in subsystem TKR (“all” includes any messages coded for “error,” “info,” or “trace”) will be logged remotely to files specified by log_user and log_info at the remote host.

Use the **list event** and **list active** commands to verify what you set with the **remote** and **noremove** commands.

Remove

Use the **remove** command to free up memory by erasing stored information. If you have previously saved the current configuration with the **save** command, remove allows you to erase the saved configuration.

Syntax:

remove

Restore

Use the **restore** command to clear all current settings (except counters) and reload the initial ELS configuration. To retain the current settings, use the **save** command before restoring the initial configuration.

Syntax:

restore

Retrieve

Use the **retrieve** command to reload the saved ELS configuration. If you have previously saved the current configuration with the **save** command, use **retrieve** to reload it. **Retrieve** does not erase the saved configuration after it executes. To erase the saved configuration, use the **remove** command.

Syntax:

retrieve

Save

Use the **save** command to store the current configuration (except counters). **Save** does not affect the default configuration (the one you set with the configuration commands). Use **save** after modifying the configuration with the monitoring commands with the intention of saving this configuration over a restart. There can be only one saved configuration at a time. To reload the saved configuration, use the **retrieve** command.

Syntax:

save

Set

Use the **set** command to set the maximum number of traps per second, to set the timestamp feature, or to set the tracing options.

Syntax:

```
set                pin . . .
                   _remote-logging . . .
                   _timestamp . . .
                   trace . . .
```

pin Use the **set pin** command to set the pin parameter to the maximum number of traps that can be sent on a per-second basis. Internally, the pin resets every tenth of a second. (One tenth of the number *max_traps* is sent every tenth of a second.)

remote-logging

Use the **set remote-logging** command to configure remote logging options.

ELS Monitoring Commands (Talk 5)

When these options are configured from the monitoring environment, the changes take effect immediately, and return to their previously configured settings when the device is rebooted.

Syntax:

```
set remote-logging      on  
                        off  
                        facility . . .  
                        level . . .  
                        local_id  
                        remote_ip_addr . . .  
                        source_ip_addr ...
```

on Turns remote logging on. Remote logging is now enabled to allow any messages selected by the **remote** command to be actively logged.

off Turns remote logging off. All messages selected by the **remote** command will be prevented from being logged.

facility

Specifies a value that, in combination with the *level* value, is used by the syslog daemon in the remote workstation to determine where to log messages. This value is used for all remotely-logged ELS messages unless you specify a different value for a particular ELS event, range, group, or subsystem with the **remote** command.

These are all possible syslog facility values:

```
log_auth  
log_authpriv  
log_cron  
log_daemon  
log_kern  
log_lpr  
log_mail  
log_news  
log_syslog  
log_user  
log_uucp  
log_local0-7
```

level Specifies a value that, in conjunction with the *facility* value, is used by the syslog daemon in the remote workstation to determine where to log messages. This value is used for all remotely-logged ELS messages unless you specify a different value for a particular ELS event, range, group, or subsystem with the **remote** command.

These are all possible syslog level values:

```
log_emerg  
log_alert  
log_crit  
log_err
```

log_warning

log_notice

log_info

log_debug

local_id

Specifies a 1-32 character identifier that appears in the remote logging message that you can use to identify which machine logged a particular message.

remote_ip_addr

This is an IP address of the remote host where the log files reside.

source_ip_addr

Specifies the IP address of the machine that originated the message that is being remotely-logged.

You should use an IP address that is configured in the 2216 for easier identification when the IP address or the hostname is shown in the remotely-logged ELS message. You should also verify that this IP address is quickly resolved to a hostname by the name server, or at least that the name server responds quickly with "address not found."

To determine that the IP address resolves properly enter the **host** command on your workstation as shown:

```
workstation>host 5.1.1.1
host: address 5.1.1.1 NOT FOUND
workstation>
```

If the response takes more than 1 second, select an IP address that resolves more quickly.

timestamp

Allows you to turn on message timestamping so that either the time of day or uptime (number of hours, minutes, and seconds, but no date, since the router was last initialized) appears next to each message, or to turn off message timestamping.

Note: If you turn on timestamping, you must remember to go back into the CONFIG process and set the router's date and time using the time command. Otherwise, all messages will come out with 00:00:00, or negative numbers in the hours, minutes, and/or seconds, for example 00:-4:-5.

Use the **set timestamp** command to enable one of the following timestamp options:

timeofday

Adds an HH:MM:SS prefix to each ELS message indicating the time of the occurrence during a 24-hour day.

uptime

Adds an HH:MM:SS prefix to each ELS message indicating the time of the occurrence during a 100-hour cycle of uptime for the router. After 100 hours of uptime, the uptime counter returns to zero to begin another 100-hour cycle.

off Turns off the ELS timestamp prefix.

Syntax:

ELS Monitoring Commands (Talk 5)

set timestamp [timeofday or uptime or off]

trace Use the **set trace** command to configure tracing options. When tracing options are configured from the monitoring environment, the changes take effect immediately, and return to their previously configured settings when the device is rebooted.

Syntax:

set trace decode . . .
default-bytes-per-pkt . . .
disk-shadowing . . .
max-bytes-per-pkt . . .
memory-trace-buffer-size . . .
off
on
reset
stop-event . . .
wrap-mode . . .

decode [off or on]

Turns packet decoding on or off. Packet decoding is not supported by all components.

default-bytes-per-pkt *bytes*

Sets the default number of bytes traced. This value is used if a value is not specified by the component doing the tracing.

disk-shadowing [[off or on] or [delete-file or record-size or time-limit]]

Turns disk shadowing on or off, sets the maximum trace file size, or sets the maximum time for disk-shadowing traces.

[off or on]

Turns disk shadowing on or off. If disk shadowing is enabled, trace records are copied to the hard disk. Once a traced record is copied to the hard disk, it can no longer be viewed from the monitoring.

Note: Disk shadowing should be set to OFF whenever the WRITE, TFTP software, RETRIEVE system dump, or COPY software commands are issued.

Turns disk shadowing on or off and sets the maximum trace file size. If disk shadowing is enabled, trace records are copied to the hard disk. Once a traced record is copied to the hard disk, it is no longer viewable through the monitoring.

record-size *bytes*

Sets the record size for trace file records:

Valid Values: 1024, 2048, or 4096 bytes

Default: 2048 bytes

ELS Monitoring Commands (Talk 5)

Notes:

1. If a trace file already exists, “Cannot change Record Size without first deleting the existing Trace File” is displayed and record size is not changed.
2. If you configure a record size and a trace file already exists, the trace will use the record size of the existing file.

delete-file

Deletes the trace file (in the subdirectory associated with the active bank only).

Note: If disk shadowing is ON when the command is issued, “ Disk-shadowing must be set to OFF before trace file can be deleted” is displayed and the file is not deleted.

time-limit *hours*

Sets the maximum time for disk-shadowing of traces:

Valid Values:

1 - 72 hours:

Default

24 hours

Note: Disk shadowing stops (tracing continues) after this time has elapsed. The actual time is reset to 0 when disk shadowing is turned on again.

max-bytes-per-pkt *bytes*

Sets the maximum number of bytes traced for each packet.

memory-trace-buffer-size *bytes*

Sets the size, in bytes, of the RAM trace buffer.

Valid Values: 0, $\geq 10,000$

Default Value: 0

off Disables packet tracing.

on Enables packet tracing.

reset Clears the trace buffer and resets all associated counters.

stop-event *event id*

Stops tracing when an event (event id) occurs. Enter either an ELS event id (for example: TCP.013) or “None”. “None” is the default. Tracing stops only if the display of the particular ELS event is enabled.

When a stop-event occurs, an entry is written to the trace buffer. The **view** command for this trace entry will display “Tracing stopped due to ELS Event Id: TCP.013”.

After tracing stops due to a stop-event, you must re-enable tracing with the **set trace on** command. (A restart will also re-enable tracing if enabled from the ELS Config> prompt.)

Example:

```
set trace stop-event TCP.013
```

ELS Monitoring Commands (Talk 5)

wrap-mode *off/on*

Turns the trace buffer wrap mode on or off. When wrap mode is enabled and the trace buffer is full, previous trace records will be overwritten by new trace records as necessary to continue tracing.

Statistics

Use the **statistics** command to display a list of all of the available subsystems and their statistics.

Note: The following example may not match your display exactly. The output of the command depends on the version and release of the installed software.

Syntax:

statistics

Example:

statistics

Subsys	Vector	Exist	String	Active	Heap
GW	105	101	3411	0	0
FLT	20	7	184	0	0
BRS	50	5	201	0	0
ARP	150	142	7030	0	0
IP	100	100	2463	2	20
ICMP	30	21	529	0	0
TCP	60	57	2420	0	0
UDP	10	6	179	0	0
BTP	40	13	695	0	0
RIP	30	22	474	0	0
OSPF	80	73	2859	0	0
MSPF	40	17	593	0	0
TFTP	35	29	819	0	0
SNMP	30	28	821	0	0
DVM	30	21	589	0	0
DN	140	115	5842	0	0
XN	35	21	780	0	0
IPX	110	110	4705	0	0
CLNP	80	58	1763	0	0
ISIS	40	24	716	0	0
ISIS	80	58	2422	0	0
DNAV	50	26	1314	0	0
AP2	80	70	1755	0	0
ZIP2	60	51	1859	0	0
R2MP	50	38	1185	0	0
VIN	90	79	3159	0	0
SRT	120	94	5040	0	0
STP	60	32	1590	0	0
BR	50	30	1616	0	0
SRLY	30	28	1409	0	0
ETH	60	47	1098	0	0
SL	50	35	584	0	0
TKR	60	45	2031	0	0
X25	70	53	1909	0	0
FDDI	30	27	1155	0	0
SDLC	100	95	4263	0	0
FRL	130	97	6068	0	0
PPP	190	186	6394	0	0
X251	50	16	546	0	0
X252	50	34	996	0	0
X253	50	42	1649	0	0
ISDN	50	43	1994	0	0
IPPN	20	4	132	0	0
WRS	40	33	1938	0	0
LNМ	70	60	3137	0	0
LLC	170	168	9840	0	0
BGP	80	74	2477	0	0
MCF	15	9	244	0	0
DLS	500	497	24340	0	0
V25B	30	28	1058	0	0

ELS Monitoring Commands (Talk 5)

BAN	30	29	1223	0	0
COMP	80	26	1050	0	0
NBS	100	50	3029	0	0
ATM	300	216	10808	0	0
LEC	200	174	7258	0	0
APPN	100	28	467	0	0
ILMI	150	23	487	0	0
SAAL	30	26	621	0	0
SVC	30	26	465	0	0
LES	400	361	22333	0	0
LECS	150	145	5666	0	0
EVLOG	1	1	105	0	0
NOT	25	15	508	0	0
NHRP	250	211	8193	0	0
XTP	64	58	2271	0	0
ESC	150	67	3122	0	0
LCS	40	22	858	0	0
LSA	70	61	3506	0	0
MPC	130	30	1677	3	44
SCSP	40	34	1234	0	0
ALLC	50	36	1842	0	0
NDR	50	38	1150	0	0
MLP	100	93	4006	0	0
SEC	50	30	688	0	0
ENCR	100	4	194	0	0
PM	25	6	120	0	0
DGW	20	9	238	0	0
QLLC	55	54	2411	0	0
Total	6490	4942	215805	5	64

Maximum:7976 vector, 155 subsystem
Memory:71784/620 vector+ 81256/217714 data+ 64 heap=371438Subsys

Subsys

Name of subsystem

Vector

Maximum size of subsystem

Exist Number of events defined in this subsystem

String Number of bytes used for message storage in this subsystem

Active Number of active (displayed, trapped, or counted) events in the subsystem

Heap Dynamic memory in use by subsystem

Trace

Use the **trace** command to select the trace events to be displayed on the system monitoring. This command provides function that is similar to the **packet trace** command described in “Packet-trace Monitoring Commands” on page 183.

Syntax:

```
trace          event . . .  
                group . . .  
                range . . .  
                subsystem . . .
```

event *subsystem.event#*

Causes the specified trace event (*subsystem.event#*) to be displayed on the system monitoring.

ELS Monitoring Commands (Talk 5)

group *groupname*

Allows trace events that were previously added to the specified group to be displayed on the router monitoring.

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Causes the trace events in the specified range for the specified subsystem to be displayed on the system monitoring.

Example:

```
trace range gw 19 22
```

Causes the trace events gw.19, gw.20, gw.21, and gw.22 to be displayed on the system monitoring.

subsystem *subsystemname*

Allows trace events associated with the specified subsystem to be displayed on the router monitoring.

Trap

Use the **trap** command to select the message to be sent to the remote SNMP network management workstation. A remote SNMP network management workstation is an IP host in the network acting as an SNMP manager.

Syntax:

```
trap                event . . .  
                    group . . .  
                    range . . .  
                    subsystem . . .
```

event *subsystem.event#*

Causes the specified message (*subsystem.event#*) to be sent to a network management workstation in an SNMP trap.

group *groupname*

Allows messages that were previously added to the specified group to be sent to a network management workstation in an SNMP trap.

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Causes the messages that are in the specified range for the specified subsystem to be sent to a network management workstation in an SNMP trap.

Example:

```
trap range gw 19 22
```

Causes the messages in events gw.19, gw.20, gw.21, and gw.22 to be sent to a network management workstation in an SNMP trap.

subsystem *subsystemname*

Allows messages associated with the specified subsystem to be sent to a management station in an SNMP trap.

Note: Messages for the IP, ICMP, ARP and UDP subsystems cannot be sent in SNMP traps because these areas are or may be used in the process of sending the SNMP trap. This could lead to an infinite loop of traffic putting an undue strain on the router.

View

Use the **view** command to view traced packets.

Syntax:

```

view                _current
                   _first
                   _jump
                   _last
                   _next
                   _prev
                   _search ...
  
```

current

Displays the current trace packet. If the current packet is not valid, the first packet in the trace buffer is displayed.

first Displays the first traced packet in the trace buffer.

jump *n*

Displays the traced packet *n* packets ahead of or behind the current packet.

last Displays the last traced packet in the trace buffer.

next Displays the next traced packet.

prev Displays the previous traced packet.

search *hexstring*

Displays the next traced packet that contains the specified hex string.

Packet-trace Monitoring Commands

This section describes the Packet-trace Monitoring commands. After accessing the Packet-trace Monitoring environment, you can enter Packet-trace Monitoring commands at the ELS Packet Trace> prompt.

Table 19. Packet Trace Monitoring Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Off	Disables packet tracing.
On	Enables packet tracing. Prompts for memory trace buffer size if not previously set.
Reset	Clears the trace buffer and resets all associated counters.

ELS Monitoring Commands (Talk 5)

Table 19. Packet Trace Monitoring Command Summary (continued)

Command	Function
Set	Configures tracing options.
Subsystems	Activates tracing for the subsystems that support packet tracing, or displays a summary.
Trace-status	Displays information on the status of packet tracing, including configuration and run-time.
View	Provides View Captured Packet Trace Buffers Console
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Off

Use the **off** command to disable packet tracing.

Syntax:

off

On

Use the **on** command to enable packet tracing.

Syntax:

on

Reset

Use the **reset** command to clear the trace buffer and reset all associated counters.

Syntax:

reset

Set

Use the **set** command to configure tracing options.

Syntax:

set decode
 default-bytes-per-pkt
 disk-shadowing
 max-bytes-per-pkt
 memory-trace-buffer-size
 stop-event
 wrap-mode
 exit

For an explanation of the set command, see "Set" on page 175.

Subsystems

Use the **subsystems** command to activate tracing for the subsystems that support packet tracing, or to display a summary.

Syntax:

```
subsystems          atm
                    lec
                    summary
```

Example:

```
subsystems atm
Network number? 0
ATM Interface is selected
on | off | list [list]? on
Note that SVC uses VPI = 0, VCI = 5
and ILMI uses VPI = 0, VCI = 16
Beginning of VPI range [0]?
End of VPI range [0]?
Beginning of VCI range [0]? 16
End of VCI range [0]? 16
Tracing event ATM.88: ATM frames
```

Example:

```
subsystems lec
Network number? 1
ATM Emulated LAN is selected
on | off | list [list]? on
Trace which types of frames (data, control, both) [both]?
Tracing event LEC.11: data frames over ATM Forum LEC: interface 1
Tracing event LEC.12: control frames over ATM Forum LEC: interface 1
Note that if the user DISABLEs and TESTs this LEC interface,
the LEC trace settings from Talk 6 Config will take effect.
```

Example:

```
subsystems summary
Subsystems Being Traced

ATM      net number = 0, VPI Range:    0 -    0
          VCI Range:    16 -    16
LEC      net number = 1
```

Trace-Status

Use the **trace-status** command to get updated information regarding packet trace.

Syntax:

```
trace-status
```

Example:

```
trace-status
----- Configuration -----
Trace Status:OFF Wrap Mode:OFF Decode Packets:OFF HD Shadowing:OFF
RAM Trace Buffer Size:0 Maximum Trace Buffer File Size:10000000
Max Packet Bytes Trace:256 Default Packet Bytes Traced:100
Trace File Record Size:2048 Stop Trace Event: None
Maximum Hours to HD Shadow: 24
----- Run-time Status -----
Packets in RAM Trace Buffer:0 Free Trace Buffer Memory:0
Trace Errors:0 First Packet:0 Last Packet:0
Trace Records Stored on HD:0 Trace Buffer File Size:0
HD-Shadowing Time Exceeded? NO
Has Stop Trace Event Occurred? NO
```

ELS Monitoring Commands (Talk 5)

View

Use the **view** command to enter the View Captured Packet Trace Buffers Monitoring.

For an explanation of the **view** commands, see “View” on page 183.

Syntax:

```
view                current
                    first
                    jump
                    last
                    next
                    prev
                    search hexstring
                    exit
```

ELS Net Filter Monitoring Commands

This section describes explains the commands to manipulate ELS net filters. To enter the filter environment, enter the **filter net** command at the ELS> prompt. Enter the monitoring commands at the ELS Filter net> prompt.

Table 20. ELS Net Filter Monitoring Commands

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Create	Creates a filter and assigns it a number. A maximum of 64 filters is allowed.
Delete	Deletes a specified filter number or all filters.
Disable	Disables a specified filter number or all filters.
Enable	Enables a specified filter number or all filters.
List	Lists a specified filter number or all filters.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Create

Use the **create** command to create an ELS net filter.

Syntax:

```
create queue                event event_name net#_start net#_end
                               range event_range net#_start net#_end
                               subsystem subsystem_name net#_start net#_end
```

queue The queue for which you are setting the filter. The valid queues are:

- Display
- Trace
- Trap

ELS Monitoring Commands (Talk 5)

Enable

Use the **enable** command to enable a specific ELS filter or all ELS filters.

Syntax:

```
enable                all  
                        filter filter#
```

all Enable all currently configured filters.

filter filter#

Enable the filter specified by *filter#*. Use the **list** command to obtain the number for the filter you want to enable.

List

Use the **list** command to list a specific ELS filter or all ELS filters.

Syntax:

```
list                  all  
                        filter filter#
```

all Lists all currently configured filters.

filter filter#

Lists the filter specified by *filter#*.

ELS Message Buffering Monitoring Commands

Table 21 describes the commands available at the ELS Config Advanced> prompt.

Table 21. ELS Message Buffering Monitoring Commands

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Flush	Clears the message buffer and turns off logging to the message buffer.
List	Displays the operational settings for message buffering.
Log	Enables logging of selected messages to the message buffer.
Nolog	Turns off logging of selected messages to the message buffer.
Read-file	Reads a formatted message buffer from a file and displays it on the console.
Set	Sets the size of the message buffer, the wrapping mode, whether logging occurs, which event will end message buffering, and what the system does when message buffering is stopped by an event.
Tftp	Sends the ELS message buffer to a file at a remote host.
View	Displays all or a specific number of messages in the message buffer. You can also control how the messages scroll off the screen.
Write-buffer	Writes the ELS message buffer to the hard drive. The buffer is formatted before it is written. The file name on the hard drive is always ELSADV.LOG.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Flush

Use the **flush** command to set logging off, clear the messages from the buffer, and release the buffer memory for other use by the system.

Syntax:

flush buffer

List

Use the **list** command to list the ELS message buffering configuration.

Syntax:

list status

Example:

```
ELS Advanced> list status
-----Configuration-----
Logging Status:  OFF      Wrap Mode:  ON      Logging Buffer Size:  8500 Kytes
Stop-Event:     APPN.2   Stop-String:  netdn for intf 6
Additional Stop-Action:  APPN DUMP
-----Run-Time Status-----
Has Stop Condition Occurred ?  YES      Messages currently in buffer:  1222
```

See “Set” on page 191 for a description of the commands that change the values in the display.

Log

Use the **log** command to select which messages will be logged to the message buffer.

Syntax:

log event
group
range
subsystem

event *subsystem.event#*

Causes the specified message (*subsystem.event#*) to be logged to the message buffer.

group *groupname*

Allows messages that were previously added to the specified group to be logged to the message buffer.

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Causes the messages that are in the specified range for the specified subsystem to be logged to the message buffer.

Example:

```
log range gw 19 22
```

ELS Monitoring Commands (Talk 5)

Causes the messages in events gw.19, gw.20, gw.21, and gw.22 to be logged to the message buffer.

subsystem *subsystemname*

Allows messages associated with the specified subsystem to be logged to the message buffer.

Nolog

Use the **nolog** command to remove messages from the defined list of messages that are logged to the message buffer.

Syntax:

```
nolog          event
                group
                range
                subsystem
```

event *subsystem.event#*

Causes the specified message (*subsystem.event#*) not to be logged to the message buffer.

group *groupname*

Allows messages that were previously added to the specified group not to be logged to the message buffer.

range *subsystemname first_event_number last_event_number*

Where *first_event_number* is the number of the first event in the specified event range, and *last_event_number* is the number of the last event of the specified event range.

Causes the messages that are in the specified range for the specified subsystem not to be logged to the message buffer.

Example:

```
log range gw 19 22
```

Causes the messages in events gw.19, gw.20, gw.21, and gw.22 not to be logged to the message buffer.

subsystem *subsystemname*

Allows messages associated with the specified subsystem not to be logged to the message buffer.

Read-file

Use the **read-file** command to read formatted ELS messages from a file on the hard drive, ELSADV.LOG, created by the **write-buffer** command.

Note: If you enter this command and a hard drive is not available, you will receive a message indicating the drive is unavailable.

Syntax:

```
read-file
```

Set

Use the **set** command to change configured ELS message buffering options.

Syntax:

```
set                logging [on or off]
                   stop action . . .
                   stop event subsystem.event#
                   stop string text
                   wrap [on or off]
```

logging [*on* or *off*]

Specifies whether message buffering will occur. This command will not take affect until you allocate a buffer using the **set buffer-size** command. The default is off.

stop action [*appn-dump* or *disk-offload* or *none* or *system-dump*]

Specifies the additional action the system takes when the “stop event” (and if specified, the “stop string”) occurs. The actions are:

appn-dump

Dumps the APPN protocol, if it is active. The APPN dump will indicate that the dump was taken as the result of a stop action.

disk-offload

Writes a formatted version of the buffer to a file on the hard drive . If the file already exists, the new file replaces it. You can then use the **tftp file** monitoring command to send the file to a remote host.

none No other action is taken after logging stops.

system-dump

Dumps the entire system. The system dump will indicate that the dump was taken as the result of a stop action.

Default value: none

stop event [*subsystem.event#* or *none*]

Specifies the event (*subsystem.event#*) that stops logging. If you have specified a stop string, the text in the stop string must also match. When the stop event occurs:

1. The next five ELS messages are logged.
2. Logging stops.
3. The system performs the specified “stop action.”

Logging remains stopped until the next time you issue the **set logging on** command or the router reboots.

If you do not specify the stop event when you enter the command, the system prompts you to enter the stop event. Specifying **none** disables the stop event function.

Default value: none

ELS Monitoring Commands (Talk 5)

stop string *text* or **none**

Specifies the string to be used in conjunction with the “stop event” to stop logging. If you have not specified a stop event, the system ignores the “stop string.”

Text can be any ASCII string up to 32 characters in length. If you do not specify *text* when you enter the command, the system will prompt you for the string. Entering **none** clears the “stop string.”

Default value: none

wrap [**on** or **off**]

Specifies whether to stop the log when the buffer is full (off) or to log the new messages at the beginning of the buffer (on).

Default value: off

Tftp

Use the **tftp** command to send the ELS message buffer to a remote host as a formatted file.

Syntax:

```
tftp                buffer [formatted ] dest_ip_address dest_filename  
                    file dest_ip_address dest_filename
```

buffer [formatted] *dest_ip_address* *dest_filename*

Specifies that the ELS message buffer is to be sent to the remote host indicated by *dest_ip_address* as file *dest_filename*. The buffer can be either formatted.

View

Use the **view** command to view all of the messages or a specific number of messages in the message buffer.

Syntax:

```
view                all [scroll/noscroll]  
                    last [scroll/noscroll number]
```

all *scroll/noscroll*

Displays all of the messages in the message buffer.

[scroll]

Specifies that the screen pauses until you hit the spacebar.

Note: If you are displaying a large number of messages, specify scroll so you do not miss any critical messages.

noscroll

Specifies that the messages will scroll off the screen if the number of messages exceeds the screen length.

last *scroll/noscroll* *number*

Display the last *number* messages in the message buffer.

ELS Monitoring Commands (Talk 5)

[scroll]

Specifies that the screen pauses after displaying a full screen of messages and waits for the user to hit the space bar to get the next screen.

Note: If you are displaying a large number of messages, specify scroll so you do not miss any critical messages.

noscroll

Specifies that the messages will continuously scroll off the screen with no scroll control until either all messages in the buffer (or the last number of messages requested) have been displayed.

number

Specify a number from 1 to the total number of messages in the message buffer. To display the total number of messages in the buffer, use the **list status** monitoring command.

Write-buffer

Use the **write-buffer** command to write formatted ELS messages to the hard drive .

Note: If you enter this command and a hard drive is not available, you will receive a message indicating the drive is unavailable.

Syntax:

write-buffer

ELS Monitoring Commands (Talk 5)

Chapter 14. Configuring and Monitoring Performance

This chapter describes how to use the Performance configuration and monitor operating commands and includes the following sections:

- “Performance Overview”
- “Performance Reporting Accuracy”
- “Accessing the Performance Configuration Environment”
- “Performance Configuration Commands” on page 196
- “Accessing the Performance Monitoring Environment” on page 197
- “Performance Monitoring Commands” on page 197

Performance Overview

Configuring performance allows you to monitor your CPU load. In the idle (non-work load) state, performance reflects operations that the router continuously performs as a part of managing external interfaces. The CPU load registered in the idle state is dependent upon:

- Number of protocols running.
- Number of interfaces/cards installed.
- Type of interfaces installed.

The performance function can be used as a tool for trend analysis, bottleneck evaluation, and capacity planning. By collecting the CPU utilization information on the router, a network manager can monitor:

- CPU load versus time of day.
- CPU load versus location of the router in the network.
- CPU load versus traffic throughput.
- CPU load versus user load (for example: TN3270 sessions, ISDN dial in clients)

Performance Reporting Accuracy

If you request a performance analysis when the 2216 first comes online, you will see values that reflect an initialization state that has little or no network traffic, so it is of little use in helping to balance your network load.

It is best to use performance reports that are generated under normal loads after approximately 2 minutes of operation.

Accessing the Performance Configuration Environment

Use the following procedure to access the Performance monitor configuration process.

1. At the OPCON prompt, enter **talk 6**. (For more detail on this command, see “Chapter 8. The Configuration Process (CONFIG - Talk 6) and Commands” on page 57 .) For example:

* talk 6
Config>

After you enter the **talk 6** command, the CONFIG prompt (Config>) displays on the terminal. If the prompt does not appear when you first enter configuration, press **Return** again.

2. At the CONFIG prompt, enter the **perf** command to get to the PERF Config> prompt.

Performance Configuration Commands

To configure Performance, enter the commands at the PERF Config> prompt.

Table 22. PERF Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Disable	Disables the collection of CPU utilization statistics or Talk 2 ELS monitor output.
Enable	Enables the collection of CPU utilization statistics or Talk 2 ELS monitor output.
List	Lists the configuration.
Set	Sets the reporting period.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Disable

Use the **disable** command to disable collection of CPU utilization statistics and disable the talk 2 ELS monitor output.

Syntax:

disable cpu statistics
t2 output

Enable

Use the **enable** command to enable collection of CPU utilization statistics and enable the talk 2 ELS monitor output.

Syntax:

enable cpu statistics
t2 output

List

Use the **list** command to display the performance monitor configuration.

Syntax:

list

Set

Use the **set** command to set the reporting period.

Syntax:

set *time*

time Specifies the short window time.

Valid Values: 2 - 30 seconds

Default Value: 2

Accessing the Performance Monitoring Environment

Use the following procedure to access the Performance monitoring commands. This process gives you access to the Performance *monitoring* process.

1. At the OPCON prompt, enter **talk 5**. (For more detail on this command, see “Chapter 10. The Operating/Monitoring Process (GWCON - Talk 5) and Commands” on page 105.) For example:

```
* talk 5
+
```

After you enter the **talk 5** command, the GWCON prompt (+) displays on the terminal. If the prompt does not appear when you first enter configuration, press **Return** again.

2. At the + prompt, enter the **perf** command to get you to the PERF Console> prompt.

Example:

```
+ perf
PERF Console>
```

Performance Monitoring Commands

This section describes the Performance monitoring commands.

Table 23. PERF Monitoring Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Clear	Clear the CPU utilization high water statistics and resets the reporting period to a new cycle.
Disable	Disables the collection of CPU utilization statistics or Talk 2 ELS monitor output.
Enable	Enables the collection of CPU utilization statistics or Talk 2 ELS monitor output.
List	Lists the configuration.
Report	Displays a report of performance statistics.
Set	Sets the reporting period.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Performance Monitoring Commands (Talk 5)

Disable

Use the **disable** command to disable collection of CPU utilization statistics and disable the talk 2 ELS monitor output.

Syntax:

```
disable                cpu statistics
                        t2 output
```

Enable

Use the **enable** command to enable collection of CPU utilization statistics and enable the talk 2 ELS monitor output.

Syntax:

```
enable                 cpu statistics
                        t2 output
```

List

Use the **list** command to display the performance monitor configuration.

Syntax:

```
list
```

Report

Use the **report** command to display performance monitor statistics.

Syntax:

```
report
```

Example:

```
PERF Console>report
-----
KEY:  SW = Short Window = 9 seconds
KEY:  LW = Long Window = 9.0 minutes (60 x SW)

CPU UTIL :  Most recent SW                = 38%
            Most recent LW                = 33%
            Highest for all SW's          = 92%
            Highest for all LW's          = 52%
            % of time cpu util (SW) was > 60% = 16%
            % of time cpu util (SW) was > 70% = 15%
            % of time cpu util (SW) was > 80% = 1%
            % of time cpu util (SW) was > 90% = 0%
            % of time cpu util (SW) was > 95% = 0%
-----
```

Set

Use the **set** command to set the reporting period.

Syntax:

Performance Monitoring Commands (Talk 5)

set

time

time Specifies the short window time.

Valid Values: 2 - 30 seconds

Default Value: 2

Performance Monitoring Commands (Talk 5)

Part 3. Understanding, Configuring and Operating Interfaces

Chapter 15. Getting Started with Network Interfaces

The chapters of this book describe how to configure and monitor network interfaces and link layer protocols supported by the Router. The purpose of this chapter is to give you some basic configuration and monitoring guidelines. This chapter also provides you with basic procedures and information needed for monitoring the interfaces via the GWCON **interface** command. This chapter includes the following sections:

- “Before You Continue”
- “Network Interfaces and the GWCON Interface Command”
- “Accessing Network Interface Configuration and Console Processes”
- “Accessing Link Layer Protocol Configuration and Console Processes” on page 204
- “Defining Spare Interfaces” on page 204

Before You Continue

Before you continue, make sure that you have familiarized yourself with the procedures necessary for accessing the network interface configuration processes.

For more information on these procedures, refer to the sections that follow in this chapter.

Network Interfaces and the GWCON Interface Command

When configuring network interfaces, you may find it necessary to display certain information about specific interfaces. While some interfaces have their own console processes for monitoring purposes, the router displays statistics for *all* installed network interfaces when you use the **interface** command from the GWCON environment. (Refer to “Interface” on page 113.)

Accessing Network Interface Configuration and Console Processes

The follow references contain the background information and examples of how to access the configuration and console prompts for interfaces.

Refer to “Accessing Network Interface Configuration and Operating Processes” on page 16 , “Accessing the Network Interface Configuration Process” on page 16, and “Accessing the Network Interface Console Process” on page 19 for complete information on accessing interface configuration and console processes. Accessing these processes allows you to change and monitor software configurable parameters for network interfaces used in your router.

Accessing Link Layer Protocol Configuration and Console Processes

Refer to “Chapter 1. Getting Started” on page 3 for complete information on accessing the protocol configuration and console processes. Accessing these processes allows you to change and monitor configurable parameters for Link Layer protocols supported by your router.

Defining Spare Interfaces

There may be occasions when you will need to define interfaces on your device that do not currently exist. You accomplish this ***dynamic reconfiguration*** of a device by defining spare interfaces while you are configuring the device and then using the console process to activate the interfaces when they are present. See “Configuring Spare Interfaces” on page 60 and “Activate” on page 106 for details.

Chapter 16. Configuring IEEE 802.5 Token-Ring Network Interfaces

This chapter describes Token-Ring interfaces configuration and operational commands. It includes the following sections:

- “Accessing the Token-Ring Interface Configuration Process”
- “Token-Ring Configuration Commands”
- “Accessing the Interface Monitoring Process” on page 208
- “Token-Ring Interface Monitoring Commands” on page 209
- “Token-Ring Interfaces and the GWCON Interface Command” on page 210

Accessing the Token-Ring Interface Configuration Process

To display the TKR config> prompt, enter the network command followed by the interface number of the Token-Ring interface. For example:

```
Config>network 0
Token-Ring interface configuration
TKR Config>
```

Use the **list devices** command at the Config> prompt to display a list of interface numbers configured on the router.

Note: Whenever you change a parameter, you must restart the router for the changes to take effect.

Token-Ring Configuration Commands

This section describes the Token-Ring configuration commands. Enter the commands at the TKR config> prompt. Table 24 lists Token-Ring configuration commands.

Table 24. Token-Ring Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Displays the selected Token-Ring interface configuration.
LLC	Accesses the LLC configuration environment and subcommands.
Media	Sets the media-type as shielded or unshielded.
Packet-size	Changes packet-size defaults for all Token-Ring networks.
Set	Sets the aging timer for the RIF cache and the physical (MAC) address.
Source-routing	Enables or disables source-routing on the interface.
Speed	Sets the interface speed in Mbps.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

List

Use the **list** command to display the current configuration for the Token-Ring interface.

Configuring Token-Ring Network Interfaces

Note: If the MAC address is 0, the default station address is used.

Syntax:

list

-

Example:

```
list
Token-Ring configuration:

    Packet size (INFO field): 2052
Speed:                        16 Mb/sec
Media:                        Shielded

RIF Aging Timer:             120
Source Routing:              Enabled
MAC Address:                  000000000000
```

Packet size

Size of the Token-Ring packet.

Speed Speed of the network.

Media Type of media the network uses, shielded or unshielded.

RIF Aging Timer

Amount of time that the router holds the information contained in the Routing Information Field (RIF).

Source Routing

Status of the source-routing feature, enabled or disabled.

MAC Address

Configured MAC address that was set with the **set physical-address** command. If all zeros are displayed, the MAC address is the default address.

LLC

Use the **LLC** command to access the LLC configuration environment. See “LLC Configuration Commands” on page 235 for an explanation of each of these commands.

Syntax:

llc

Note: If APPN is not included in your router software load, you will receive the following message if you try to use this command:

```
LLC configuration is not available for this network.
```

The LLC configuration environment is only available if APPN is included in the software load.

Media

Use the **media** command to change the network media type. The default media type is STP cable. Valid media type values are shielded and unshielded. Enter the media command followed by the *media-type*.

Syntax:

Configuring Token-Ring Network Interfaces

media

media-type

Example:

```
media unshielded
```

Packet-Size

Use the **packet-size** command to change maximum packet-size for all Token-Ring networks. Enter the **packet-size** command followed by the desired number of bytes.

Syntax:

```
packet-size bytes
```

Table 25. Token-Ring 4/16 Valid Packet Sizes

Network Data Speed	Values (# of bytes)
4 Mbps	516 to 4498 Note: If a value greater than 4498 is defined for a 4 Mb TR then the software will set it to 4498. If the user does not specify a value, then the default is 2052.
16 Mbps	516 to 18144 Note: If you do not specify a value, then the default is 2052.

Note: If packet sizes are increased, buffer memory requirements will also increase.

Set

Use the **set** command to set the Routing Information Field (RIF) timer and the physical (MAC) address.

Syntax:

```
set physical-address  
rif-timer
```

physical-address

Indicates whether you want to define a locally administered address for the Token-Ring interface's MAC sublayer address, or use the default factory station address (indicated by all zeroes). The MAC sublayer address is the address that the Token-Ring interface uses to receive and transmit frames.

Note: Pressing **Return** leaves the value the same. Entering **0** and pressing **Return** causes the router to use the factory station address. The default is to use the factory station address.

Valid values: Any 12-digit hexadecimal address.

Default value: burned-in address (indicated by all zeroes).

Example:

```
set physical-address  
MAC address in 00:00:00:00:00:00 form []?
```

rif-timer

Sets the maximum amount of time (in seconds) that the information in the RIF is maintained before it is refreshed. The default is 120.

Configuring Token-Ring Network Interfaces

Example:

```
set rif-timer  
RIF aging timer value [120]? 120
```

Source-routing

Use the **source-routing** command to enable or disable end station source routing. Source routing is the process by which end stations determine the source route to use to cross source routing bridges. Source routing allows the IP, IPX, and AppleTalk Phase 2 protocols to reach nodes on the other side of the source routing bridge.

This switch is completely independent of whether this interface is providing source routing via the SRT forwarder. The default setting is enabled.

Some stations cannot properly receive frames with a Source Routing RIF on them. This is especially common among NetWare drivers. Disabling source routing in this situation will allow you to communicate with these stations.

Source routing should be enabled only if there are source-routing bridges on this ring that you want to bridge IP, IPX, and AppleTalk Phase 2 packets through. Source routing must also be enabled so LLC test response messages can be returned.

Syntax:

```
source-routing          enable  
                        disable
```

Speed

Use the **speed** command to change data speed. The default speed is 4 Mbps. Enter the **speed** command followed by the speed-value (in Mbps).

Syntax:

```
speed                  speed-value  
speed-value
```

The speed to which you are setting the token-ring interface.

Valid values: 4 or 16 Mbps

Default value: 4 Mbps

Accessing the Interface Monitoring Process

To display the Token-Ring monitoring prompt (TKR>), enter the network command followed by the interface number of the Token-Ring interface. For example:

```
+network 0  
TKR>
```

Use the **list devices** command at the Config> prompt to display a list of interface numbers configured on the router.

Follow the procedure described in "Accessing the Network Interface Configuration Process" on page 16 to access the interface monitoring process for the interface

Configuring Token-Ring Network Interfaces

described in this chapter. Once you have accessed the desired interface monitoring process, you can begin entering monitoring commands.

Token-Ring Interface Monitoring Commands

This section summarizes the Token-Ring monitoring commands. Enter commands at the TKR> monitoring prompt. Table 26 lists the monitoring commands.

Table 26. Token-Ring Monitoring Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Dump	Displays a dump of the RIF cache.
LLC	Displays the LLC monitoring prompt.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Dump

When source routing is enabled in the tkr config> process, you can use the **dump** command to request a dump of the RIF cache contents.

Syntax:

dump

Example:

```
dump
MAC address      State      Usage      RIF
0000C90B1A57    ON_RING    Yes         0220
```

MAC address

Displays the MAC address of the Token-Ring interface.

State Displays one of the interface states:

On_ring - indicates that a RIF was found for a node on the ring.

Have_route - indicates that a RIF was found for a node on a remote ring.

No_route - is displayed for a brief period of time as an explorer frame is sent out and the router is waiting for a return.

Discovering - indicates that the router sent an explorer frame to rediscover the RIF.

St_route - indicates that a route obtained from a Spanning tree explorer.

Usage Indicates that a RIF was used in a packet. The number is arbitrary and has no functional significance.

RIF Displays a code that indicates the RIF in hexadecimal.

Note: The RIF is displayed only if Source Route Bridging is enabled on the Token-Ring interface.

- NetBIOS RIF data can be displayed using the following sequence of commands: **talk 5, protocol ASRT, name-caching, list cache rifs.**

Configuring Token-Ring Network Interfaces

- Data Link Switching RIF data can be displayed using the following sequence of commands: **talk 5, protocol dlsw, list llc2 session all.**

LLC

Use the **LLC** command to access the LLC monitoring prompt. LLC commands are entered at this new prompt. See “LLC Monitoring Commands” on page 239 for an explanation of each of these commands.

Syntax:

llc

Token-Ring Interfaces and the GWCON Interface Command

While Token-Ring interfaces have their own monitoring processes for monitoring purposes, the router also displays complete statistics for installed network interfaces when you use the **interface** command from the GWCON environment.

Statistics Displayed for 802.5 Token-Ring Interfaces

The following statistics display when you enter the **interface <net#>** command for a Token-Ring interface from the GWCON environment.

Nt	Nt'	Interface	Slot-Port	Self-Test Passed	Self-Test Failed	Maintenance Failed
0	0	TKR/0	Slot: 1 Port: 1	1	0	0

Token-Ring/802.5 MAC/data-link on Token-Ring interface

Physical address	08005AFE0106		
Microcode Level	ww19cg		
Network speed	16 Mbps		
Max packet size (INFO)	2052		
Handler state	Ring open		
Last Reported Ring status	SERR CO		
# times Signal lost	0	# times Beacons	0
Hard errors	0	Loose wire faults	0
Auto-removal errors	0	Removes received	0
Ring recovery actions	0		
Line errors	0	Burst errors	0
ARI/FCI errors	0	Inputs dropped	0
Frame copy errors	0	Token errors	0
Lost frames	0		
Input overflows	0	Driver output errors	0

The following section describes general interface statistics:

Nt Global interface number

Nt' Applies only to dial circuits

Interface

Interface name and Number of this interface within interfaces of type “intrfc”

Port Port number

Slot Slot number

Self-Test: Pass

Number of times self-test succeeded

Self-Test: Fail

Number of times self-test failed

Maint: Fail

Number of maintenance failures

The following section describes the statistics displayed that are specific to the Token-Ring interfaces:

Physical address

Specifies the physical address of the Token-Ring interface.

Network speed

Specifies the speed of the Token-Ring network that connects to the interface. The Network Speed counter displays the number of packets that the interface can pass per second.

Max packet size (info)

Displays the maximum packet size configured for that interface. The Max Packet Size counter displays the maximum length, in bytes, of a packet that the interface transmits or receives. This counter is user-defined.

Handler state

Displays the current state of the Token-Ring handler. The Handler state counter displays the state of the handler after the self-test runs.

Last ReportedRing status

Last Ring Status of the Token Ring interface.

- SIGL** SIGNAL_LOSS The interface has detected a loss of signal on the ring.
- HERR** HARD_ERROR The interface is presently transmitting or receiving beacon frames on the ring.
- SERR** SOFT_ERROR The interface has transmitted a report error MAC frame.
- BEAC** TRANSMIT_BEACON The interface is transmitting beacon frames to or from the ring.
- LWF** LOBE_WIRE_FAULT The interface has detected an open or short circuit in the cable between the interface and the wiring concentrator. The interface is closed and is at the state following initialization.
- ARMV** AUTO_REMOVAL_ERROR The interface has failed the lobe wrap test, which resulted from the beacon auto-removal process, and has removed itself from the ring. The interface has closed and is at the state following initialization.
- RMVD** REMOVED_RECEIVED The interface has received a remove ring station MAC frame request and has removed itself from the ring. The interface is closed and is at the state following initialization.
- CO** COUNTER_OVERFLOW One of the following error counters has incremented from 254 to 255: Line, ARI/FCI, Frame Copy, Lost Frames, Burst, Lobe wire faults, Removes received. This display shows these error counters.
- SSTA** SINGLE_STATION The interface has sensed that it is the only station on the ring.

Using the GWCON Interface Command

RR RING_RECOVERY The interface observes claim Token MAC frames on the ring. The interface may be transmitting the claim Token frames. This status remains until the interface transmits a ring purge frame.

of times signal lost

Specifies the total number of times that the router was unable to transmit a packet due to loss of signal.

Hard errors

Displays the number of times the interface transmits or receives beacon frames from the network.

Auto-removal errors

Displays the number of times the interface, due to the beacon auto-removal process, fails the lobe wrap test and removes itself from the network.

Ring recovery actions

Displays the number of times the interface detects claim token medium access control (MAC) frames on the network.

Line errors

The Line Errors counter increments when a frame is repeated or copied and the Error Detected Indicator (EDI) is zero for the incoming frame:

One of the following conditions must also exist:

- A token with a code violation exists.
- A frame has a code violation between the starting and ending delimiter.
- A Frame Check Sequence (FCS) error occurs.

ARI/FCI errors

The ARI/FCI (Address Recognized Indicator/Frame Copied Indicator) Errors counter increments if the interface receives either of the following:

An Active Monitor Present (AMP) MAC frame with the ARI/FCI bits equal to zero and a Standby Monitor Present (SMP) MAC frame with the ARI/FCI bits equal to zero.

More than one SMP MAC frame with the ARI/FCI bits equal to zero, without an intervening AMP MAC frame.

This error indicates that the upstream neighbor copied the frame but is unable to set the ARI/FCI bits.

Frame copy errors

Displays the number of times the interface in receive/repeat mode recognizes a frame addressed to its specific address but finds the address recognize indicator (ARI) bits not equal to zero. This error indicates a possible line hit or duplicate address.

Lost frames

Displays the number of times the interface is in transmit mode (stripping) and fails to receive the end of a transmitted frame.

Input overflows

Specifies the number of frames that were received that were larger than the input buffer size. Frames that are too large to fit into a single input buffer are discarded.

times beaconing

Displays the number of times the interface transmits a beacon frame to the network.

Using the GWCON Interface Command

Lobe wire faults

Displays the number of times the network detects an open or short circuit in the cable between the interface and the wiring concentrator.

Removes received

Displays the number of times the interface receives a remove ring station MAC frame request and removes itself from the network.

Burst errors

Displays the number of times the interface detects the absence of transitions for five half-bit times between the start delimiter (SDEL) and the end delimiter (EDEL) or between the EDEL and the SDEL.

Inputs dropped

Displays the number of times an interface in repeat mode recognizes a frame addressed to it but has no buffer space available to copy the frame.

Token errors

The token errors counter increments when the active monitor detects a token protocol with any of the following errors:

- The MONITOR_COUNT bit of token with nonzero priority equals one.

- The MONITOR_COUNT bit of a frame equals one. No token or frame is received within a 10-ms window.

- The starting delimiter/token sequence has a code violation in an area where code violations must not exist.

Using the GWCON Interface Command

Chapter 17. Configuring and Monitoring the Fast Token-Ring Network

Fast Token-Ring FasTR uses the existing IBM 2216 ATM adapters as fast token-ring adapters. It supports IP routing, DLSw, APPN, and SRB (Source Route Bridging).

This chapter describes FasTR network configuration and operational commands for FasTR. It includes the following sections:

- “Accessing the FasTR Interface Configuration Process”
- “FasTR Configuration Commands”
- “Accessing the Interface Monitoring Process” on page 218
- “FasTR Interface Monitoring Commands” on page 218
- “FasTR Interfaces and the GWCON Interface Command” on page 219

Accessing the FasTR Interface Configuration Process

To display the FasTR `config>` prompt, enter the network command followed by the interface number of the FasTR interface. For example:

```
Config>network 0
Fast Token-Ring interface configuration
FasTR Config>
```

Use the **list devices** command at the `Config>` prompt to display a list of interface numbers configured on the router.

Note: Whenever you change a parameter, you must restart the router for the changes to take effect.

FasTR Configuration Commands

This section describes the FasTR configuration commands. Enter the commands at the FasTR `config>` prompt. Table 27 lists FasTR configuration commands.

Table 27. FasTR Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Displays the selected FasTR interface configuration.
LLC	Accesses the LLC configuration environment and subcommands.
Media	Defaults to fiber. No input allowed.
Packet-size	Sets maximum packet-size for FasTR networks.
Set	Sets the aging timer for the RIF cache and the physical (MAC) address.
Source-routing	Enables or disables source-routing on the interface.
Speed	Defaults to 155 Mbps. No input allowed.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Configuring the FasTR Network

List

Use the **list** command to display the current configuration for the FasTR interface.

Note: If the MAC address is 0, the default station address is used.

Syntax:

```
list
```

Example:

```
list
```

```
Fast Token-Ring configuration:
    Packet size (INFO field): 2052
Speed:                        155Mbps
Media:                        Fiber

RIF Aging Timer:             120
Source Routing:              Enabled
MAC Address:                  000000000000
```

Packet size	Maximum FasTR packet size.
Speed	Speed of the network, 155Mbps.
Media	Type of media the network uses, fiber.
RIF Aging Timer	Amount of time that the router holds the information contained in the Routing Information Field (RIF).
Source Routing	Status of the source-routing feature, enabled or disabled.
MAC Address	Configured MAC address that was set with the set physical-address command. If all zeros are displayed, the MAC address is the default address.

LLC

Use the **LLC** command to access the LLC configuration environment. See “LLC Configuration Commands” on page 235 for an explanation of each of these commands.

Syntax:

```
llc
```

Example:

```
llc
```

```
LLC config>
```

Note: If APPN is not included in your router software load, you will receive the following message if you try to use this command:

```
LLC configuration is not available for this network.
```

The LLC configuration environment is only available if APPN is included in the software load.

Media

The default media type is fiber. No input allowed.

Packet-Size

Use the **packet-size** command to set the maximum packet-size for FasTR networks. Enter the **packet-size** command followed by the desired number of bytes.

Note: If the packet size is increased, buffer memory requirements will also increase.

Syntax:
packet-size #bytes

Example:
packet-size 4399

Set

Use the **set** command to set the Routing Information Field (RIF) timer and the physical (MAC) address.

Syntax: set
physical-address
rif-timer

physical-address

Indicates whether you want to define a locally administered address for the FasTR interface's MAC sublayer address, or use the default factory station address (indicated by all zeroes). The MAC sublayer address is the address that the FasTR interface uses to receive and transmit frames.

Note: Pressing **Return** leaves the value the same. Entering **0** and pressing **Return** causes the router to use the factory station address. The default is to use the factory station address.

Valid values: Any 12-digit hexadecimal address.

Default value: burned-in address (indicated by all zeroes).

Example:
set physical-address
MAC address in 00:00:00:00:00:00 form []?

rif-timer

Sets the maximum amount of time (in seconds) that the information in the RIF is maintained before it is refreshed. The default is 120.

Example:
set rif-timer
RIF aging timer value [120]? 120

Source-routing

Use the **source-routing** command to enable or disable end station source routing. Source routing is the process by which end stations determine the source route to use to cross source routing bridges. Source routing allows the IP protocol to reach nodes on the other side of the source routing bridge.

This switch is completely independent of whether this interface is providing source routing via the SRT forwarder. The default setting is enabled.

Some stations cannot properly receive frames with a Source Routing RIF on them. This is especially common among NetWare drivers. Disabling source routing in this situation will allow you to communicate with these stations.

Configuring the FasTR Network

Source routing should be enabled only if there are source-routing bridges on this ring that you want to bridge IP packets through. Source routing must also be enabled so LLC test response messages can be returned.

Syntax: source-routing

enable

disable

Example: `source-routing enable`

Speed

The default speed is 155 Mbps. No input allowed.

Accessing the Interface Monitoring Process

To display the token-ring monitoring prompt (TKR>), enter the network command followed by the interface number of the FasTR interface. For example:

```
+network 0
TKR>
```

Use the **list devices** command at the Config> prompt to display a list of interface numbers configured on the router.

Follow the procedure described in “Chapter 15. Getting Started with Network Interfaces” on page 203 to access the interface monitoring process for the interface described in this chapter. Once you have accessed the desired interface monitoring process, you can begin entering monitoring commands.

FasTR Interface Monitoring Commands

This section describes the FasTR monitoring commands. Enter commands at the TKR> monitoring prompt. Table 28 lists the monitoring commands.

Table 28. FasTR Monitoring Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Dump	Displays a dump of the RIF cache.
LLC	Displays the LLC monitoring prompt.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Dump

When source routing is enabled in the FasTR config> process, you can use the **dump** command to request a dump of the RIF cache contents.

Syntax:

dump

Example:

`dump`

Configuring the FasTR Network

```
MAC address  State  Usage  RIF
0000C90B1A57 ON_RING Yes 0220
```

MAC address	Displays the MAC address of the FasTR interface.
State	Displays one of the interface states: On_ring - indicates that a RIF was found for a node on the ring. Have_route - indicates that a RIF was found for a node on a remote ring. No_route - is displayed for a brief period of time as an explorer frame is sent out and the router is waiting for a return. Discovering - indicates that the router sent an explorer frame to rediscover the RIF. St_route - indicates that a route obtained from a Spanning tree explorer.
Usage	Indicates that a RIF was used in a packet. The number is arbitrary and has no functional significance.
RIF	Displays a code that indicates the RIF in hexadecimal. Note: The RIF is displayed only if Source Route Bridging is enabled on the FasTR interface. <ul style="list-style-type: none">• NetBIOS RIF data can be displayed using the following sequence of commands: talk 5, protocol ASRT, name-caching, list cache rifs.• Data Link Switching RIF data can be displayed using the following sequence of commands: talk 5, protocol dlsw, list llc2 session all.

LLC

Use the **LLC** command to access the LLC monitoring prompt. LLC commands are entered at this new prompt. See “LLC Monitoring Commands” on page 239 for an explanation of each of these commands.

Syntax:

```
llc
```

Example:

```
llc
LLC user monitoring
LLC>
```

FasTR Interfaces and the GWCON Interface Command

While FasTR interfaces have their own monitoring processes for monitoring purposes, the router also displays complete statistics for installed network interfaces when you use the **interface** command from the GWCON environment.

Statistics Displayed for FasTR Interfaces

The following statistics display when you enter the **interface <net #>** command for a FasTR interface from the GWCON environment.

```
+i 0
Nt Nt' Interface Slot-Port          Self-Test  Self-Test  Maintenance
0  0  TKR/0   Slot: 1  Port:          Passed    Failed    Failed
0                                     1         1         0
```

Token-Ring/802.5 MAC/data-link on Fast Token Ring interface

Using the GWCON Interface Command

```

Physical address      0000000019100
Network speed        155 Mbps
Max packet size (INFO) 2052
Handler state        Ring open

Hdr Thresh:          0 Bad CRC:          0
Bad Length:          0 Max Len Exc.:      0
Rcv Timeout:         0 Fwd Aborts:       0
Nonzero CPI:         0

Cells Rcvd:          0 NUD Rcvd:         0
NUD Bad CRC:         0 Bad HEC:         0

LCD Events:
AAL0 No Buf:         0 AAL5 No Buf:       0
NUD No Buf:          0
Rx No Sysbuf:        0 Tx No Chrmbf:     0

GPDMA Events:
Tx DMA Error:        0 Rx DMA Error:     0
Buf Overflow:        0 Virt Mem Res:     0
Lost Events:         0 Ill. Events:      0
+

```

The following section describes general interface statistics:

Nt	Global interface number
Nt'	Applies only to dial circuits
Interface	Interface name and Number of this interface within interfaces of type "intrfc"
Slot-Port	Slot number and Port number
Self-Test: Pass	Number of times self-test succeeded
Self-Test: Fail	Number of times self-test failed
Maintenance Failed	Number of maintenance failures

The following section describes the statistics displayed that are specific to the FasTR interfaces:

Physical address	Specifies the physical address of the FasTR interface.
Network speed	Specifies the speed of the FasTR network that connects to the interface. The Network Speed counter displays the number of packets that the interface can pass per second.
Max packet size (info)	Displays the maximum packet size configured for that interface. The Max Packet Size counter displays the maximum length, in bytes, of a packet that the interface transmits or receives. This counter is user-defined.
Handler state	Displays the current state of the FasTR handler. The Handler state counter displays the state of the handler after the self-test runs.
Hdr Thresh	Packet header thresholds exceeded.
Bad CRC	Packets received with bad CRC.
Bad Length	Packets received with bad length.
Max Len Exc.	Packets received exceeding maximum length.
Rcv Timeout	Timeouts on received packet reassembly.
Fwd Aborts	Received packets terminated with a forward abort.
Nonzero CPI	Packets received with CPI field not set to zero.
Cells Received	Cells received (not packets).
NUD Rcvd	Non-user data fields received.
NUD Bad CRC	Non-user data fields received with bad CRC_10.
Bad HEC	Cells received with bad Header Error Check.
LCD Events	
AAL0 No Buf	AAL0 cells dropped due to lack of pools buffers.
AAL5 No Buf	AAL5 cells dropped due to lack of pools buffers.
NUD No Buf	Non-user data dropped due to lack of pools buffers.

Using the GWCON Interface Command

Rx No Sysbuf	Packets received but dropped because no system buffers were available.
Tx No Chrmbuf	Transmit packets dropped because no adapter buffers were available.
GPDMA Events	
Tx DMA Error	Transmit DMAs with errors.
Rx DMA Error	Receive DMAs with errors.
Buf Overflow	Received packets that exceeded the real buffer size.
Virt Mem Res	Virtual Memory resource events, writing cells into virtual memory.
Lost Events	Events lost because the receive queue was full.
Ill. Events	Unrecognized events.

Using the GWCON Interface Command

Chapter 18. Using FDDI

This chapter describes how to set software-configurable information for the Fiber Distributed Data Interface (FDDI) in the router.

This chapter contains the following sections:

- “Fiber Distributed Data Interface (FDDI) Overview”

Fiber Distributed Data Interface (FDDI) Overview

Fiber Distributed Data Interface (FDDI) is described by the ANSI X3T9.5 and ISO 9314 committees as a dual counter-rotating ring that operates at a defined speed of 100 Mbps.

In many ways, FDDI is similar to the IEEE 802.5 token-ring, although there are differences, some of which are described in “Differences Between FDDI and Token-Ring” on page 224.

Token-Passing Ring Network

FDDI is defined as a token-passing protocol. Each station has the chance to transmit data when a token passes. A station can decide how many frames it will transmit using an algorithm that permits “bandwidth” allocating.

FDDI also allows a station to transmit many frames without releasing the token in a way that is similar to the IEEE 802.5 token-ring standard.

An FDDI ring network consists of a set of stations/devices connected as a serial string of stations/devices and transmission media to form a physically closed loop. Information is transmitted sequentially as a stream of suitably encoded signals from one active station/device to the next active one.

Each station/device generally regenerates and repeats each token and can serve as the means of attaching one or more stations/devices to the network.

Primary and Secondary Rings

FDDI defines two rings:

- The *primary ring*, which is similar to the main ring path in a token-ring network.
- The *secondary ring*, which is similar to the backup ring path in a token-ring network.

Each ring path consists of two fibers, each fiber transmitting one signal; one is pushed and one is pulled in a device. Each fiber is equivalent to a pair of copper conductors. The physical approach in terms of fiber optics is similar to physical fiber optic token-ring paths.

Attachment of Devices

FDDI permits many attachment units:

- Stations or devices

Using FDDI

- Concentrators
- Bridges

These units can be attached to FDDI networks in various ways, similar to those for token-ring networks.

Differences Between FDDI and Token-Ring

The main differences between FDDI and token-ring techniques are:

- A device can be attached directly to rings without a concentrator, such as a multi-station access unit (MSAU) on a token ring.
- A device can be attached to either or both of the primary and secondary rings.

FDDI defines two device classes, A and B, to differentiate between devices that attach to one ring or both rings, as described in the next section.

Device Classes A and B

FDDI defines two device classes:

- A **Class A** device attaches to both rings directly.
It can be a station, called a *Class A station* or *Dual Access Station (DAS)*, or it can be a Concentrator, called a *Dual Access Concentrator (DAC)*
- A **Class B** device attaches to only one of the rings directly or through a concentrator.
It can be a station, called a *Class B station* or *Single Access Station (SAS)*, or it can be a Concentrator, called a *Single Access Concentrator (SAC)*

FDDI Network Diagram

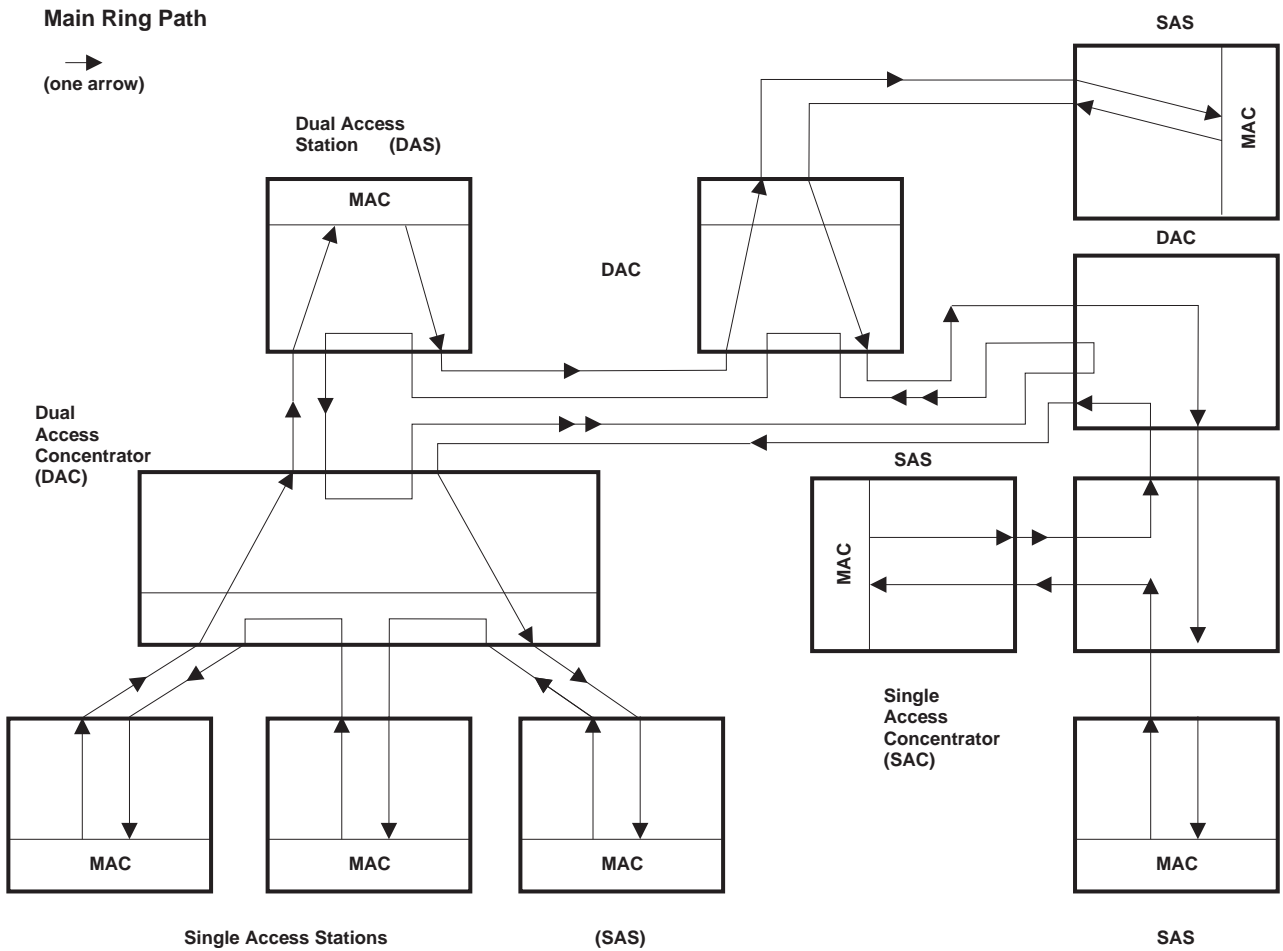


Figure 15. FDDI Network Diagram. This diagram shows Single Access Stations (SAS), Dual Access Stations (DAS), Single Access Concentrators (SAC), and Dual Access Concentrators (DAC) in one Main Ring Path of an FDDI network.

Chapter 19. Configuring and Monitoring FDDI

This chapter describes the FDDI interface configuration and operational commands. It includes the following sections:

- “Accessing the FDDI Configuration Commands”
- “FDDI Configuration Commands”
- “Accessing FDDI Monitoring Commands” on page 230
- “FDDI Monitoring Commands” on page 230

Accessing the FDDI Configuration Commands

You can access FDDI configuration from Talk 6. To do so, enter the **add device** command to add an FDDI interface to the network and assign an interface number to it, and then use the **network** command to access the FDDI interface as shown in the following example:

```
800 Config> add device fddi
SK-NET FDDI device in slot 0 port 1 as interface #2
Use "net 2" to configure SK-NET FDDI parameters

800 Config> network ?
0 :CHARM ATM Adapter
1 :ATM Token Ring LAN Emulation: elan1
2 :SK-NET FDDI

800 Config> network 2
FDDI Interface Configuration
FDDI Config>
```

This will get you to the FDDI Config> prompt.

When you are finished, enter **Exit** to return to the previous prompt level.

FDDI Configuration Commands

This section describes the FDDI configuration commands as shown in Table 29. Enter the commands from the FDDI Config> prompt.

Table 29. FDDI Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
LLC	Provides access to the LLC configuration environment.
List	Displays the selected FDDI configuration.
Set	Sets FDDI parameters.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

LLC

Use the **LLC** command to access the LLC configuration environment. See “LLC Configuration Commands” on page 235 for an explanation of LLC command.

Syntax:

Configuring FDDI

llc

List

Use the **list** command to display the current configuration for the FDDI.

Syntax:

```
list                all  
                    ler  
                    pmf  
                    tmax  
                    tmin  
                    treq  
                    tvx  
                    userdata
```

- all** Lists all of the output for the various parameters that follow.
- ler** Lists the link error rate alarms and cutoff values for port A and port B.
a -- lists the link error rate alarms and cutoff values for port A.
b -- lists the link error rate alarms and cutoff values for port B.
- pmf** Displays the PMF Password (maximum of 8 characters).
- tmax** Lists the Maximum Token Rotation Time (in milliseconds).
- tmin** Lists the Minimum Token Rotation Time (in milliseconds).
- treq** Lists the Requested Target Token Rotation Time (in milliseconds).
- tvx** Lists the Valid transmission timer expiration (in microseconds)
- userdata**
Displays the user data (maximum of 32 characters).

Set

Use the **set** command to configure FDDI.

Syntax:

```
set                ler  
                    pmf  
                    tmax  
                    tmin  
                    treq  
                    tvx  
                    userdata  
  
ler port# type    Sets the alarm and cutoff values for port A and port  
                    B as follows:
```


ler a alarm

Sets the alarm values for port A.

ler a cutoff

Sets the cutoff values for port A.

ler b alarm

Sets the alarm values for port B.

ler b cutoff

Sets the cutoff values for port B.

Valid values and defaults

Alarm or Cutoff	Valid Values	Default
Alarm	4 to 15	8
Cutoff	4 to 15	7

pmf

Sets the PMF Password (maximum of 8 characters).

tmax

Sets the Maximum Token Rotation Time (in milliseconds) that this station can accept. Commonly referred to in FDDI specifications as T_Max.

Valid values: 5 to 165 milliseconds

Default: 165 milliseconds

tmin

Sets the Minimum Token Rotation Time (in milliseconds) that this station can accept. If the negotiated TTRT is less than this value, then the adapter will not provide proper service to the layers above it. Commonly referred to in FDDI specifications as T_Min.

Valid values: 5 to 165 milliseconds

Default: 5 milliseconds

treq

Sets the Requested Target Token Rotation Time (in milliseconds) that this station will bid during initialization. Commonly referred to in FDDI specifications as T_Req.

Valid values: 5 to 165 milliseconds

Default: 165 milliseconds

tvx

Sets the Valid transmission timer expiration (in microseconds). This timer is reset every time a valid frame or nonrestricted token is seen by the station. If the timer expires, it indicates that traffic is not circulating properly on the ring and therefore the claim process is started. Commonly referred to in FDDI specifications as TVX.

Valid values: 2500 to 10 000 microseconds

Default: 2500 microseconds.

userdata

Sets the User data (maximum of 32 characters).

Accessing FDDI Monitoring Commands

You can access FDDI configuration from Talk 5 by entering the **network** command to access the FDDI interface as shown in the following example:

```
800+ network ?
0 :CHARM ATM Adapter
1 :ATM Token Ring LAN Emulation: elan1
2 :SK-NET FDDI

800 + network 2
FDDI Interface
FDDI>
```

This will get you to the FDDI> prompt.

When you are finished, enter **Exit** to return to the previous prompt level.

FDDI Monitoring Commands

The monitoring commands for FDDI are:

Table 30. FDDI Monitoring Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Displays the FDDI adapter information
LLC	Displays the LLC monitoring prompt.
Srt-stats	Displays the FDDI bridging statistics.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

LLC

Use the **LLC** command to access the LLC configuration environment. See “LLC Configuration Commands” on page 235 for an explanation of LLC command.

Syntax:

llc

List

Use the **list** command to display the current FDDI configuration parameters.

Syntax:

list

Example:

```
FDDI> list
MAC Address: 00:00:5A:00:00:01
```

Srt-stats

Use the **srt-stats** command to display the hardware assisted bridged statistics on this interface.

Syntax:**srt-stats****Example:**

```

srt-stats
Port Supports:                Transparent Bridging Only

Frames received:                806
Bytes received:                34588
Maximum size of filter table in adapter: 4088
Number of entries in filter table: 0
Number of dynamic entries in filter table: 0

```

FDDI Interfaces and the GWCON Command

While the FDDI interfaces have their own monitoring processes for monitoring, the router also displays complete statistics for installed network interfaces when you use the interface command from the GWCON environment.

Statistics Displayed from FDDI Interfaces

The following statistics are displayed when you enter the **interface net#** command for a FDDI interface from the GWCON environment.

```

          Self-Test   Self-Test   Maintenance
Nt Nt'  Interface Slot-Port      Passed   Failed   Failed
0  0    FDDI/0   Slot: 1  Port: 1      1         0         0

IEEE 802.2/FDDI MAC/data-link on SK-NET FDDI interface
Address: 00:60:94:C4:00:40
UNA:     00:00:5A:02:2D:1E -> DNA: 00:00:5A:02:2D:1E
-----
ECM State Machine:      IN
PCM State Machine Port A: SIGNAL
PCM State Machine Port B: ACTIVE
CFM State Machine Port A: ISOLATED
CFM State Machine Port B: CONCATENATED
CF State Machine:      C WRAP B
MAC Current Path:      PRIMARY
RMT State Machine:      RING_OP
-----
TVX expired ct: 0
Beacon ct: 0
Claim ct: 0
RingOp ct: 1
-----
PHYA:LEM_Ct: 0 LEM_Reject_Ct: 0 LCT fails: 40
      Alarm: 10^-8 Cutoff: 10^-7 Estimate: 10^-15
PHYB:LEM_Ct: 0 LEM_Reject_Ct: 0 LCT fails: 40
      Alarm: 10^-8 Cutoff: 10^-7 Estimate: 10^-15
-----
T_Notify 10 sec, SMT frames in:55363 SMT frames out:35317
-----
Frames:211764, Errors:0, Losses:0, Xmts:144058, Copied:171046, Not Copied:0

```

The following section describes general interface statistics:

Nt Global interface number

Nt' Applies only to dial circuits

interface

Interface name and number of this interface within interfaces of type "intrfc".

Port Port number

Slot Slot number

Monitoring FDDI

Self-Test Passed

Number of times self-test succeeded.

Self-Test Failed

Number of times self-test failed.

Maintenance Failed

Number of maintenance failures.

The following section describes the statistics displayed that are specific to the FDDI interfaces:

Address

Specifies the physical address of the FDDI interface.

UNA Specifies the physical address of the upstream neighbor.

DNA Specifies the physical address of the downstream neighbor.

ECM State Machine

Entity Coordination Management controls the management of the media interface, including all the ports at the node. It also controls the optical bypass.

OUT
IN
TRACE
LEAVE
PATH-TEST
INSERT
CHECK
DEINSERT

PCM State Machine

Physical Connection Management controls the management of the physical connection between a port being managed and another port in the adjacent node.

OFF
BREAK
TRACE
CONNECT
NEXT
SIGNAL
JOIN
VERIFY
ACTIVE
MAINT

CFM State Machine

Configuration Management manages the configuration of MACs and ports within a node.

ISOLATED
LOCAL
SECONDARY
PRIMARY
CONCATENATED
THRU

CF State Machine

Attachment configuration.

ISOLATED
LOCAL_A
LOCAL_B
LOCAL_AB
LOCAL_S
WRAP_A
WRAP_B
WRAP_AB
WRAP_S
C_WRAP_A
C_WRAP_B
C_WRAP_S
THRU

MAC Current Path

Current path which this MAC is inserted.

ISOLATED
LOCAL
SECONDARY
PRIMARY

RMT State Machine.

Ring Management controls the timing of the MAC management frames.

ISOLATED
NON_OP
RING_OP
DETECT_BEACON
NON_OP_DUP
RING_OP_DUP
DIRECTED
RM-TRACE
DETECT_CLAIM
DETECT_IDLE

TVX expired ct

Number of times TVX expired.

Beacon ct

Number of times beacon state entered.

Claim ct

Number of times claim state entered.

RingOp ct

Number of times ring has entered operational state.

LEM_Ct

Link error monitor error count.

LCT fails

Count of consecutive times the link confidence test has failed.

Alarm Estimate at which a link connection will generate an alarm.

Cutoff Estimate at which a link connection will be broken.

Estimate

Long term average link error rate.

Frames

Number of frames received.

Errors Number of frames detected in error.

Losses Number of format errors during reception.

Xmts Number of frames transmitted.

Copied

Number of frames copied.

Not Copied

Number of frames not copied.

T_Notify

Neighbor notification timer.

SMT frames in

Number of SMT frames received.

SMT frames out.

Number of SMT frames sent.

Monitoring FDDI

Chapter 20. Configuring and Monitoring LLC Interfaces

This chapter describes how to configure specific LLC interfaces in the router by using either the interface commands or the GWCON interface command.

Logical Link Level can be thought of as a “sub-protocol”. It is not accessed directly from either the Talk 6 (configuration) or the Talk 5 (monitoring) environment. Instead, it is accessed from the Token Ring, Point-to-Point (PPP), or Frame Relay protocols by entering an **LLC** command.

This chapter includes the following sections:

- “Accessing the Interface Configuration Process”
- “Accessing the Interface Monitoring Process” on page 238
- “LLC Monitoring Commands” on page 239
- “LLC Configuration Commands”

Accessing the Interface Configuration Process

Access the configuration commands for the protocol you wish to configure over LLC:

- Token Ring, as described in “Chapter 16. Configuring IEEE 802.5 Token-Ring Network Interfaces” on page 205
- Point-to-Point, as described in “Chapter 39. Using Point-to-Point Protocol Interfaces” on page 531
- Frame Relay, as described in “Chapter 37. Using Frame Relay Interfaces” on page 469
- FDDI, as described in “Chapter 18. Using FDDI” on page 223

Each of these prompt levels has an LLC command. Enter **LLC** to access the LLC configuration commands and perform LCC configuration. When you are finished, enter **Exit** to return to the prompt level for the protocol you are configuring.

LLC Configuration Commands

LLC configuration is required when you need to pass packets over an SNA network. To enter these commands, you must first enter the LLC configuration environment (see “Accessing the Token-Ring Interface Configuration Process” on page 205).

This section summarizes and then explains all of the LLC configuration commands. These commands, shown in Table 31, enable you to configure LLC when you need to pass packets over a SNA network.

Table 31. LLC Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Displays the selected LLC configuration.

Configuring LLC

Table 31. LLC Configuration Command Summary (continued)

Command	Function
Set	Sets the timers associated with LLC, and the size of the transmit and receive windows.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

List

Use the **list** command to display the current configuration for the LLC.

Syntax:

list

Example:

```
list
Reply Timer (T1):          1 seconds
Receive ACK Timer (T2):   100 milliseconds
Inactivity Timer (Ti):     30 seconds
Max Retry value (N2):     8
Rcvd I-frames before ACK (N3): 1
Transmit Window (Tw):     2
Receive Window (Rw):      2
Acks needed to increment Ww (Nw): 1
```

Reply Timer (T1)

This timer expires when the LLC fails to receive a required acknowledgment or response from the other LLC station.

Receive ACK Timer (T2)

This timer is used to delay sending of an acknowledgment for a received I-format frame.

Inactivity Timer (Ti)

This timer expires when the LLC does not receive a frame for a specified time period. When this timer expires the LLC transmits an RR until the other LLC responds or the N2 retry count is exceeded. Default is 30 seconds.

Max Retry value (N2)

The maximum number of retries by the LLC protocol. Default is 8.

Rcvd I-frames before ACK (N3)

This value is used with the T2 timer to reduce acknowledgment traffic for received I-frames. This counter sets a specified value and decrements each time an I-frame is received. When this counter reaches 0 or the T2 timer expires, an acknowledgment is sent. Default is 1.

Receive Window (Rw)

Indicates the maximum number of unacknowledged sequentially numbered I-frames that an LLC can receive from a remote host.

Transmit Window (Tw)

Indicates the maximum number of I-frames that can be sent before receiving an RR.

Acks needed to increment Ww (Nw)

This field is set to a default value of 1.

Set

Use the **set** command to configure the LLC.

Attention: Changing LLC parameters from the defaults can affect how the LLC protocol works.

Syntax:

```

set          n2-max-retry count
             n3-frames-rcvd-before-ack count
             nw-acks-to-inc-window count
             rw-receive-window count
             t1-reply-timer seconds
             t2-receive-ack-timer seconds
             ti-inactivity-timer seconds
             tw-transmit-window count

```

n2-max-retry

The maximum number of retries by LLC protocol. For example, N2 is the maximum number of times the LLC transmits an RR without receiving an acknowledgment when the inactivity timer expires. Default is 8. Minimum is 1. Maximum is 127.

Example:

```

set n2-max-retry
Max Retry value (N2) [8]?

```

n3-frames_rcvd-before-ack

This value is used with the T2 timer to reduce acknowledgment traffic for received I-frames. Set this counter to a specified value. Each time an I-frame is received, this value decrements. When this counter reaches 0 or the T2 timer expires, an acknowledgment is sent. Default is 1. Minimum is 1. Maximum is 255.

Example:

```

set n3-frames_rcvd-before-ack
Number I-frames received before sending ACK(N3) [1]?

```

rw-receive-window

Indicates the maximum number of unacknowledged sequentially numbered I-frames that an LLC can receive from a remote LLC peer. This value must be equal to or less than 127.

Example:

```

set rw-receive-window
Receive Window (Rw), 127 Max. [2]?

```

nw-acks-to-inc-ww

This field is set to a default value of 1.

t1-reply-timer

This timer expires when the LLC fails to receive a required acknowledgment or response from the other LLC station. When this timer expires, an RR is sent with the poll bit set and T1 is started again. If the LLC receives no response after the configured maximum number of retries (N2), the link underneath is declared inoperative. Default is 1. Minimum is 1. Maximum is 256.

Configuring LLC

Example:

```
set t1-reply-timer
Reply Timer (T1) in sec. [1]?
```

t2-receive-ack-timer

This timer is used to delay sending of an acknowledgment for a received I-format frame. This timer is started when an I-frame is received. The timer is reset when an acknowledgment is sent. If this timer expires, LLC2 sends an acknowledgment as soon as possible. Set this value so that it is less than that of T1. This insures that the remote LLC2 peer receives the delayed acknowledgment before the T1 timer expires. Default is 1 (100 ms). Minimum is 1. Maximum is 2560.

Example:

```
set t2-receive-ack-timer
Receive Ack timer (T2) in 100 millisec. [1]?
```

Note: If this timer is set to 1 (the default) it will not run (for example, **n3-frames_rcvd-before-ack = 1**).

ti-inactivity-timer

This timer expires when the LLC does not receive a frame for a specified time period. When this timer expires the LLC transmits an RR until the other LLC responds or the N2 retry count is exceeded. Default is 30 seconds. Minimum is 1 second. Maximum is 256 seconds.

Example:

```
set ti-inactivity-timer
Inactivity Timer (Ti) in sec. [30]?
```

tw-transmit-window

Sets the maximum number of I-frames that can be sent before receiving an RR. Assuming that the other end of the LLC session can actually receive this many consecutive I-frames, and the router has enough heap memory to keep copies of these frames until an acknowledgment is received, increasing this value may increase the throughput. Default is 2. Minimum is 1. Maximum is 127.

Example:

```
set tw-transmit-window
Transmit Window (Tw), 127 Max. [2]?
```

Accessing the Interface Monitoring Process

Access the monitoring commands for the protocol you wish to monitor over LLC:

- Token Ring, as described in “Chapter 16. Configuring IEEE 802.5 Token-Ring Network Interfaces” on page 205
- Point-to-Point, as described in “Chapter 40. Configuring and Monitoring Point-to-Point Protocol Interfaces” on page 547
- Frame Relay, as described in “Chapter 38. Configuring and Monitoring Frame Relay Interfaces” on page 487
- FDDI, as described in “Chapter 18. Using FDDI” on page 223

Each of these prompt levels has an LLC command. Enter **LLC** to access the LLC monitoring commands to monitor LCC. When you are finished, enter **Exit** to return to the prompt level for the protocol you are monitoring.

LLC Monitoring Commands

This section summarizes and then explains all of the LLC monitoring commands. These commands, shown in Table 32, let you monitor the LLC while passing packets over an SNA network.

Table 32. LLC Monitoring Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Clear-counters	Clears all statistical counters.
List	Displays interface, SAP, and session information.
Set	Allows the user to dynamically configure LLC parameters that are valid for the life of the session.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Clear-Counters

Use the **clear-counters** command to clear all the LLC statistical counters.

Syntax:

clear-counters

List

Use the **list** command to display interface, service access point (SAP), and session information.

Syntax:

```
list                interface
                    sap . . .
                    session
```

interface

Displays all SAPs opened on this interface.

Example:

```
list interface
SAP      Number of Sessions
F4       1
```

sap sap_number

Displays information for the specified SAP on the interface.

Example:

```
list sap
SAP value in hex (0FE) [1]? F4

Interface                0, TKR/0
Reply Timer(T1)          1 sec
Receive ACK Timer (T2)   100 millisec
Inactivity Timer (Ti)    30 sec
MAX Retry Value (N2)     8
MAX I-field Size (N1)    2052
Rcvd I-frames before ACK (N3) 1
Transmit Window Size (Tw) 2
Acks Needed to Inc Ww (Nw) 1
```

Monitoring LLC

Frame	Xmt	Rcvd
UI-frames	4	5
TEST-frames	0	1
XID-frames	0	0
I-frames	291	26
RR-frames	81	291
RNR-frames	0	0
REJ-frames	0	0
SABME-frames	1	0
UA-frames	0	1
DISC-frames	0	0
DM-frames	0	0
FRMR-frames	0	0
I-frames discarded by LLC		0
I-frames Refused by LLC user		0
Cumulative number of sessions		1
Number of active sessions		1

Session ID (int-sap-id)	Local MAC	Remote MAC	Remote SAP	State
00F40000	00:00:C9:08:41:DB	10:00:5A:F1:02:37	F4	OPENED

SAP value in hex (0FE)

The SAP value of the session.

Interface

The interface number and type over which the session is running.

Reply Timer (T1)

Indicates the time it takes for this timer to expire when the LLC fails to receive an acknowledgment or response from the other LLC station.

Receive ACK Timer (T2)

Indicates the time delay the LLC uses before sending an acknowledgment for a received I-frame.

Inactivity Timer (Ti)

Indicates the time the LLC waits during inactivity before issuing an RR.

MAX Retry Value (N2)

The maximum number of retries by the LLC protocol.

MAX I-field Size (N1)

Maximum amount of data (in bytes) allowed in the I-field of an LLC2 frame.

Rcvd I-frame before ACK (N3)

Indicates the value that is used with T2 timer to reduce acknowledgment traffic for received I-frames.

Transmit Window Size (Tw)

Indicates the maximum number I-frames that can be sent before receiving an RR.

Acks Needed to Inc Ww (Nw)

This field is set to a default value of 1.

Frames Xmt and Rcvd

Counter that displays the total number of frame types transmitted (Xmt) and (Rcvd).

I-frames discarded by LLC

Counter that displays the total number of I-frames discarded by the LLC, usually because the sequence number is out of sequence.

I-frames refused by LLC user

Counter that displays the number of I-frames discarded by the software above the LLC. For example, DLSw (Data Link Switching).

Cumulative number of sessions

The total number of sessions that were opened over this SAP.

Number of active sessions

The total number of currently active sessions that are running over the interface.

Session ID (int-sap-id)

The session ID for the monitoring interface.

Local MAC

The router's LLC MAC address.

Remote MAC

The remote LLC's MAC address.

Remote SAP

The remote SAP of the LLC connection.

Remote State

The finite state(s) that results from interaction between the LLC peers. There are 21 states that are described below.

Link_Closed

The remote LLC peer is not known to the local LLC peer and is considered as not existing.

Disconnected

The local LLC peer is known to the other peer. This LLC peer can send and receive XID, TEST, SABME, and DISC commands; and XID TEST, UA, and DM responses.

Link_Opening

The state of the local LLC peer after sending a SABME or UA in response to a received SABME.

Disconnecting

The state of the local LLC after sending a DISC command to the remote LLC peer.

FRMR_Sent

The local LLC peer has entered the frame reject exception state and has sent a FRMR response across the link.

Link_Opened

The local LLC peer is in the data transfer phase.

Local_Busy

The local LLC peer is unable to receive additional I-frames.

Rejection

A local LLC peer that has received one or more out-of-sequence I-frames.

Checkpointing

The local LLC peer has sent a poll to the remote LLC peer and is waiting for an appropriate response.

CKPT_LB

A combination of checkpointing and local busy states.

Monitoring LLC

CKPT_REJ

A combination of the checkpointing and rejection states.

Resetting

The local LLC peer has received a SABME and is reestablishing the link.

Remote_Busy

The state that occurs when an RNR is received from the remote LLC peer.

LB_RB

A combination of local_busy and remote_busy states.

REJ_LB

A combination of rejection and local_busy states.

REJ_RB

A combination of rejection and remote_busy states.

CKPT_REJ_LB

A combination of checkpointing, rejection, and local_busy states.

CKPT_CLR

A combination state resulting from the termination of a local_busy condition while the LLC peer is CKPT_LB.

CKPT_REJ_CLR

A combination state resulting from the transfer of an unconfirmed local busy clear while the link station is in the CKPT_REJ_LB state.

REJ_LB_RB

A combination of the rejection, local_busy, and remote_busy states.

FRMR_Received

The local LLC peer has received an FRMR response from the remote LLC peer.

Session

Displays information on the specified LLC session that is open on the interface.

Example:

```
list session
Session Id: [0]? 00-F4-0000

Interface0,           TKR/0
Remote MAC addr      10:00:5A:F1:02:37
Source MAC addr      00:00:C9:08:35:47
Remote SAP            F4
Local SAP             F4
RIF                   (089E 0101 0022 0010)
Access Priority       0
State                 LINK_OPENED
Replay Timer          1 sec
Receive ACK Timer (T2) 100 millisec
Inactivity Timer (Ti) 30 sec
MAX I-field Size (N1) 2052
MAX Retry Value (N2)  8
Rcvd I-frames before ACK (N3) 1
Transmit Window Size (Tw) 2
Working Transmit Size (Ww) 2
Acks Needed to Inc Ww (Nw) 1
Current Send Seq (Vs)  9
Current Rcv Seq (Vr)   7
Last ACK'd sent frame (Va) 9
No. of frames in ACK pend q 0
No. of frames in Tx pend q 0
Local Busy            NO
Remote Busy           NO
Poll Retry count      8
Appl output flow stopped NO
Send process running  YES

Frame                Xmt   Rcvd
I-frames              1456  2678
```

RR-frames	502	403
RNR-frames	0	0
REJ-frames	0	0
I-frames discarded by LLC		0
I-frames Refused by LLC user		0

Session Id

Indicates the session ID number.

Interface

Indicates the number of the interface over which this session is running.

Remote MAC addr

Indicates the MAC address of the remote LLC peer.

Source MAC addr

Indicates the MAC address of the local LLC.

Remote SAP

The remote side SAP of the LLC connection.

Local SAP

The local side SAP of the LLC connection.

RIF The actual RIF of the frame.

Access Priority

Priority of the packet. 07 for upper layer control.

State The finite state(s) that results from interaction between the LLC peers. Refer to the **list sap** command on page 239 for more information.

Receive ACK timer (T2)

Indicates the time delay the LLC uses before sending an acknowledgment for a received I-frame.

Inactivity timer (Ti)

Indicates the time the LLC waits during inactivity before issuing an RR.

MAX I-field size (N1)

Maximum size of the data field (in bytes) of a frame. Default is the size of the interface.

MAX Retry Value (N2)

The maximum number of times the LLC transmits an RR without receiving an acknowledgment

Rcvd I-frames before ACK (N3)

Indicates the value that is used with T2 timer to reduce acknowledgment traffic for received I-frames.

Transmit window size (Tw)

Indicates the maximum number of I-frames that can be sent before receiving an RR.

Working transmit size (Ww)

The maximum number of I-frames that are sent before receiving an RR.

Acks Needed to Inc Ww (Nw)

This field is set to a default value of 1.

Monitoring LLC

Current send seq (Vs)

Send state variable (Ns value for the next I-frame to be transferred).

Current Rcv seq (Vr)

Receive state variable (next in-sequence Ns to be accepted).

Last ACK'd sent frame (Va)

Acknowledged state variable (last valid Nr received).

No. of frames in ACK pend q

Number of transmitted I-frames waiting for acknowledgment.

No. of frames in transmit pend q

Number of frames waiting to be transmitted.

Local Busy

The local side of the LLC connection is sending RNRs.

Remote Busy

The remote side of the LLC is receiving RNRs.

Poll Retry count

Indicates the current value of the retry of the counter (counts down) in the LLC protocol.

Appl output flow stopped

The LLC has told the application to stop giving it outgoing data frames.

Send process running

This process runs concurrently with all other frame actions and takes I-frames in the transmit queue and sends them.

Frames Xmt and Rcvd

Displays the total number of frame types transmitted (Xmt) and (Rcvd).

I-frames discarded by LLC

Counter that displays the total number of I-frames discarded by the LLC, usually because the sequence number is out of sequence.

I-frames refused by LLC user

Counter that displays the number of I-frames discarded by the software above the LLC. For example, DLSw (Data Link Switching).

Set

Use the **set** command to dynamically configure the LLC parameters on a current LLC session. Any changes that you make to the parameters are effective for the life of session. These parameters are the same as those listed in "Set" on page 237.

Attention: Changing LLC parameters from the default can affect how the LLC protocol works.

Syntax:

```
set                n2-max_retry count  
                   n3-frames-rcvd-before-ack count  
                   nw-acks-to-inc-ww count
```


t1-reply-timer *seconds*

t2-receive-ack-timer *seconds*

ti-inactivity-timer *seconds*

tw-transmit-window *seconds*

n2-max_retry

The maximum number of retries by LLC protocol. For example, N2 is the maximum number of times the LLC transmits an RR without receiving an acknowledgment when the inactivity timer expires. Default is 8. Minimum is 1. Maximum is 127.

n3-frames-rcvd-before-ack

This value is used with the T2 timer to reduce acknowledgment traffic for received I-frames. Set this counter to a specified value. Each time an I-frame is received, this value is decremented. When this counter reaches 0 or the T2 timer expires, an acknowledgment is sent. Default is 1. Minimum is 1. Maximum is 255.

nw-acks-to-inc-ww

This field is set to a default value of 1.

t1-reply-timer

This timer expires when the LLC fails to receive a required acknowledgment or response from the other LLC station. When this timer expires, an RR is sent with the poll bit set and T1 is started again. If the LLC receives no response after the configured maximum number of retries (N2), the link underneath is declared inoperative. Default is 1. Minimum is 1. Maximum is 256.

t2-receive-ack-timer

This timer is used to delay sending of an acknowledgment for a received I-format frame. This timer is started when an I-frame is received and reset when an acknowledgment is sent. If this timer expires, LLC2 sends an acknowledgment as soon as possible. Set this value so that it is less than that of T1. This insures that the remote LLC2 peer receives the delayed acknowledgment before the T1 timer expires. Default is 1 (100 ms). Minimum is 1. Maximum is 2560.

Note: If this timer is set to 1 (the default) it will not run (for example, **n3-frames-rcvd-before-ack=1**).

ti-inactivity-timer

This timer expires when the LLC does not receive a frame for a specified time period. When this timer expires the LLC transmits an RR until the other LLC responds or the N2 timer expires. Default is 30 seconds. Minimum is 1 second. Maximum is 256 seconds.

tw-transmit-window

Sets the maximum number of I-frames that can be sent before receiving an RR. Assuming that the other end of the LLC session can actually receive this many consecutive I-frames, and the router has enough heap memory to keep copies of these frames until an acknowledgment is received, increasing this value may increase the throughput. Default is 2. Minimum is 1. Maximum is 127.

Monitoring LLC

Chapter 21. Using the Ethernet Network Interface

This chapter describes how to use the Ethernet interface. It includes "Displaying Ethernet Statistics through the Interface Command".

Displaying Ethernet Statistics through the Interface Command

You can also use the **interface** command from the GWCON environment to display the following statistics.

```
+ interface 4
Nt Nt' Interface Slot-Port Self-Test Passed Self-Test Failed Maintenance Failed
4 4 Eth/0 Slot: 4 Port: 1 3 1 0
Ethernet/IEEE 802.3 MAC/data-link on Ethernet interface
Physical address AA0004000318
PROM address 10005AFF0016
Microcode Level Uu17c

Input statistics:
failed, packet too long 0 failed, CRC error 1
failed, alignment error 0 failed, FIFO over-run 0
buffer full warnings 0 packets missed 1
internal mac rx errors 0

Output statistics:
initially deferred 12 single collision 1
multiple collisions 1 total collisions 4
failed, excess collisions 0 failed, FIFO under-run 0
failed, carrier check 0 CD heartbeat error 0
```

These statistics have the following meaning:

Nt Global network number.

Nt' This field is for the serial interface card. Disregard the output.

Interface

Interface name and its instance number.

Port Port number

Slot Slot number

Self-Test: Passed

Number of self-tests that succeeded.

Self-Test: Failed

Number of self-tests that failed.

Maintenance: Failed

Number of maintenance failures.

Physical address

The Ethernet address of the device currently in use. This may be the PROM address or an address overwritten by some other protocol.

PROM address

The permanent unique Ethernet address in the PROM for this Ethernet interface.

Input statistics:

failed, packet too long or failed, frame too long

The Failed, Packet Too Long counter increments when the interface

Using Ethernet Network Interfaces

receives a packet that is larger than the maximum size of 1518 bytes for an Ethernet frame. This data is exported via SNMP as the dot3StatsFrameTooLongs counter.

failed, CRC error or failed, FCS (Frame Check Sequence) error

The Failed, CRC (Cyclic Redundancy Check) Error counter increments when the interface receives a packet with a CRC error. This data is exported via SNMP as the dot3StatsFCSErrors counter.

failed, framing error or failed, alignment error

The Failed, Framing Error counter increments when the interface receives a packet whose length in bits is not a multiple of eight.

failed, FIFO over-run or failed, FIFO overrun

The Failed, FIFO (First In, First Out) Overrun counter increments when the Ethernet chipset is unable to store bytes in the local packet buffer as fast as they come off the wire.

buffer full warnings

The Buffer Full Warnings counter increments each time the local packet buffer is full.

packets missed

The Packets Missed counter increments when the interface attempts to receive a packet, but the local packet buffer is full. This error indicates that the network has more traffic than the interface can handle.

internal mac rcv errors

Receive errors that are not late, excessive, or carrier check collisions. This data is exported via SNMP as the dot3StatsInternalMacReceiveErrors counter. This statistic is the sum of the FIFO Overruns.

Output statistics:

initially deferred or deferred transmission

The Initially Deferred counter increments when the carrier sense mechanism detects line activity causing the interface to defer transmission. This data is exported via SNMP as the dot3StatsDeferredTransmissions counter.

single collision

The Single Collision counter increments when a packet has a collision on the first transmission attempt, and then successfully sends the packet on the second transmission attempt. This data is exported via SNMP as the dot3StatsSingleCollisionFrames counter.

multiple collisions

The Multiple Collisions counter increments when a packet has multiple collisions before being successfully transmitted. This data is exported via SNMP as the dot3MultipleCollisionFrames counter.

total collisions

The Total Collisions counter increments by the number of collisions a packet incurs.

failed, excess collisions

The Failed, Excess Collisions counter increments when a packet transmission fails due to 16 successive collisions. This error indicates a high volume of network traffic or hardware problems with the network. This data is exported via SNMP as the dot3StatsExcessiveCollisions counter.

failed, FIFO underrun

The Failed, FIFO Underrun counter increments when packet transmission fails due to the inability of the interface to retrieve packets from the local packet buffer fast enough to transmit them onto the network.

failed, carrier check or failed, carrier sense error

The Failed, Carrier Check counter increments when a packet collides because carrier sense is disabled. This error indicates a problem between the interface and its Ethernet transceiver. This data is exported via SNMP as the dot3StatsCarrierSenseErrors counter.

CD heartbeat error or SQE test error

The CD (Collision Detection) Heartbeat Error or SQE (Signal Quality Error) counter increments when the interface sends a packet but detects that the transceiver has no heartbeat. The packet is treated as successfully transmitted because some transceivers do not generate heartbeats. This data is exported via SNMP as the dot3StatsSQETestErrors counter.

Using Ethernet Network Interfaces

Chapter 22. Configuring and Monitoring the Ethernet Network Interface

This chapter describes Ethernet interface configuration and operational commands. It includes the following sections:

- “Accessing the Ethernet Interface Operating Process” on page 253
- “Ethernet Interface Monitoring Commands” on page 253

Accessing the Ethernet Interface Configuration Process

Use the following procedure to access the configuration process. This process gives you access to an Ethernet interface’s *configuration* process.

1. At the OPCON prompt, enter **talk 6**. (For more detail on this command, refer to “Chapter 4. The OPCON Process” on page 29.) For example:

```
* talk 6
Config>
```

The CONFIG prompt (Config>) displays on the console. If the prompt does not appear when you first enter configuration, press **Return** again.

2. At the CONFIG prompt, enter the **list devices** command to display the network interface numbers for which the router is currently configured.
3. Record the interface numbers.
4. Enter the **network** command and the number of the Ethernet interface you want to configure. For example:

```
Config> network 0
ETH Config>
```

The Ethernet configuration prompt (ETH Config>), is displayed.

Ethernet Configuration Commands

This section summarizes and then explains the Ethernet configuration commands. Enter the commands at the ETH config> prompt.

Table 33. Ethernet Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Connector-Type	Sets the connector type.
IP-Encapsulation	Sets the IP encapsulation as Ethernet (type X'0800') or IEEE (802.3 with SNAP).
List	Displays the current connector-type, NetWare IPX encapsulation, and IP encapsulation.
Physical-Address	Sets the physical MAC address.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Ethernet Configuration Commands (Talk 6)

Connector-Type

Use the **connector-type** command to set the connector type. 2216s support AUI (10BASE5) and RJ-45 (10BASE-T) connectors, and auto-config options.

Syntax:

```
connector-type          name
```

IP-Encapsulation

Use the **IP-encapsulation** command to select Ethernet (Ethernet type X'0800') or IEEE 802.3 (Ethernet 802.3 with SNAP). Enter **e** or **i**.

Syntax:

```
ip-encapsulation      type
```

List

Use the **list** command to display the current configuration for the Ethernet interface including the connector-type, IPX encapsulation type, and IP encapsulation type.

Syntax:

```
list                  all
```

Example:

```
list all
Connector type:      AUI (10BASE5)
MAC Address:        12:15:00:FA:00:FE
```

Physical-Address

Use the **physical-address** command to set the physical (MAC) address.

Syntax: physical-address *address*

physical-address

This command lets you indicate whether you want to define a locally administered address for the Ethernet interface's MAC sublayer address, or use the default burned-in address (indicated by all zeros). The MAC sublayer address is the address that the Ethernet interface uses to receive and transmit frames.

Note: Pressing **Enter** leaves the value the same. Entering **0** causes the router to use the burned-in address. The default is to use the burned-in address.

Valid Values: Any 12-digit hexadecimal address.

Default Value: burned-in address (indicated by all zeros).

Example:

```
physical-address
MAC address in 00:00:00:00:00:00 form []? 12:15:00:FA:00:FE
```


Accessing the Ethernet Interface Operating Process

To monitor information related to the Ethernet Network Interface, access the interface monitoring process by doing the following:

1. At the OPCON prompt, enter **talk 5**. For example:

```
* talk 5
```

The GWCON prompt (+) is displayed on the console. If the prompt does not appear when you first enter GWCON, press **Return** again.

2. At the GWCON prompt, enter the **configuration** command to see the protocols and networks for which the router is configured. For example:

```
+ configuration
```

See page “Configuration” on page 108 for sample output of the **configuration** command.

3. Enter the **network** command and the number of the Ethernet interface. In this example:

```
+ network 0
ETH>
```

The Ethernet monitoring prompt is displayed. You can now view information about the Ethernet interface by entering monitoring commands.

Ethernet Interface Monitoring Commands

This section summarizes and explains the Ethernet monitoring commands. Enter commands at the ETH> prompt. Table 34 lists the monitoring commands.

Table 34. Ethernet monitoring command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Collisions	Displays collision statistics for the specified Ethernet interface.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Collisions

This command shows the counts of transmissions for packets that incurred collisions before successful transmission. Counters are given for packets sent after the collision XXXXx packets sent after 15 collisions. Increasing numbers of packets transmitting with collisions and higher numbers of collision per packet are signs of transmitting onto a busy Ethernet.

These counters are cleared by the OPCON **clear** command. This data is exported via SNMP as the dot3CollTable counter.

Syntax:

collisions

Example:

Ethernet Interface Monitoring Commands (Talk 5)

```
Eth> coll
Transmitted with 1 collisions:0
Transmitted with 2 collisions:0
Transmitted with 3 collisions:0
Transmitted with 4 collisions:0
Transmitted with 5 collisions:0
Transmitted with 6 collisions:0
Transmitted with 7 collisions:0
Transmitted with 8 collisions:0
Transmitted with 9 collisions:0
Transmitted with 10 collisions:0
Transmitted with 11 collisions:0
Transmitted with 12 collisions:0
Transmitted with 13 collisions:0
Transmitted with 14 collisions:0
Transmitted with 15 collisions:0
```

Chapter 23. Using the 10/100 Mbps Ethernet Network Interface

This chapter describes how to use the 10/100 Mbps Ethernet interface. It includes the following section:

- “Displaying 10/100 Mbps Ethernet Statistics”

Displaying 10/100 Mbps Ethernet Statistics

You can use the **interface** command from the GWCON environment to display the following statistics.

```
+i 0
                                     Self-Test  Self-Test Maintenance
Nt  Nt'  Interface Slot-Port          Passed    Failed    Failed
0   0   Eth/0    Slot: 1  Port: 1          1         0         0

Ethernet/IEEE 802.3 MAC/data-link on 100MB Ethernet interface

Physical address      10005A991431
PROM address          10005A991431
Actual address        10005991431
Adapter Level         0
Configured Duplex     : Auto-Negotiation
Actual Duplex          : Half Duplex
Configured Speed      : Auto-Negotiation
Actual Speed           : 100 Mbps

Input statistics:
failed, packet too long      0  failed, CRC error          0
failed, alignment error      0  failed, receive overflow    0
*receive collision           0  *missed frame               0
**frames filtered            0  receive underrun            0

Output statistics:
one retry                    0  single collision            0
multiple collisions           0  failed, transmit underflow  0
failed, excess collisions     0  failed, loss of carrier     0
late collisions               0  more than one retry         0
buffer error                  0  total collisions            0
excessive deferral            0  deferred                    0
memory error                  0

* cannot be cleared
** cleared automatically when read
```

These statistics have the following meaning:

Nt Global network number.

Nt' This field is for the serial interface card. Disregard the output.

Interface

Interface name and its instance number.

Self-Test: Passed

Number of self-tests that succeeded.

Self-Test: Failed

Number of self-tests that failed.

Maintenance: Failed

Number of maintenance failures.

Physical address

The Ethernet address of the device currently in use. This may be the PROM address or an address overwritten by some other protocol.

Using 10/100 Mbps Ethernet Network Interfaces

PROM address

The permanent unique Ethernet address in the PROM for this Ethernet interface.

Actual address

Adapter level

Configured duplex

The value configured for duplex. Values can be Half Duplex, Full Duplex, or Auto-Negotiation.

Actual duplex

The value at which the adapter is presently operating. It might be different from the value configured, depending on the switch capability. If the adapter is not Up, the value displayed will be "Unknown". Otherwise the value can be Half Duplex or Full Duplex.

Note: The value indicated here might not be accurate. This is due to the implementation of the negotiation and link signaling support in the manufacturer's products.

Configured speed

The value configured for speed. Values can be 10 Mbps, 100Mbps, or Auto-Negotiation.

Actual speed

The speed at which the adapter is presently operating. It might be different from the speed configured, depending on the switch capability. If the adapter is not Up, the value displayed will be "Unknown". Otherwise the value can be 10 Mbps or 100 Mbps.

Note: The value indicated here might not be accurate. This is due to the implementation of the negotiation and link signaling support in the manufacturer's products.

Input statistics:

failed, packet too long or failed, frame too long

The Failed, Packet Too Long counter increments when the interface receives a packet that is larger than the maximum size of 1518 bytes for an Ethernet frame. This data is exported via SNMP as the dot3StatsFrameTooLongs counter.

failed, CRC error or failed, FCS (Frame Check Sequence) error

The Failed, CRC (Cyclic Redundancy Check) Error counter increments when the interface receives a packet with a CRC error. This data is exported via SNMP as the dd3StatsFCSErrors counter.

failed, alignment error

The Failed, Framing Error counter increments when the interface receives a packet where the length in bits is not a multiple of eight.

failed, receive overflow

Overflow error indicates that the receiver has lost all or part of the incoming frame, due to an inability to move data from the receive FIFO into memory buffer before the internal FIFO overflowed.

receive collision

Indicates the total number of collisions encountered by the receiver support on the adapter.

Using 10/100 Mbps Ethernet Network Interfaces

Note: This counter cannot be cleared by the **clear statistics** command because it is maintained on the adapter. The **test network** command is the only way to reset this counter.

missed frame

Indicates the number of incoming receive frames lost due to unavailability of a receive buffer in the system. This error indicates that the system is not processing received frames as fast as they are being received from the local network.

Note: This counter cannot be cleared by the **clear statistics** command because it is maintained on the adapter. The **test network** command is the only way to reset this counter.

frames filtered

Indicates the number of incoming frames that were discarded by the adapter. This counter is updated only when bridging is enabled.

Note: This counter is maintained on the adapter, and is cleared every time it is read. This counter will be cleared by the **interface statistics** and the **test network** commands.

receive underrun

Indicates the number of times the adapter did not have a second buffer to store a long frame (requiring more than one buffer).

Output statistics:

one retry

Indicates that exactly one retry was needed to transmit a frame. This data is exported via SNMP as the dot3StatsDeferredTransmissions counter.

single collision

The Single Collision counter increments when a packet has a collision on the first transmission attempt, and then successfully sends the packet on the second transmission attempt. This data is exported via SNMP as the dot3StatsSingleCollisionFrames counter.

multiple collisions

The Multiple Collisions counter increments when a packet has multiple collisions before being successfully transmitted. This data is exported via SNMP as the dot3MultipleCollisionFrames counter.

failed, transmit underflow

Transmit underrun indicates that transmitter has truncated a message because it could not read data from the memory fast enough. It also indicates that the FIFO on the adapter has emptied out before the end of the frame was reached. IFO into memory buffer before the internal FIFO overflowed.

failed, excess collisions

The Failed, Excess Collisions counter increments when a packet transmission fails due to 16 successive collisions. This error indicates a high volume of network traffic or hardware problems with the network. This data is exported via SNMP as the dot3StatsExcessiveCollisions counter.

failed, loss of carrier

Loss of carrier is set when the carrier is lost during transmission. The adapter does not retry upon loss of carrier. It will continue to transmit the whole frame until done.

Using 10/100 Mbps Ethernet Network Interfaces

late collisions

A late collision indicates that a collision has occurred after the first channel slot time has elapsed. The adapter does not retry on late collisions.

more than one retry

More than one retry indicates that more than one retry was needed to transmit a frame.

buffer error

Buffer error occurs if there is a memory corruption problem in the system, or under certain FIFO underflow conditions on the adapter.

total collisions

The Total Collisions counter increments by the number of collisions a packet incurs.

excessive deferral

Excessive deferral indicates that the transmitter on the adapter has experienced Excessive Deferral on this a transmit frame, where Excessive Deferral is defined in the ISO 8802-3 (IEEE/ANSI 802.3) standard.

deferred

Deferred indicates the number of times the adapter had to defer while trying to transmit a frame. This condition occurs if the DMA channel is busy when the adapter is ready to transmit.

memory error

Memory errors occur when the adapter is not given access to the system interface bus within the programmable length of time. This error will normally occur during transmit operations, indicating transmit underrun.

Chapter 24. Configuring and Monitoring the 10/100 Mbps Ethernet Network Interface

This chapter describes the 10/100 Mbps Ethernet interface configuration and operational commands. It includes the following sections:

- “Accessing the Interface Configuration Process”
- “10/100 Mbps Ethernet Configuration Commands”
- “Accessing the 10/100 Mbps Interface Monitoring Process” on page 261
- “10/100 Mbps Ethernet Interface Monitoring Commands” on page 262

Accessing the Interface Configuration Process

Use the following procedure to access the configuration process. This process gives you access to an Ethernet interface’s *configuration* process.

1. At the OPCON prompt, enter **talk 6**. (For more detail on this command, refer to “Chapter 4. The OPCON Process” on page 29.) For example:

```
* talk 6
Config>
```

The CONFIG prompt (Config>) displays on the console. If the prompt does not appear when you first enter configuration, press **Return** again.

2. At the CONFIG prompt, enter the **list devices** command to display the network interface numbers for which the router is currently configured.
3. Record the interface numbers.
4. Enter the **network** command and the number of the Ethernet interface you want to configure. For example:

```
Config> network 0
Ethernet 100 interface configuration
ETH100 Config>
```

The 10/100 Mbps Ethernet configuration prompt (ETH100 Config>), is displayed.

10/100 Mbps Ethernet Configuration Commands

This section describes the 10/100 Mbps Ethernet configuration commands. Enter the commands at the ETH config> prompt.

Table 35. 10/100 Mbps Ethernet Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Duplex	Sets the duplex mode.
IP-Encapsulation	Sets the IP encapsulation as Ethernet (type X’0800’) or IEEE (802.3 with SNAP).
List	Displays the current connector-type, and IP encapsulation.
Physical-Address	Sets the physical MAC address.
Speed	Sets the link speed.

Configuring Ethernet Network Interfaces

Table 35. 10/100 Mbps Ethernet Configuration Command Summary (continued)

Command	Function
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Duplex

Use the **duplex** command to set the duplex mode.

Note: The default value of **auto** is recommended. The value **half-duplex** or **full-duplex** should be specified only if the link partner is also configured for the same mode.

Syntax:

```
duplex                _half_duplex
                    _full_duplex
                    _auto
```

Half_duplex

The interface will not transmit while receiving or receive while transmitting.

Full_duplex

The interface will transmit and receive simultaneously.

Auto The interface will automatically select half-duplex or full duplex depending on the link partner’s capability.

IP-Encapsulation

Use the **IP-encapsulation** command to select Ethernet (Ethernet type X'0800') or IEEE 802.3 (Ethernet 802.3 with SNAP). Enter **e** or **i** for the type.

Syntax:

```
IP-encapsulation      type
```

Example: IP-encapsulation e

List

Use the **list** command to display the current configuration for the 10/100 Mbps Ethernet interface.

Syntax:

```
list                  _all
```

Example:

```
list all
The duplex is  HALF DUPLEX
The speed is   100Mb
IP Encapsulation:  Ether
MAC Address:    023456789A56
```


Physical-Address

Use the **physical-address** command to set the physical (MAC) address.

Syntax:

physical-address *address*

physical-address

This command lets you indicate whether you want to define a locally administered address for the Ethernet interface's MAC sublayer address, or use the default burned-in address (indicated by all zeros). The MAC sublayer address is the address that the Ethernet interface uses to receive and transmit frames.

Note: Pressing **Enter** leaves the value the same. Entering **0** causes the router to use the burned-in address. The default is to use the burned-in address.

Valid Values: Any 12-digit hexadecimal address.

Default Value: burned-in address (indicated by all zeros).

Example:

```
physical-address
MAC address in 00:00:00:00:00:00 form []? 12:15:00:FA:00:FE
```

Speed

Use the **speed** command to set the speed used by this interface.

Note: The default value of **auto** is recommended. The values of **ten** and **hundred** should be specified only if the link partner is also configured for the same speed.

Syntax:

speed ten
 hundred
 auto

Ten The interface will operate at 10 Mbps.

Hundred

The interface will operate at 100 Mbps

Auto The interface will automatically select the speed (10 Mbps or 100 Mbps) depending on the link partner's capability.

Accessing the 10/100 Mbps Interface Monitoring Process

To monitor information related to the 10/100 Mbps Ethernet Network Interface, access the interface monitoring process by doing the following:

1. At the OPCODE prompt, enter **talk 5**. For example:

```
* talk 5
```

Configuring Ethernet Network Interfaces

The GWCON prompt (+) is displayed on the console. If the prompt does not appear when you first enter GWCON, press **Return** again.

2. At the GWCON prompt, enter the **configuration** command to see the protocols and networks for which the router is configured. For example:

```
+ configuration
```

See “Configuration” on page 108 for sample output of the **configuration** command.

3. Enter the **network** command and the number of the Ethernet interface. In this example:

```
+ network 0  
ETH100>
```

The 10/100 Mbps Ethernet monitoring prompt is displayed. You can now view information about the 10/100 Mbps Ethernet interface by entering monitoring commands.

10/100 Mbps Ethernet Interface Monitoring Commands

This section summarizes the 10/100 Mbps Ethernet monitoring commands. Enter commands at the ETH100> prompt. Table 36 lists the monitoring commands.

Table 36. Ethernet Monitoring Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Collisions	Displays collision statistics for the specified Ethernet interface.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Collisions

This command displays the counts of transmissions for packets that incurred collisions before successful transmission. Counters are displayed for packets sent after 15 collisions. An increased number of packets transmitted with collisions and higher numbers of collisions per packet are signs of transmitting onto a busy Ethernet.

These counters are cleared by the OPCON **CLEAR** command. This data is exported via SNMP as the dot3CollTable counter.

Syntax:

collisions

Example:

```
Eth100> coll  
Transmitted with 1 collisions:0  
Transmitted with 2 collisions:0  
Transmitted with 3 collisions:0  
Transmitted with 4 collisions:0  
Transmitted with 5 collisions:0  
Transmitted with 6 collisions:0  
Transmitted with 7 collisions:0  
Transmitted with 8 collisions:0  
Transmitted with 9 collisions:0  
Transmitted with 10 collisions:0
```

Configuring Ethernet Network Interfaces

```
Transmitted with 11 collisions:0  
Transmitted with 12 collisions:0  
Transmitted with 13 collisions:0  
Transmitted with 14 collisions:0  
Transmitted with 15 collisions:0
```

Configuring Ethernet Network Interfaces

Chapter 25. Overview of LAN Emulation

Note: See the glossary for definitions of the acronyms and terms used in this chapter.

The IBM 2216 implements the *LAN Emulation Over ATM: Version 1.0 Specification* which is widely accepted as the industry standard for multivendor multiprotocol interoperability. This chapter introduces basic LAN emulation (LE) concepts in the context of the MSS implementation. It begins by examining the motivation for installing emulated LANs (ELANs).

LAN Emulation Benefits

LAN emulation protocols allow ATM networks to provide the appearance of Ethernet and Token-Ring LANs. Although LAN emulation does not exploit all of the benefits of ATM, it is useful in migrating to ATM technology and lowering network management costs. It enables you to utilize high-speed ATM links and still protect your software and hardware investments.

Software investments are protected because application interfaces are unchanged (LAN emulation is implemented within the data link control layer, which is below the device driver interface of end stations). Hardware investments are protected with forwarding engines that bridge LAN and ATM networks so that existing adapters and wiring can continue to be used.

LAN emulation allows incremental installation of ATM adapters in stations with high-bandwidth requirements, for example, servers and engineering or multimedia workstations. Physical and logical views of a simple LAN emulation example are illustrated in 16.

Overview of LAN Emulation

Simple LAN Emulation Network

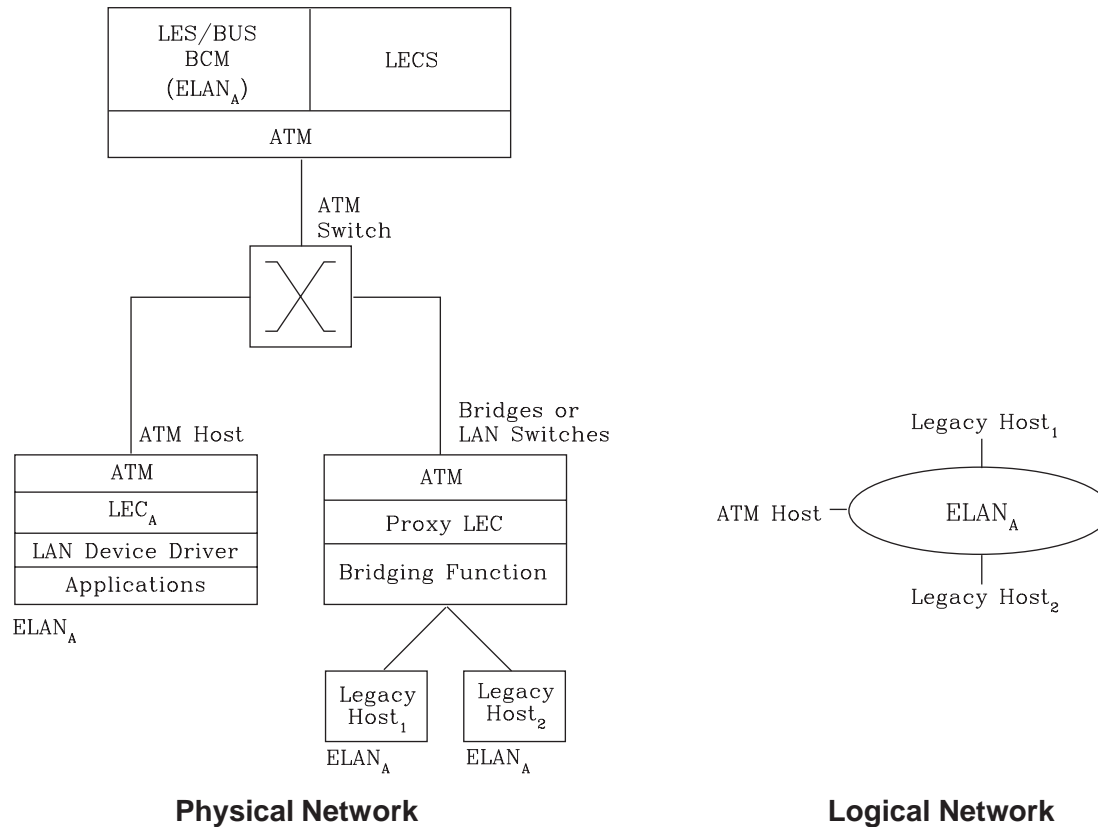


Figure 16. Physical and Logical Views of a Simple LAN Emulation Network

The network management benefits of emulated LANs (ELANs) come from increased flexibility in handling moves, adds, and changes. Membership in an ELAN is not based on physical location; instead, logically-related stations are grouped to form an ELAN (stations can also be members of multiple ELANs).

As long as ELAN memberships are retained, no reconfiguration is needed when stations move to new physical locations. Similarly, no wiring modifications are needed to move stations from one ELAN to another.

LAN Emulation Components

The following components implement an ELAN:

LAN emulation (LE) clients (LECs)

LAN emulation components that represent users of the Emulated LAN.

LE configuration server (LECS)

A LAN emulation service component that centralizes and disseminates configuration data.

LE server (LES)

A LAN emulation service component that resolves LAN destinations to ATM addresses.

Broadcast and Unknown Server (BUS)

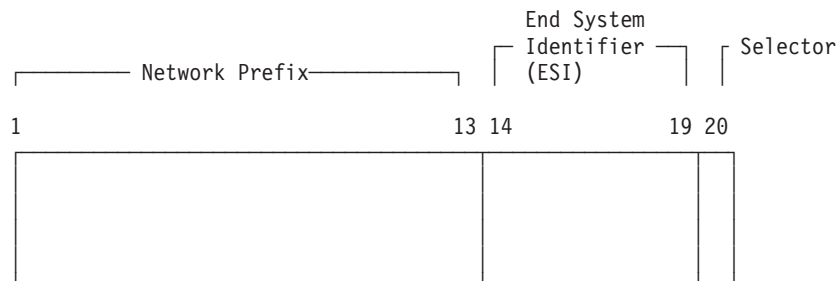
A LAN emulation service component responsible for the delivery of multicast and unknown unicast frames.

The LES, BUS, and LECS are collectively referred to as the LE service components. Each ELAN has a dedicated LES and BUS. LE clients reside in end systems, either in ATM-attached hosts or in bridges or LAN switches. The bridges or LAN switches represent hosts that are connected to Ethernet or Token-Ring LANs. LE clients provide a MAC-level service to higher level software. Either Ethernet IEEE 802.3 or IEEE 802.5 Token-Ring LANs can be emulated, but all stations on an ELAN must be of the same type.

The function that bridges between Token-Ring or Ethernet LAN segments and ELANs is called a Proxy LEC. To emulate a LAN, LE clients request services from the LECS, LES, and BUS. The following sections briefly review ATM addressing and pertinent Interim Local Management Interface (ILMI) functions. You need to understand these concepts before you can understand how the LE components function in the network.

Addressing in ATM

ATM uses 20-byte hierarchical addressing:



The first 13 octets of an ATM address are the Network Prefix. Each switch in your ATM network must have a unique Network Prefix. ATM switches use the Network Prefix to route VCC setup requests to the destination ATM switch. End systems, like this router, retrieve their Network Prefix from their ATM switch when they activate.

Octets 14–19 of an ATM address are the End System Identifier (ESI). Each end system attached to the same switch must use a disjoint set of ESIs. When an end system activates, it attempts to register its ESIs with its ATM switch using the Interim Local Management Interface (ILMI).

The ILMI defines a set of SNMP-based procedures used to manage the interface between an end system and an ATM switch. End systems use ILMI to:

- Obtain the network prefix from the switch
- Register their ESIs with the switch
- Dynamically determine the UNI version of the ATM switch
- LECs may get a list of LECS addresses from the switch

The switch forces all of its registered ESIs to be unique.

Octet 20 of an ATM address is the selector.

Overview of LAN Emulation

End stations obtain their Network Prefix from the switch and form their own addresses by appending an ESI and selector. These addresses must then be registered with the switch, which rejects the registration if the ATM address is not unique.

ESI

Each ATM interface on the router has a universally administered, or burned-in, MAC address. You can use the MAC address as an ESI for some or all of the router's ATM addresses. Alternatively, you can define up to 64 locally administered ESIs on each interface. If every end system uses its universally administered MAC address as its ESI, then ATM addresses are guaranteed to be unique. This eases the configuration burden. However, using locally administered ESIs can ease problem determination. You can use any combination of universal or locally administered ESIs.

One way to obtain a unique ATM address is to use a burned-in IEEE MAC address as the ESI and to locally choose a unique selector. By default, the router uses the MAC address of the ATM interface as the ESI in its ATM addresses. Additional ESIs can be configured on each ATM interface.

Each ESI can have up to 255 associated selectors (0x00 through 0xff). The range of selectors is partitioned into two subranges, a configured selector range and an automatically assigned selector range. The ATM interface parameter `max-configured-selector` gives the upper bound on the configured selector range.

The ATM components on the router have various ways of choosing a selector. Some components require you to explicitly configure a selector from the configured selector range. LES/BUSs are an example of such a component. Other components, such as Classical IP clients, allow the selector to be automatically assigned at run-time. You do not have to choose the selector because the router does this when it activates. This selector is not guaranteed to be consistent across router restarts. Automatic selector assignment is useful only for those ATM components whose ATM address does not have to be already known by other network devices.

You must configure ATM before you configure emulated LANs, bridging or routing.

ATM Addresses of LAN Emulation Components

In general, ATM addresses must be unique among LAN emulation components. The only exception is that a LES and BUS serving the same ELAN can share an ATM address, as is the case on the router.

LAN emulation components are configured for a particular ATM interface. You can decide to use the burned-in MAC address as the ESI portion of the ATM address of the component or you can select one of the locally-administered ESIs that have been defined for the ATM interface. Multiple LE components can share the same ESI if they have unique selectors. By default, the configuration interface assigns each LE component a unique selector value for the configured ESI; however, you can override this assignment and explicitly configure a particular selector value.

An ATM interface parameter determines the number of selectors per ESI reserved for explicit assignment. The remainder are available for dynamic assignment by the ATM interface at run-time. LE components use only the selectors reserved for

explicit assignment; by default, 200 of the 256 possible selectors per ESI are reserved for explicit assignment. Run-time selector assignment is beneficial when you do not need to control the assigned selector, for example, when you are configuring clients in Classical IP that are not paired with an ARP server.

While ATM addresses must be unique among LE components, LE components can use the same ATM addresses as non-LE components, such as Classical IP servers.

Overview of Related ILMI Functions

ILMI defines a set of SNMP-based procedures used to manage the user-network interface (UNI) between an ATM end system and an ATM switch. The following three ILMI functions are particularly relevant to LAN emulation:

1. ATM address registration, which is described in “Addressing in ATM” on page 267
2. Dynamic determination of the signaling version being run at the switch
3. Acquisition of the LECS ATM addresses

As mentioned in “Addressing in ATM” on page 267, ATM address registration is a joint effort between ATM end systems and switches. ATM addresses must be registered with the switch before calls can be placed or received.

By default, the ATM interfaces of a router use ILMI procedures to query the switch MIB in an attempt to determine the signaling version (UNI 3.0 or 3.1) being run at the switch. If the query succeeds, the ATM interface runs the same UNI version as the switch; if the query fails, the ATM interface runs UNI 3.0. Alternatively, you can override the default and explicitly configure the UNI version that will run on the ATM interface.

Manual Configuration of the Signaling Version

You need to configure the signaling version manually if the ATM switch runs UNI 3.1 and has no UNI Version MIB variable. In this case, the ATM interface cannot dynamically determine the UNI version. Because the ATM interface in the router uses UNI 3.0 by default, you should manually configure the ATM interface to use UNI 3.1.

Locating the LECS Using ILMI

ILMI is the method of choice for locating the LECS. The ILMI MIB at the ATM switch includes a list of LECS ATM addresses that can be retrieved by LE clients. This method is useful because the LECS ATM addresses need only be configured at ATM switches, not at LE clients, and there are fewer switches than LE clients. Clients attempt to connect to the first LECS on this list. If the connection fails, they try the next LECS address in succession until a connection is established.

Overview of the LECS Function

LE clients are not required to use the LECS, although it is recommended. If the LECS is not used, each LE client must be configured with the ATM address of the LES that serves its ELAN. The LECS reduces the network management burden by serving as a centralized repository for configuration data, minimizing configuration of the LE clients.

Note: At most, one LECS is configurable on each router.

Clients connect to the LECS using well-defined procedures. The following steps are attempted by a client, in order, until a virtual channel connection (VCC) to the LECS is established:

1. Connect to the LECS using any configured LECS address information (configuration of an LECS ATM address at LE clients is optional and is **not** recommended).
2. Obtain a list of LECS addresses using ILMI and attempt to connect to each LECS on the list, in order, until a VCC is established.
3. Establish a VCC to the well-known LECS ATM address as defined by the ATM Forum.

As previously stated, ILMI is the preferred method for LE clients to locate the LECS. The well-known LECS address is needed because some switches do not support the ILMI method. Configuring the LECS address at the LE clients should be done **only** when the switch does not support the ILMI method and the LE service does not support the well-known LECS address.

The router and the IBM ATM switch support all three methods: the pre-configured LECS address, ILMI connection, and the well-known LECS ATM address.

The LECS must provide initial configuration data to LE clients. The most crucial piece of data is the ATM address of the LES. To provide this information to an LE client, the LECS must be able to identify the LE client and to determine the correct LES for that LE client. The LECS identifies an LE client using information in the LE_CONFIGURATION_REQUEST frame sent by the LE client. The configuration request can also contain information to identify the ELAN that the LE client is seeking to join. The following information can be included in the configuration request:

1. Primary ATM address of the LE client
This field is required and uniquely identifies the LE client.
2. LAN destination associated with the LE client
This field can contain a MAC address or a route descriptor that uniquely identifies the LE client or it can be unspecified.
3. ELAN Name
This field can contain a name identifying the requested ELAN or the requesting LE client. In the router implementation, ELAN names are standard ASCII strings. The ELAN name can be unspecified in the request.
4. ELAN Type
This field can specify that the LE client belongs to an Ethernet or Token-Ring ELAN, or it can be unspecified. If the LE client specifies the type of ELAN, the LECS cannot assign the client to an ELAN of a different type.
5. Maximum frame size supported by the LE client

Overview of LAN Emulation

This field can specify the upper bound on the size of a data frame that can be processed by the LE client, or it can be unspecified. The LECS cannot assign a client to an ELAN with a maximum frame size **larger** than that specified by the client. If the ELAN allows frames too large for the client to handle, the client cannot function on that ELAN.

Given this information, the LECS assigns the LE client to a LES. This is accomplished through the use of policies and policy values. A policy is a criterion that the LECS uses to make LE client-to-LES assignment decisions. A policy value is a (value, LES) pair that indicates that the specified value should be assigned to the specified LES. For example, a policy could be the MAC address of the LE client, and a policy value could be (MAC_ADDR_A, LES_1). An LE client with MAC_ADDR_A will be assigned to LES_1 if the LE client has not already been assigned to another LES because of a higher-priority policy. One set of policies and policy values applies to all the ELANs.

In accordance with the LE service MIB Specification of the ATM forum, these are the six policies defined:

1. ATM address
2. MAC address
3. Route descriptor
4. ELAN type
5. Max frame size
6. ELAN name

Policies also have priorities. The LECS examines policies in prioritized order. Policies with smaller values in the priority field are considered before policies with larger values in the priority field. Policies with equal values in the priority field are considered at the same time and *ANDed* together.

The LECS assigns an LE client to a LES when all of the policies at the current priority level are satisfied and in agreement. The policies are satisfied when there is a policy value that matches the corresponding field in the configuration request for each policy at the current level. The policies are in agreement when the set of matches include a LES that is common to all the policies. If these conditions are not met, the LECS considers the policies at the next priority level. If the LECS is unable to find a LES at any priority level, an unsuccessful configuration response is returned to the LE client.

To understand the meaning of agreement of the policies, consider this example of policies not in agreement. Suppose that the policies at priority 1 are a MAC address and an ELAN name. One of the policy values is (X'400000121225', LES_A) and one is (ELAN 1, LES_B). If the LE client provides a LAN destination of X'400000121225', the MAC address policy is satisfied. If the LE client provides an ELAN name of *ELAN 1*, then the ELAN name policy is also satisfied. In this case the policies at priority 1 are **not** in agreement because they refer to different LESs. In this example, the LECS would examine the policies at the next priority level.

After determining the correct LES for an LE client, the LECS returns a configuration response to the LE client that includes the following information: LES ATM address, ELAN type, max frame size, and ELAN name. The configuration response can also include type/length/value (TLV) parameters. TLVs provide a method to download optional or user-defined parameters to the LE client.

This setup requires configuring the LE clients with the correct ELAN Name.

- Use names for the LE clients

Each LE client can be given its own name. For example, you could create the policy values (Joe, LES_A) and (Mary, LES_A). Then, the LE clients configured with these names would be directed to the same LES. This method requires configuring the ELAN name at each LE client and at the LECS. However, it allows Joe and Mary to move the client to a new location. Even though moving causes the client to have a new ATM address or MAC address, as long as you configure the new LE client with the same ELAN name, you retain membership in the original ELAN. This technique also offers a moderate amount of security if the names of each LE client are considered to be passwords.

ELAN Type Policy

ELAN type policy values are most useful for providing default ELANs. For example, the following policy values would ensure that every LE client is assigned to one of the LESs:

```
(Token-ring ELAN Type,  LES_A)
(Ethernet ELAN Type,    LES_B)
(Unspecified ELAN Type, LES_C)
```

In general, policies used for providing default ELAN assignments should be given a low priority, so that the more specific policies are considered first.

Max Frame Size Policy

The max frame size policy can also be used to provide default ELAN assignments.

Duplicate Policy Values

Duplicates occur when the same policy value is associated with multiple LESs for a given policy. Duplicate policy values are allowed for the ELAN type and max frame size policies, but are not allowed for other policies. Duplicate values are useful only when combined with a different policy of the same priority.

For example, assume that there are three ELANs: an Ethernet ELAN with a max frame size of 4544 bytes, a Token-Ring ELAN with a max frame size of 4544 bytes, and another Token-Ring ELAN with a max frame size of 18190 bytes. LE clients could be assigned to the appropriate ELAN by setting the ELAN type and max frame size policies to the same priority level and defining the following policy values:

```
(Ethernet ELAN Type,    LES_1)    (Max Frame Size = 4544,  LES_1)
(Token-Ring ELAN Type,  LES_2)    (Max Frame Size = 4544,  LES_2)
(Token-Ring ELAN Type,  LES_2)    (Max Frame Size = 18190, LES_2)
```

More Information About TLVs

TLVs are defined on an ELAN basis; therefore, the same set of TLVs is returned to all LE clients that are assigned to a particular ELAN. When a TLV is included in a configuration response, the LE client **must** use the value specified in the TLV as an operating parameter (if the LE client recognizes the ELAN type). A few examples of situations where TLVs might be beneficial are as follows:

- When ELANs are spread over large geographic locations, the default timeout values for LE clients may be insufficient. These timeouts can be controlled for all LE clients by specifying their value in a TLV at the LECS.

Overview of LAN Emulation

- By default, ELANs use best-effort connections to connect to the BUS. For ELANs where BUS traffic is heavy, better performance can be obtained by using reserved bandwidth connections to the BUS. The characteristics of the Multicast Send VCC between the LE client and the BUS can be controlled with TLVs.
- A TLV can be used to download the ELAN segment number to source route bridges.

In addition to fine-tuning the configuration, TLVs force all clients on the ELAN to operate with consistent parameters. The IBM 2216 supports all ATM Forum-defined TLVs along with arbitrary, user-defined TLVs.

Connecting to the LES

After obtaining the ATM address of the LES, the LE client initiates a Control Direct VCC to the LES. When this VCC has been established, the LE client sends an LE_JOIN_REQUEST to the LES. The LES responds by adding the LE client to the appropriate point-to-multipoint Control Distribute VCC and returning an LE_JOIN_RESPONSE. By default, the LES partitions proxy and non-proxy clients onto separate Control Distribute VCCs as illustrated in Figure 17; however, you can configure the LES to use a single Control Distribute VCC for all LE clients in order to reduce the number of point-to-multipoint VCCs that are required. Partitioning the VCCs is generally useful because it reduces the amount of nuisance traffic that is sent to non-proxy clients. No LE_ARP_REQUESTs are sent to non-proxy LE clients, as described in “Address Resolution” on page 275.

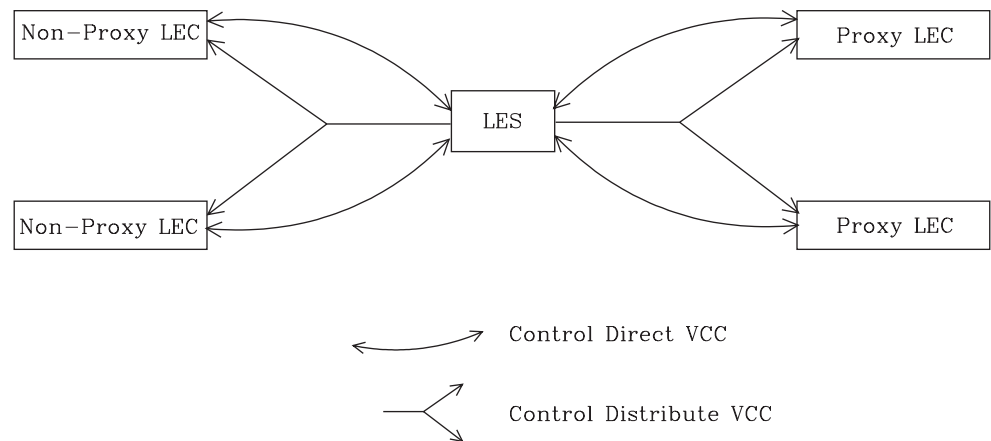


Figure 17. Default Connections Between LE Clients and the LES

The following ATM connections are established between the LE client and the LES:

Control Direct VCC (bidirectional point-to-point)

From LE client to LES

Control Distribute VCC (point-to-multipoint)

From LES to LE client

Address Registration

LE clients register LAN destinations with the LES to ensure uniqueness and to allow the LES to answer LE_ARP_REQUESTs, which LE clients issue to learn the ATM address associated with a particular LAN destination. Registrations include the LAN destination and the ATM address that the LE client associates with the LAN destination. A LAN destination can be either a MAC address or a route descriptor.

Proxy LE clients do not register the MAC addresses of stations on LAN segments that they are bridging to the ELAN. On the other hand, non-proxy LE clients must register all the LAN destinations that they represent. All route descriptors must be registered, regardless of whether they are associated with a proxy or a non-proxy LE client. Route descriptors are applicable only to proxy LECs that are performing source route bridging. A route descriptor contains the bridge number of the proxy LE client and the segment number of a ring that the LE client is bridging to that is equivalent to one hop away.

Address Resolution

LAN communications are based upon source and destination MAC addresses. To enable such communication on an ATM network, MAC addresses must be resolved to ATM addresses. An LE client sends an LE_ARP_REQUEST to the LES to learn the ATM address of a particular LAN destination. If the LAN destination is registered, the LES responds with the ATM address associated with the LAN destination. Otherwise, the request is forwarded to all proxy LE clients on the Control Distribute VCC. There is no need to forward the request to non-proxy LECs because all of their LAN destinations are registered; however, if the LES is configured to use a single Control Distribute VCC, both proxy and non-proxy LE clients will receive the request. Control Distribute VCCs provide an efficient way for the LES to distribute control frames to multiple LE clients.

Proxy LE clients respond to LE_ARP_REQUESTs for unregistered MAC addresses that they represent. The LE_ARP_RESPONSE is sent to the LES on the Control Direct VCC, and the LES forwards the response to the LE client that issued the request.

Connecting to the BUS

After connecting to the LES, an LE client issues an LE_ARP_REQUEST for the all 1s broadcast MAC address. The LES responds with the ATM address of the BUS. The LE client then initiates the establishment of a Multicast Send VCC to the BUS. The BUS responds by adding the LE client to the appropriate point-to-multipoint Multicast Forward VCC. By default, the BUS partitions proxy and non-proxy clients onto separate Multicast Forward VCCs; however, as was the case with the Control Distribute VCC, you can configure the BUS to use a single Multicast Forward VCC for all LE clients. Figure 18 on page 276 shows partitioned Multicast Forward VCCs.

Overview of LAN Emulation

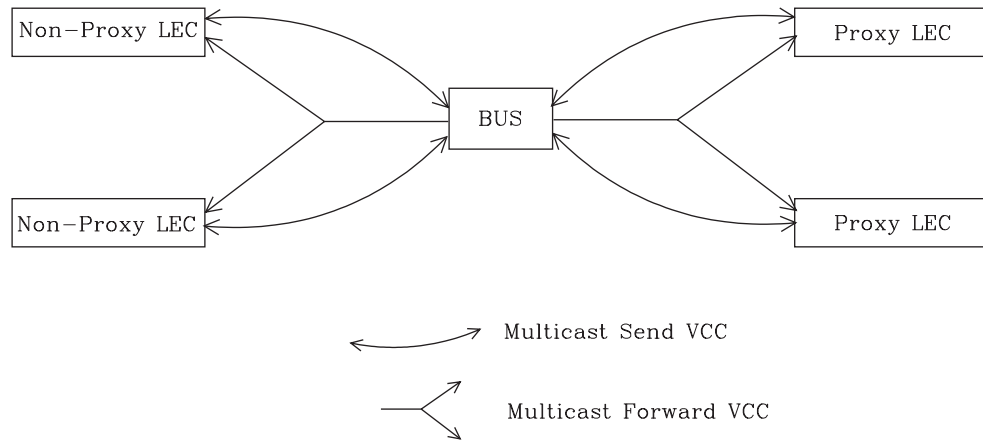


Figure 18. Default Connection Between LE Clients (LECs) and BUS

This list is provided to help you clarify the ATM connections that are established between the LE client and the BUS:

Multicast Send VCC (bidirectional point-to-point)

From LE client to BUS

Multicast Forward VCC (point-to-multipoint)

From BUS to LE client

BUS Functions

The BUS has two basic functions:

1. Distribute multicast frames to all the LE clients in the ELAN
2. Forward unicast frames to the appropriate destinations

An LE client sends unicast frames to the BUS if it does not have a direct connection to the LE client that represents the destination. To avoid creating a bottleneck at the BUS, the rate at which an LE client can send unicast frames to the BUS is limited.

In the router implementation, the BUS has two modes of operation: partitioning the unicast frame domain and not partitioning the unicast frame domain. If you partition the unicast frame domain, the BUS uses two Multicast Forward VCCs. Otherwise, the BUS uses a single Multicast Forward VCC.

If a single Multicast Forward VCC is used, the BUS operation is very simple; all received frames are simply forwarded to all LE clients. If two Multicast Forward VCCs are used, the BUS will not broadcast unicast frames to all LE clients; instead, unicast frames destined for non-proxy LE clients will be transmitted directly to the destination LE client on a Multicast Send VCC, and all other unicast frames will be transmitted only to proxy LE clients, using the Proxy Multicast Forward VCC. When two multicast VCCs are used, the router is considered to be in intelligent BUS (IBUS) mode.

IBUS mode reduces nuisance unicast frames, which are unicast frames not destined for the client; proxy clients do not receive unicast frames destined for non-proxy clients, and non-proxy clients never receive nuisance unicast frames. Network bandwidth devoted to nuisance frames is also reduced. On the other hand,

BUS processing requirements are increased and multicast frames must be transmitted twice (once on each Multicast Forward VCC). In general, IBUS operation is recommended; however, this option should be disabled in configurations that have source route bridges that join the ELAN as non-proxies.

Establishing Data Direct VCCs

Data Direct VCCs connect two LE clients, and are used to exchange unicast frames without involving the BUS. The LE client uses the address resolution procedures to determine the ATM address associated with the required LAN destination. If the LE client already has a Data Direct VCC to the ATM address (perhaps for another LAN destination represented by the target LE client), unicast data frames are subsequently transmitted on the existing VCC; otherwise, the LE client invokes the signaling protocol to establish a new VCC.

The LE client maintains an LE_ARP cache containing LAN destination-to-ATM address mappings. Entries in this cache are aged and must be periodically refreshed. The entries are refreshed when a data frame is received from the LAN destination. The LE client also attempts to refresh entries in the absence of data traffic.

Utilization of Data Direct VCCs is also monitored and the VCCs are released if there is no traffic for the VCC time-out period, which is configurable. Additionally, Data Direct VCCs are released in a least-recently used manner when establishment of a new Data Direct VCC fails due to insufficient resource availability.

Overview of Extensions for LAN Emulation

IBM has made value-add extensions to ATM Forum LAN Emulation available on the router. These extensions offer improved performance, reliability, security, and manageability:

Broadcast Manager (BCM)

This function can improve overall network performance by reducing ELAN broadcasts.

Redundancy

The redundancy mechanism improves reliability by allowing backup servers to take over if failures occur at primary servers.

Security

Security is improved by letting the LECS control ELAN memberships.

BUS Monitor

This function enhances manageability by identifying the top users of the BUS.

The following sections describe each of these extensions.

Broadcast Manager

Broadcast Manager (BCM) is an extension to LAN emulation that consists of IBM enhancement of the LAN emulation BUS. Without BCM, the following events occur:

- A multicast frame sent to the BUS is forwarded to all LE clients on the ELAN.

Overview of LAN Emulation

- LE clients that include the proxy function to provide bridging support forward the broadcast frame on to other LAN segments.
- All end stations receive and process every broadcast frame.

BCM can be enabled on individual ELANs for any of these protocols:

IP
IPX
NetBIOS

When BCM is enabled, a minimal amount of layer 2 and layer 3 information is decoded for specific types of broadcast frames sent to the BUS. Whenever possible, BCM transforms broadcast frames into unicast frames, and sends them only to interested LE clients and end stations. BCM reduces both network traffic and associated end-station overhead by filtering nuisance broadcast frames. These functions can improve overall system performance and enable practical deployment of larger ELANs.

BCM Support for IP

When enabled for IP, BCM scans all IP ARP requests and replies to learn the location of IP addresses in the IP subnet that contains this ELAN. The objective is for BCM to take each broadcast ARP request frame and forward it as a unicast frame directly to the LE client representing the target IP station. Both network traffic and end-station processing time are reduced when the request is forwarded directly to the appropriate LE client on the Multicast Send VCC instead of being broadcast to all LE clients on the Multicast Forward VCCs. When the destination station is located behind a bridge function, the LAN that the destination station belongs to also benefits from the reduced broadcast traffic.

BCM Support for IPX

For IPX, BCM limits the scope of advertisements and other broadcast requests. IPX routers and servers periodically broadcast their known network and service information. IPX clients send broadcast requests to locate a particular service or router. Generally, these broadcasts, called Routing Information Protocol (RIP) and Service Advertising Protocol (SAP) packets, need to be received only by other IPX routers and servers.

When it is enabled for IPX, BCM dynamically identifies the set of IPX routers and servers based on advertisement transmissions, and only forwards RIP and SAP advertisements and other broadcast requests to other IPX routers and servers. A broadcast frame managed by BCM IPX is sent as a series of unicast frames to the dynamically-learned set of IPX routers and servers.

When BCM IPX Server Farm Detection is enabled, BCM IPX will detect an IPX server farm when the number of IPX routers and servers discovered behind a given LEC exceeds a configurable threshold, the *BCM IPX Server Farm Threshold*. When a server farm is detected, BCM IPX broadcasts a managed frame to each LEC representing a server farm, rather than transmitting multiple unicast frames to each downstream IPX router and server in the server farm. BCM IPX can now intelligently use the broadcast mechanism in areas of the network where it is desirable to do so.

With BCM IPX enabled, any quiet device (that is, a device that does not transmit IPX advertisements) that needs to receive IPX advertisements has to be configured as a BCM static target. An example of such a device is a station running software that discovers the IPX network topology by monitoring IPX advertisements.

If BCM IPX Server Farm detection is enabled and you wish to prevent a particular LEC from being treated by BCM IPX as a Server Farm, configure a BCM static target with the LEC's ATM address and a MAC address of 00.00.00.00.00.00. This forces BCM IPX to send frames managed by BCM as multiple unicast frames to each downstream IPX router and server detected behind this LEC, even if the number of routers and servers detected exceeds the *BCM IPX Server Farm Threshold*.

BCM Support for NetBIOS

NetBIOS is considered to be a broadcast-abusive protocol and therefore an excellent candidate for BCM. NetBIOS communication is based on names. Transmitting stations can learn the MAC address associated with a particular destination name by broadcasting a query or by having the frame multicasted to the NetBIOS functional address. In the latter case, every NetBIOS device in the network must receive the frame and determine whether the destination name on the frame applies to itself. To make things even worse, NetBIOS devices tend to repeat transmission of certain types of frames as much as 10 times. Historically, this was to ensure that all devices receive the frame in cases where the network is heavily congested.

The BCM strategy is to associate unique NetBIOS names with MAC addresses and LE clients by learning names from NetBIOS frames sent to the BUS. After a unique NetBIOS name is learned, subsequent NetBIOS broadcast frames destined for that name are forwarded to a single LE client as a unicast frame. BCM also filters certain NetBIOS frames that are broadcast repeatedly.

BCM provides support for NetBIOS Namesharing. That is, BCM NetBIOS handles OS/2 LANServer stations with multiple LAN adapters sharing the same NetBIOS name.

BCM Support for Source Route Bridging

Source Route Management (SRM) is an additional BCM feature that can be configured for 802.5 ELANs. When enabled, this feature will further process frames managed by BCM IP or BCM NetBIOS and, whenever possible, transform All Routes Explorer (ARE) or Spanning Tree Explorer (STE) frames into Specifically Routed Frames (SRF). Once a frame is transformed into an SRF, the frame no longer needs to be transmitted onto each ring in the bridged network.

The Token-Ring topology behind each LE client is learned by recording the routing information field (RIF) of frames received by the BUS. Because SRM dynamically learns Token-Ring topology information, an aging mechanism is used to remove information that has not been refreshed recently.

To decide whether to enable BCM or SRM (or both), you should compare the net system-wide benefit with the inevitable reduction in the rate at which packets are forwarded when BCM or SRM is enabled.

Overview of LAN Emulation

Note: Broadcast Manager and Source Route Management are unavailable and cannot be enabled if **bus-mode** is set to *adapter*.

LAN Emulation Reliability

A perceived lack of robustness has been one of the most widely proclaimed criticisms of LAN emulation. While the ATM Forum is addressing this issue with specifications for distributing the LE service, the router offers an answer in the interim. Figure 19 provides a framework for describing the MSS redundancy solution.

Each LES/BUS may be independently configured for redundancy (the default is no

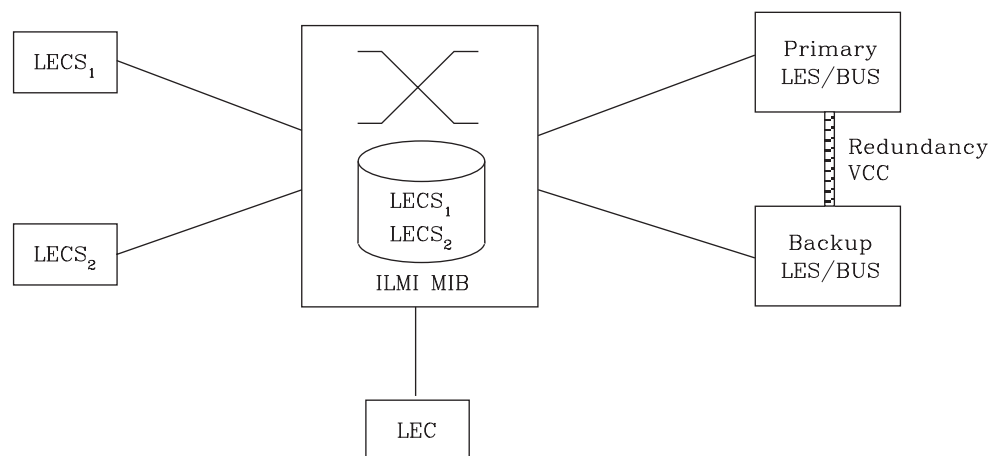


Figure 19. LAN Emulation Redundancy

redundancy). If redundancy is enabled, the LES/BUS is configured to assume the role of a primary or a backup LES/BUS. Unless it has been configured as a redundant LES/BUS, the LES/BUS is primary. The primary LES/BUS is typically the only LES/BUS visible to the LE clients. It is responsible for setting up and maintaining a Redundancy VCC to the backup LES. The presence of this VCC indicates that the primary LES/BUS is operational. The backup LES will not accept Control Direct VCC calls while the Redundancy VCC is established. However, if the Redundancy VCC is **not** present, the backup LES/BUS services ELAN requests in the usual manner.

For the redundancy protocol to be effective, LE clients must detect the failure of the primary LES/BUS and connect to the backup. LE clients detect server failures by means of released VCCs. Connection to the backup LES/BUS is accomplished through the LECS.

Upon receiving an LE_CONFIGURE_REQUEST, the LECS assigns the LE client to the appropriate LES and ELAN. If this LES has no configured backup, then the LECS returns the ATM address of the LES. If the LES is configured with a backup LES, then the LECS returns either the primary or backup LES address.

The LECS returns the backup LES address if the backup LES exists on the same MSS Server as the LECS and is currently serving the ELAN, if the primary LES exists on the same MSS Server as the LECS and it is not currently serving the ELAN, or if neither LES exists on the same MSS Server as the LECS and the client was last assigned to the primary LES (within the past 5 minutes). Otherwise, it returns the primary LES address to the LE client.

The LECS retains a short-term memory of all client assignments so that it can alternately direct an LE client to a primary and backup LES. This simple heuristic makes the correct assignment in the nominal case of no failure and is self-correcting. At worst, the heuristic causes the LE client to repeat the configuration phase of joining an ELAN.

LECS robustness can be achieved by establishing duplicate LECSs on multiple platforms and including their ATM addresses in the ILMI database. LE clients will then connect to the backup LECS if the primary is unavailable. could be on MSS Server 1, while

LAN Emulation Security

Traditional LANs offer security in the sense that a physical connection implies that two stations are on the same LAN. Because multiple emulated LANs can exist on a single ATM network, stations that are not on the ELAN can be physically connected to stations that are on the ELAN. This situation presents a security risk in that unauthorized stations can connect to the LES and attempt to use its services.

To control ELAN membership, an MSS LES can be configured to validate LE_JOIN_REQUESTs with the LECS. In this mode the LES forms an LE_CONFIGURE_REQUEST on behalf of the LE client using information from the LE_JOIN_REQUEST. These LE_CONFIGURE_REQUESTs include the source LAN destination, source ATM address, ELAN type, max frame size, and ELAN name from the LE_JOIN_REQUEST, along with an IBM Security TLV. The security requests are transmitted to the LECS by a multiplexing component called the LECS interface, and the LECS must validate the requests using its ELAN assignment database before LE clients are allowed to join the ELAN.

A LECS interface is associated with an ATM interface, and all LESs configured on the ATM interface use the same LECS interface. The LECS interface conserves VCC resources by multiplexing security requests from multiple LESs onto a single VCC to the LECS. The LECS interface locates the LECS dynamically using the ILMI and well-known LECS address mechanisms. After the VCC to the LECS is established, the LECS interface issues a local query to determine whether the LECS is located on the same router. If the LECS is located on the same router, a local interface is used to confirm requests to join without transmitting requests onto the ATM network.

With the LECS interface, the router may ensure that an LE Client joins an ELAN only if the LECS approves of the join. This shifts the security burden from the LES to the LECS. Unfortunately, the LECS is also non-secure. The LECS accepts connections and queries from any station without verification. An intruder station may connect to the LECS and repeatedly query it for various configurations. The intruder may also pose as some other station and download another station's configuration.

LECS Access Controls permit the user to configure a list of ATM address prefixes which are not allowed access to the LECS configuration database. All LECS connection attempts and LE_CONFIGURE_REQUESTs from matching ATM addresses are automatically rejected. When used in conjunction with the LECS interface, a secure LANE environment is provided.

To maximize the security of an ELAN, the following steps are recommended:

Overview of LAN Emulation

1. At the LECS, use ATM addresses to assign clients to the LES. See “Overview of the LECS Function” on page 270 for more information.
2. Activate the LECS Interface on the router.
3. Activate the security option of the LESs.
4. Activate LECS Access Controls for any ATM address prefixes that should not be allowed to access the LECS.
5. Use *Address Screening* at the ATM switches. This option causes switches to validate that calling stations use their actual ATM addresses in the call setup. Thus, stations cannot impersonate other stations.

These steps ensure that stations are correctly identified and that only authorized stations join the ELAN.

Key Configuration Parameters for LAN Emulation

This section briefly describes the required configuration parameters of the router LAN emulation components. The ATM interface for the LAN emulation components must be defined before the components can be created.

1. **LEC:**

To create an LE client, you only need to specify the ELAN type. If you define two LE clients on a single ATM interface and bridge them together, then one of the LE clients must use a non-default MAC address. By default, LE clients use the burned-in MAC address of the ATM interface. The default maximum frame size is 1516 bytes for Ethernet LE clients and 4544 bytes for token-ring LE clients.

Chapter 26. Using ATM

This chapter describes how to use the ATM interface. It includes the following sections:

- “ATM and LAN Emulation”
- “How to Enter Addresses”
- “ATM-LLC Multiplexing” on page 284
- “ATM Virtual Interface Concepts” on page 284

ATM and LAN Emulation

LAN emulation provides support for virtual Token-Ring and Ethernet LANs over an ATM network. Refer to “How to Enter Addresses” for a discussion of ATM addressing.

How to Enter Addresses

Enter addresses in two ways, depending upon whether the address represents (1) an IP address, or (2) an ATM address, MAC address, or route descriptor, as follows:

1. IP address

Enter IP addresses in dotted decimal format, a 4-byte field represented by four decimal numbers (0 to 255) separated by periods (.).

Example of IP Address:

01.255.01.00

2. ATM or MAC address or route descriptor

Enter ATM addresses, MAC addresses, and route descriptors as strings of hexadecimal characters with or without optional separator characters between bytes. Valid separator characters are dashes (-), periods (.), or colons (:).

Examples of ATM address, MAC address or route descriptor

A1FF01020304

or

A1-FF-01-02-03-04

or

A1.FF.01.02.03.04

or

39.84.0F.00.00.00.00.00.00.00.00.00.03.10.00.5A.00.DE.AD.08

or

A1:FF:01:02:03:04

or even

A1-FF.01:0203:04

Each type of address requires a different number of hexadecimal characters:

ATM 40

MAC 12

ESI 12

Route descriptor

4

Configuring ATM and LAN Emulation

This information applies to addresses entered for ATM; LAN emulation; Classical IP and ARP over ATM; and IPX and ARP over ATM.

ATM-LLC Multiplexing

Protocols that run natively over an ATM interface can use ATM-LLC multiplexing to share ATM addresses and both SVC and PVC channels between users. ATM-LLC is implicitly configured when the protocols are configured and can be monitored using the ATM Config+ command prompt from **t 5**. There are no explicit configuration options for the ATM-LLC multiplexing function. For example, if two protocols which use ATM-LLC multiplexing are configured to use the same local ATM address (local endpoint), this implicitly configures ATM-LLC to use the same shared ATM address for both protocols.

See “ATM-LLC Monitoring Commands” on page 299 for additional information.

Sharing of ATM addresses or SVC/PVC channels is not possible between protocols that use the ATM-LLC multiplexing function and those that do not use the ATM-LLC multiplexing function (such as Classical IP). Currently, Server Cache Synchronization Protocol (SCSP) and APPN are the only two protocols that use the ATM-LLC multiplexing function.

ATM Virtual Interface Concepts

An ATM Virtual Interface (AVI) creates the appearance of multiple ATM interfaces when, in fact, there is only one physical ATM interface. One or more AVIs can be configured for each physical ATM interface on the router. AVIs have the following characteristics:

- Each AVI must be defined on one (and only one) physical ATM interface. ATM real interface (ARI) will be used to mean a physical ATM interface.
- One or more AVIs can be configured on each ARI on a router.
- Higher layer protocols treat ARIs and AVIs equally. The protocols see the total number of ATM interfaces as the sum of the number of ARIs and AVIs configured on the router.
- Protocols can be configured on each ATM interface (real or virtual) independently of other interfaces.

For example, one can configure IP on interface 0 (which is a real ATM interface) with IP address 9.1.1.1 and another instance of IP with address 9.2.1.1 on interface 1 (which is an AVI). Whether an interface is a real ATM interface or a virtual interface configured on a real interface makes no difference to the protocol (IP in the example). In addition, whether virtual interface 1 is configured on top of real ATM interface 0 or some other physical ATM interface is also transparent to the protocols.

Advantages of Using ATM Virtual Interfaces

Major advantages of using the ATM Virtual Interfaces are:

- Using the ATM Virtual Interface feature increases the number of protocol instances that can be supported on a physical ATM interface.

The actual number of AVIs that can be configured on an ARI is limited by physical resources, such as memory, available on the router. The total number of

ATM Virtual Interface Configuration Concepts

interfaces that can be created depends on the data packet size for the interfaces and is limited to a maximum number of 253 per router.

The use of AVIs significantly improves the configuration options for protocols such as IPX that are limited to one instance or address per ATM interface. By configuring an appropriate number of AVIs, several IPX addresses can be supported on each physical ATM interface.

- The ATM Virtual Interface feature is crucial for supporting multicast routing protocols (such as MOSPF) over ATM networks.

In order for multicast to operate correctly, each logical subnet *must* be configured on a different interface because multicast routing protocols typically function in such a way that a packet coming in from a router interface will never be sent out over the same interface. Thus, if more than one subnet is configured on an interface and a source in one subnet sends a multicast packet to a member in another subnet defined on the same interface, this member will never receive the packet.

By creating an individual virtual interface for each subnet, packet multicasting can be performed successfully. Typically, the number of ATM interfaces on a router will be limited, in turn limiting the number of subnets that can be correctly configured for multicast operation. However, by creating as many AVIs as needed (according to the number of subnets that are required to be configured on the router), the number of physical ATM interfaces will no longer limit the number of subnets that can be configured on a router for correct multicast operation.

For example, the “one-armed” router cannot support multicast traffic over interfaces other than ELANs without the AVI feature, because incoming packets will never be sent out the same interface and will be discarded instead.

- Creating multiple AVIs on an ARI and configuring each different protocol instance (for example, each IP subnet) on a different AVI on the same ARI, can improve performance.

For example, when multiple subnets are configured on a single physical ATM interface, the interface will have to reduce the maximum transmission unit or MTU (the maximum packet size that can be sent or received over that interface) to the smallest MTU of all subnets sharing the same interface. However, if multiple AVIs are created on that ARI and each IP subnet is configured on a different AVI, every subnet can continue to use its existing MTU size without consideration of other subnets configured on the same physical ATM interface. This avoids possible reduction in throughput and delays due to packet fragmentation and reassembly caused by MTU size reduction.

Another performance improvement can be achieved by distributing the number of protocol addresses configured on a physical interface over different virtual interfaces configured on the same physical interface. The per-interface protocol lists get shortened, resulting in faster searches and reduced processing time.

Disadvantages of using ATM Virtual Interfaces

The disadvantages of using ATM Virtual Interfaces are:

- Because AVIs do not have any physical resources of their own, each virtual interface may have fewer Virtual Connections (VCs) than a single physical interface. The available resources (in this example VCs) are partitioned among the different virtual interfaces configured on a single ARI and the ARI itself.

In the current implementation, resource allocation is *on demand*. Each physical ATM interface has a pool of resources that are available for use by all AVIs and the single ARI itself.

ATM Virtual Interface Configuration Concepts

Note: Because all resources are shared among the ARI and all its AVIs, an ESI added on an ARI is automatically available to all AVIs configured on the ARI. You should not assign the same ESI and selector combination to two different protocol clients using the same ARI even though they are configured on different AVIs.

Limited PVC sharing is allowed across the ARI and the AVIs configured on the ARI. PVC sharing is limited to different protocol instances. Multiple instances of the same protocol are not allowed to share the same PVC.

Chapter 27. Configuring and Monitoring ATM

This chapter describe the ATM interface configuration and operational commands. It includes the following sections:

- “Accessing the ATM Interface Configuration Process”
- “ATM Configuration Commands”
- “ATM Interface Configuration Commands” on page 288
- “ATM Virtual Interface Configuration Commands” on page 295
- “ATM Virtual Interface Monitoring Commands” on page 300
- “Accessing the ATM Monitoring Process” on page 296
- “ATM Monitoring Commands” on page 296
- “ATM Interface Monitoring Commands (ATM INTERFACE+ Prompt)” on page 297

- “ATM-LLC Monitoring Commands” on page 299

Accessing the ATM Interface Configuration Process

Use the following procedure to access the configuration process.

1. At the OPCON prompt, enter **talk 6**. (For more detail on this command, refer to “Chapter 4. The OPCON Process” on page 29.) For example:

```
* talk 6
  Config>
```

The CONFIG prompt (Config>) displays on the console. If the prompt does not appear when you first enter configuration, press **Return** again.

2. At the CONFIG prompt, enter the **list devices** command to display the network interface numbers for which the router is currently configured.
3. Record the interface numbers. If ATM is not specified as an interface, then create an ATM interface by using the **add device** command at the Config> prompt.
4. Enter the **network** command and the number of the ATM interface you want to configure. For example:

The ATM configuration prompt (ATM Config>), is displayed.

ATM Configuration Commands

This section summarizes the ATM configuration commands. Enter the commands at the ATM config> prompt.

Table 37. ATM Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.

ATM Configuration Commands (Talk 6)

Table 37. ATM Configuration Command Summary (continued)

Command	Function
INTERFACE	Displays the ATM Interface Config> prompt from which you can list, change, or configure the ATM Interface. <ul style="list-style-type: none"> • Add an ESI. • List the current configuration or list ESIs. • Remove an ESI. • Set parameters of the ATM network. • Enable or disable an ESI. • Exit
LE-CLIENT	Displays the LE Client Config> prompt from which you can list, change, or configure the LAN Emulation Client Interface as described in "Chapter 28. Using LAN Emulation Clients" on page 301 . <ul style="list-style-type: none"> • Add a LAN Emulation Client (LEC) for a token-ring or Ethernet emulated LAN. • Configure a LEC by network #. This command displays the LE Config> prompt, from which you can configure a specific LAN Emulation Client (LEC). • List LAN Emulation Clients (LECs). • Remove a LAN Emulation Client (LEC).
VIRTUAL ATM	Displays the ATM Virtual Interface Config> prompt from which you can list, add, or remove the ATM Virtual Interface as described in "ATM Virtual Interface Configuration Commands" on page 295
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

ATM Interface Configuration Commands

This section summarizes and then explains the commands for configuring a specific ATM interface.

Enter the commands at the ATM INTERFACE> prompt.

Table 38. ATM INTERFACE Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Add	Adds an ESI.
List	Lists the current configuration or list ESIs.
Qos	Displays the ATM I/F 0 QoS Config> prompt from which you can configure Quality of Service as described in "QoS Configuration" on page 290.
Remove	Removes an ESI.
Set	Sets parameters of the ATM network.
Disable	Disables an ESI.
Enable	Enables an ESI.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Add

Use the **add** command to add an ESI to your ATM configuration.

Octets 14–19 of an ATM address are the End System Identifier (ESI). Each end system attached to the same switch must use a disjoint set of ESIs. When an end system activates, it attempts to register its ESIs with its ATM switch using ILMI. The switch forces all of its registered ESIs to be unique.

Syntax:

add esi *esi-address*

esi *esi-address*

Address of End System Identifier.

Valid Values: Any 12 hexadecimal digits

Default Value:

none

List

Use the **list** command to list the configuration of this ATM device or to list the set of configured ESIs.

Syntax:

list configuration
esi

configuration

Lists the ATM device configuration. For an explanation of the listed fields, see “Set” on page 290.

Example: list con

```

ATM Configuration
Interface (net) number = 0
Maximum VCC data rate Mbps = 155
Maximum frame size = 9234
Maximum number of callers = 209
Maximum number of calls = 1024
Maximum number of parties to a multipoint call = 512
Maximum number of Selectors that can be configured = 200
UNI Version = UNI 3.0
Packet trace = OFF
    
```

esi Lists the ESIs in the ATM configuration.

Example: list esi

```
ATM INTERFACE> list esi
```

ESI	Enabled
000000000009	YES
000000000100	YES

ATM Interface Configuration Commands (Talk 6)

QoS Configuration

Use the **qos-configuration** command to display the ATM I/F 0 QoS Config> prompt from which you can configure Quality of Service as described in “QoS Configuration”.

Syntax:

qos-configuration

Remove

Use the **remove** command to remove an ESI from your ATM configuration. All ATM components using this ESI should be reconfigured to use a different ESI. An ATM component that attempts to use a removed ESI may not activate on the next router restart.

Syntax:

remove esi *esi-address*

esi *esi-address*

Address of End System Identifier.

Valid Values: Any 12 hexadecimal digits

Default Value:

none

Set

Use the **set** command to specify ATM network parameters.

Syntax:

set max-data-rate
max-frame
max-config-selectors
max-calls
max-callers
max-mp-parties
trace
uni-version
network-id

max-data-rate *speed*

Sets the default and upper bound for VCC traffic parameters of most LANE and CIP connections. For example, this is the default PCR for best-effort VCCs initiated by LE Clients. Signaled SCRs and PCRs cannot exceed this limit. The default value should be satisfactory in most situations. An example of a situation where it is beneficial to change this value would be if the majority of the stations use 25-Mbps adapters. In this case, it may be

ATM Interface Configuration Commands (Talk 6)

desirable to limit the data rate on VCCs to 25 Mbps so that the lower speed stations are not overwhelmed with frames from the router. The units for this parameter are Mbps.

Valid Values:

25

100

155

Default Value:

155

Example:

```
ATM INTERFACE> set speed 155
```

max-calls

Sets the maximum number of switched virtual circuits (SVCs) that can exist on this ATM device. Every point-to-point and point-to-multipoint SVC uses system resources. This parameter helps limit the system resources reserved for signaling and switched connections. Increasing this parameter will allow more simultaneous SVCs. However, more system memory will be required to manage these connections.

Valid Values:

An integer in the range 64 - 10500

Default Value:

1024

Example:

```
ATM INTERFACE> set max-calls 500
```

max-callers

Sets the maximum number of entities on the router that use the ATM interface. Each LEC, Classical IP Client, and 1483 bridge interface qualifies as a user of the ATM interface. Increasing this parameter allows more users of the interface and uses more system memory.

Valid Values:

An integer in the range 64 – 1024

Default Value:

209

Example:

```
ATM INTERFACE> set max-callers 25
```

max-config-selectors

Sets the maximum number of selectors under your specific control.

The selector is used to distinguish different users on the same end system. VCC setup requests are routed in the following hierarchical fashion: ATM switches route to the destination ATM switch using the Network Prefix, the destination ATM switch routes to the destination end system using the ESI, and the end system notifies the destination user based on the selector.

Each ESI can have up to 255 associated selectors (0x00 through 0xff). The range of selectors is partitioned into two subranges, a configured selector

ATM Interface Configuration Commands (Talk 6)

range and an automatically assigned selector range. The ATM interface parameter `max-configured-selector` gives the upper bound on the configured selector range.

The ATM components on the router have various ways of choosing a selector. Some components require you to explicitly configure a selector from the configured selector range. Other components, such as Classical IP clients, allow the selector to be automatically assigned at run-time. You do not have to choose the selector because the router does this when it activates. This selector is not guaranteed to be consistent across router restarts. Automatic selector assignment is useful only for those ATM components whose ATM address does not have to be already known by other network devices.

The relative sizes of the selector range can be modified to conform to the types and numbers of ATM users on the router.

Valid Values:

0 – 255 (0x00 – 0xFF)

Default Value:

200

Note: The selector is byte 20 of a 20-byte ATM address.

Example:

```
ATM INTERFACE> set max-config-selectors 225
```

max-frame

Sets the maximum number of octets permitted in any data frame sent or received on the ATM interface. System memory is allocated based upon this parameter. Increasing the `max-frame` requires more system memory, but allows processing of larger frames.

All router entities using the ATM interface must use a maximum frame size less than or equal to the `max-frame-size` of the ATM interface. This includes all LECs and 1483 bridge interfaces.

Valid Values:

An integer in the range 16 – 32000

Default Value:

9234

Example:

```
ATM INTERFACE> set max-frame 1000
```

max-mp-parties

Sets the maximum number of leaves on a point-to-multipoint connection initiated by the router. This parameter affects system memory allocation. Increasing this value is necessary if the router must set up point-to-multipoint connection(s) to a large number of destinations.

Valid Values:

An integer in the range 1 – 5000

Default Value:

512

Example:

```
ATM INTERFACE> set max-mp-parties 300
```


ATM Interface Configuration Commands (Talk 6)

trace Sets the packet tracing parameters on the interface. Packet tracing can be enabled or disabled on a range of VPI/VCI values. Common VPI/VCI values to trace are:

- 0/5 for signalling packets
- 0/16 for ILMI packets.

Valid Values:

ON or OFF

Default Value:

ON

You are prompted for the VPI/VCI range you want to trace.

Beginning VPI Valid Values:

0 – 255

Default Value:

0

Ending VPI Valid Values:

0 - 255

Default Value:

255

Beginning VCI Valid Values:

0 - 65535

Default Value:

0

Ending VCI Valid Values:

0 - 65535

Default Value:

65535

Example:

```
ATM INTERFACE> set trace on
beginning of VPI range [0]? 0
end of VPI range [255]? 0
beginning of VCI range [0]? 5
end of VCI range [65535]? 5
```

uni-version

Sets the User Network Interface (UNI) version used by the ATM interface with communicating with the attached ATM switch. If the UNI versions are configured on the ATM switch and ATM device interface to a specific version (not AUTO-DETECT), the UNI versions must match.

If the UNI version is configured as AUTO, the ATM device attempts to learn the UNI version to use from the switch.

In UNI AUTO-DETECT mode, if the switch does not respond to the query for UNI version, the default is UNI 3.0. If the switch responds with a value other than UNI 3.0 or UNI 3.1, the default is UNI 3.1.

Valid Values:

[UNI 3.0|UNI 3.1|AUTO-DETECT|None]

Default Value:

UNI 3.0

ATM Interface Configuration Commands (Talk 6)

Note: Must be compatible with the ATM switch.

Example:

```
ATM INTERFACE> set uni-version 3.0
```

network-id

Sets the network id of the ATM interface. Multiple ATM interfaces should have the same network id if there is ATM connectivity between the interfaces.

Valid Values:

0 - 255

Default Value:

0

Enable

Use the **enable** command to enable an ESI in the configuration of your ATM device. The ATM interface attempts to register only enabled ESIs when it activates.

Syntax:

enable esi *esi-address*

esi *esi-address*

Address of End System Identifiers.

Valid Values:

Any 12 hexadecimal digits

Default Value:

none

Example: enable esi

```
ATM INTERFACE> enable esi 00:00:00:00:00:09
```

Disable

Use the **disable** command to disable an ESI in the configuration. ATM components using disabled ESIs will not become active on the next router restart.

Syntax: disable esi *esi-address*

esi *esi-address*

Address of End System Identifiers.

Valid Values:

Any 12 hexadecimal digits

Default Value:

none

Example: disable esi

```
ATM INTERFACE> disable esi 00:00:00:00:00:09
```

Accessing the Virtual ATM Interface Configuration Process

From the ATM Config> prompt of a selected real ATM interface, use the **Virtual ATM** command to enter the Virtual ATM configuration command mode.

ATM Virtual Interface Configuration Commands

This section summarizes the ATM virtual interface configuration commands. Enter the commands at the ATM virtual interface config> prompt.

Table 39. ATM Virtual Interface Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Add	Adds a virtual ATM interface.
List	Lists the current configured virtual ATM interfaces.
Remove	Removes the virtual ATM interface from the current configuration.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Add

Use the **add** command to add an ATM virtual interface. A new ATM virtual interface is added to the corresponding ATM real interface (the configuration menu from which this ATM virtual interface configuration menu is accessed). The net/interface number assigned to the newly created ATM virtual interface is displayed and it is one number greater than the current largest interface number.

Syntax:

add

Example:

```
ATM Virtual Interface config> add
Added ATM Virtual Interface Net as interface 5 on physical ATM interface 0
ATM Virtual Interface config>
```

List

Use the **list** command to list configured ATM virtual interfaces defined on the current real ATM interface.

Syntax:

list

Example:

```
ATM Virtual Interface config> list

                        ATM Virtual Interface Nets
-----
ATM interface number = 0
ATM Virtual Interface Net interface number = 5

ATM Virtual Interface config>
```

Remove

Use the **remove** command to delete an ATM virtual interface. The virtual ATM interface on the real ATM interface with the specified interface number will be removed from the SRAM configuration records. If you do not specify an interface

ATM Virtual Interface Configuration Commands (Talk 6)

number, the last ATM virtual interface on this real ATM interface will be deleted. If you enter a question mark (?), all ATM virtual interfaces on the current real ATM interface will be listed and you can select from that list the interface you want to remove.

Syntax:

```
remove n
```

Example: remove 5

```
Virtual ATM 5 deleted successfully.  
ATM Virtual Interface config>
```

Accessing the ATM Monitoring Process

Use the following procedure to access the ATM monitoring commands. This process gives you access to an ATM's *monitoring* process.

1. At the OPCON prompt, enter **talk 5**. (For more detail on this command, refer to "Chapter 4. The OPCON Process" on page 29.) For example:

```
* talk 5  
+
```

The GWCON prompt (+) is displayed on the console. If the prompt does not appear when you first enter the console, press **Return** again.

2. Enter **interface** at the + prompt to display a list of configured interfaces.
3. Record the interface numbers.
4. Enter **network** followed by the number of the ATM interface.

```
+ network 5  
ATM+
```

The ATM monitoring prompt (ATM+) is displayed.

ATM Monitoring Commands

This section summarizes the ATM monitoring commands for monitoring ATM interfaces. Enter the commands at the ATM+ prompt.

Table 40. ATM monitoring command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Interface	Displays the ATM Interface+ prompt from which you can monitor the ATM Interface, as described in "ATM Interface Monitoring Commands (ATM INTERFACE+ Prompt)" on page 297 .
Atm-llc	Displays the ATM LLC+ prompt from which you can monitor endpoints, a set of user clients, and a set of ATM channels.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Interface

Displays the ATM Interface+ prompt, described in "ATM Interface Monitoring Commands (ATM INTERFACE+ Prompt)" on page 297.

Syntax:
interface
_

ATM-LLC

Displays the ATM-LLC+ prompt, described in “ATM-LLC Monitoring Commands” on page 299.

Syntax:
atm-llc
_

ATM Interface Monitoring Commands (ATM INTERFACE+ Prompt)

This section summarizes and then explains the commands for monitoring a specific ATM interface.

Enter the commands at the ATM INTERFACE+ prompt.

Table 41. ATM INTERFACE monitoring command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Lists ATM addresses and VCCs.
Trace	Starts/Stops packet tracing on a specified VPI/VC1 range. Trace can be viewed by ELS.
Wrap	Starts/Stops a loopback test on the VCC.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

List

Use the **list** command to list various categories of ATM data.

Syntax:

list addresses
_ all
circuit
vccs
reserved-bandwidth

addresses

Lists the ATM addresses, along with a descriptive name, in use on the device.

Example:

ATM INTERFACE+ **list addresses**

```

-----
          ATM Address                               Name
-----
39999999999999999999000099999020000041347391804  LEC 1 'eth1'
39999999999999999999000099999020000041347391802  LES/BUS 'eth1'
```

all Lists all of the following:

- Addresses

ATM Interface Monitoring Commands (Talk 5)

- Circuit statistics
- VCCs
- Reserved Bandwidth

circuit Lists the statistics for a particular VCC by specifying the particular VCI-VPI pair. You can also specify the circuit on the command line; for example: list circuit 33.

Example:

```
ATM INTERFACE+ list circuit
VPI [0]?
VCI [32]?33

Frames transmitted = 2 Bytes transmitted = 216
Frames received = 2 Bytes received = 216
```

vccs Lists all the VCCs established by the router. The VCCs may be permanent (PVC) or switched (SVC), point-to-point or point-to-multipoint, and each is identified by a unique VPI/VCI. The trace command uses the VPI/VCI value for a VCC to perform packet tracing over a particular VCC.

Example:

```
P-P point to point VCC
P-MP point to multipoint VCC
ILMI Interim Local Management Interface VCC
SAAL signalling VCC
Bx-y Internally bound VCC to VPI x, VCI y
Sx-y Internally spliced VCC to VPI x, VCI y
```

reserved-bandwidth

Lists the reserved bandwidth on the ATM Interface.

Example:

```
ATM INTERFACE+ list reserved-bandwidth
Line Rate : 155000 Kbps
Peak Reserved Bandwidth : None
Sustained Reserved Bandwidth : None
```

Trace

Use the **trace** command activate packet tracing over a specified range of VPI/VCI values. You can view trace data by using ELS as described in “View” on page 183.

Syntax:

```
trace list
on
off
```

list Displays the current packet tracing options on the ATM interface.

Example:

```
ATM Interface+ trace
on | off | list []? list
Packet trace is ON
Range of VPIs to be traced: 0 - 0
Range of VCIs to be traced: 32 - 39
```

ATM Interface Monitoring Commands (Talk 5)

on Starts packet tracing on all active VCCs within the specified VPI/VCI range.

Example:

```
ATM Interface+ trace on
beginning of VPI range [0]?
end of VPI range [0]?
beginning of VCI range [32]?
end of VCI range [65535]? 39
```

off Stops packet tracing on all VCCs.

Example:

```
ATM Interface+ trace off
ATM Interface+ trace list
Packet trace is OFF
```

Wrap

Use the **wrap** command to perform a loopback data test on the ATM interface of the adapter. Wrap can be issued on a per VC basis by specifying VPI-VCI pairs. Data is looped back internally.

You can selectively start a wrap, stop a wrap, or display the current wrap settings.

If you stop or display a wrap, the following statistics will be displayed:

- Wrap transmits
- Wrap receives
- Wrap transmit errors
- Wrap receive errors
- Wrap receive timeouts

For display, the current wrap statistics are displayed.

For stop, the final wrap statistics are displayed.

Syntax:

```
wrap                display
                        start
                        stop
```

display

Displays the current wrap settings.

start Starts the wrap procedure and specifies the VPI-VCI length of pattern and the pattern itself.

Example:

```
ATM Interface+ wrap start
VPI [0]?
VCI [32]?
wrap pattern length [32]?
Enter 32-byte wrap pattern: [ABCDEFGH IJKLMNOPQRSTUVWXYZ123456]?
```

stop Stops the wrap procedure and displays final wrap statistics.

ATM-LLC Monitoring Commands

This section explains the commands for monitoring ATM LLC multiplexing.

ATM-LLC Monitoring Commands (Talk 5)

Enter the commands at the ATM-LLC+ prompt.

Table 42. ATM LLC Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Lists various options
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

List

Use the **list** command to list various categories of ATM LLC monitoring data.

Syntax:

```
list                endpoints  
                    channels
```

endpoints

Lists the ATM addresses in use by protocols using the ATM-LLC multiplexing function on the device. The endpoint is displayed as the End System Identifier and the Selector.

Example: list endpoints

```
ATM-LLC+ list endpoints
```

channels

Lists the channels in use by protocols using the ATM-LLC multiplexing function on the device.

Example: list channels

```
ATM-LLC+ list channels
```

ATM Virtual Interface Monitoring Commands

Monitoring the ATM virtual interface is done using the ATM LLC monitoring commands. See “ATM-LLC Monitoring Commands” on page 299 for additional information.

Chapter 28. Using LAN Emulation Clients

This chapter describes LAN Emulation Clients (LECs). It includes the following sections:

- “LAN Emulation Client Overview”

LAN Emulation Client Overview

On the router, LECs serve the purpose of “ports” or “interfaces” on traditional routers and bridges. The router bridges and routes traffic between ports by receiving and transmitting traffic through its LECs.

LEC has two prompt levels:

1. `LE Client Config>` lets you enter commands that control the environment of all your LECs. The commands for this prompt level are described in “Configuring LAN Emulation Clients” on page 303
2. One of the commands, **config**, gets you to another prompt level, `LEC Config>`, at which you can enter commands to configure a specific LEC.

An explanation of commands for LAN Emulation Clients follows.

Chapter 29. Configuring and Monitoring LAN Emulation Clients

This chapter describes how to configure LAN Emulation Clients (LECs). It includes the following sections:

- “Configuring LAN Emulation Clients”
- “Configuring an ATM Forum-Compliant LE Client” on page 305
- “Accessing the LEC Monitoring Environment” on page 318
- “LEC Monitoring Commands” on page 319

Configuring LAN Emulation Clients

This section summarizes and explains the commands for configuring and using the set of LE Clients on a particular ATM interface.

To get to the LE Client Config> prompt, enter **le-c** at the ATM Config> prompt as described in “ATM Configuration Commands” on page 287.

Enter the commands at the LE Client Config> prompt under the ATM Config> prompt, as described in “ATM Configuration Commands” on page 287.

Table 43. LAN EMULATION Client Configuration Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Add	Adds a LEC for the following types of ATM Forum-compliant Emulated LANs architectures: <ul style="list-style-type: none">• Ethernet• Token Ring
Config	Gets you to the LEC Config> prompt, from which you can configure a specific LAN Emulation Client.
List	Lists the LEC.
Remove	Removes a LEC.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Add

Use the **add** command to add a LEC for a Token-Ring or Ethernet emulated LAN.

Syntax:

```
add                Ethernet
                   Token Ring
```

token-ring

Token-ring emulated LAN

Example: add token ring

```
LE Client Config> add token-ring
Added Emulated LAN as interface 3
```


Configuring an ATM Forum-Compliant LE Client

This section explains the commands for configuring an ATM Forum-compliant LAN Emulation Client. Enter the appropriate commands at either the Ethernet Forum Compliant LEC Config> prompt or the Token Ring Forum Compliant LEC Config> prompt. Commands in the following table apply to both Token-Ring and Ethernet LECs except where indicated.

Enter the commands at the LEC Config> prompt after entering the **config** command at the LE Client Config> prompt.

Table 44. LAN Emulation Client Configuration Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
ARP-Configuration	Allows you to configure the LE-ARP configuration for the ATM Forum-compliant client
RIF-Timer	Sets the maximum amount of time that information in the RIF is maintained before it is refreshed. Applies only to Token-Ring LECs.
Source-routing	Used to enable or disable source-route bridging. Applies only to Token-Ring LECs.
IP-Encapsulation	Sets the IP encapsulation as Ethernet (type X'0800') or IEEE (802.3 with SNAP). Applies only to Ethernet LECs.
List	Lists the LAN Emulation Client configuration.
QoS-Configuration	Gets you to the e _{lan-x} LEC QoS Config> prompt from which you can configure Quality of Service as described in LE Client QoS Configuration Commands in <i>Using and Configuring Features</i> .
Set	Sets the LAN Emulation Client parameters.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

ARP Configuration

Use the **arp-configuration** command to configure the static LE-ARP entries for the ATM forum-compliant LAN Emulation Client.

Syntax:

arp-configuration

Example:

```
Token Ring Forum Compliant LEC Config> arp-configuration
ATM LAN Emulation Clients ARP configuration
```

Table 45. ATM LAN Emulation Client ARP Configuration Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Add	Adds an LE-ARP cache entry using a MAC or route descriptor ARP.
Config	Sets cache entry QoS parameter values.
List	Lists configured ARP cache entries.

Configuring Forum LE Clients

Table 45. ATM LAN Emulation Client ARP Configuration Commands Summary (continued)

Command	Function
Remove	Removes an ARP cache entry.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Add

Use the **add** command to add an ARP cache entry using the MAC address or a route descriptor.

MAC addresses, and route descriptors are entered as strings of hexadecimal characters with or without optional separator characters between bytes. Valid separator characters are dashes (-), periods (.), or colons (:).

Syntax:

```
add                mac
                   route-descriptor
```

Example 1:

```
ARP config for LEC>add mac
MAC address of LE ARP Entry []? 123456789098
ATM address in 00.00.00.00.00.00:... form []? 390f0000000000000000000000000000123456789098
Destination Type - REMOTE or LOCAL [Remote]?
```

Example 2:

```
ARP config for LEC>add route 12.34
ATM address in 00.00.00.00.00.00:... form []? 390f00000000000000000000000000001234567890988888
ARP config for LEC>
```

Config

Use the **Config** command to configure the permanent ARP cache entry QoS parameters for the ATM forum-specific LAN Emulation Client.

Syntax:

```
config                arp-entry-number
```

Example:

```
ARP config for LEC> config
ARP entry number [1]
Configure LEC ARP entry
```

Table 46. ATM LAN Emulation Client ARP Config Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Set	Sets QoS parameter values.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Set:

Use the **Set** command to configure the permanent ARP cache entry QoS parameters for the ATM forum-specific LAN Emulation Client.

Syntax:

```
set                max-reserved-bandwidth  
                   traffic-type  
                   peak-cell-rate  
                   sustained-cell-rate  
                   qos-class  
                   max-burst-size
```

Example:

```
ARP entry 'identifier' config> set ?  
MAX-RESERVED-BANDWIDTH  
TRAFFIC-TYPE  
PEAK-CELL-RATE  
SUSTAINED-CELL-RATE  
QOS-CLASS  
MAX-BURST-SIZE
```

See Configuring and Monitoring Quality of Service (QoS) in *Using and Configuring Features* for detailed information about the QoS parameters.

List

Use the **list** command to display information about ARP configuration.

Remove

Use the **remove** command to remove an configured MAC address or Route Descriptor LE-ARP entry.

Select the ARP entry number to be removed from the list provided.

Syntax:

```
remove            arp-entry-number
```

RIF-Timer (for Token-Ring Forum-compliant LEC only)

Use the **RIF-Timer** command to set the maximum amount of time that information in the RIF is maintained before it is refreshed. Range is 0 to 4096. The default is 120 seconds.

Syntax:

```
rif-timer        value
```

Example:

```
rif-timer 100
```

Source-Routing (for Token-Ring Forum-Compliant LEC only)

Use the **source-routing** command to enable or disable end station source-routing. Source routing is the process by which end stations determine the source route to use to cross source routing bridges. Source routing allows the IP, IPX, and AppleTalk Phase 2 protocols to reach nodes on the other side of the source route bridge.

Configuring Forum LE Clients

This function of the device is not changed whether source routing is enabled or disabled. The default setting is enabled.

Some stations cannot properly receive frames with Source Routing RIF on them. This is especially common among NetWare drivers. Disabling source routing in this situation will allow you to communicate with these stations.

Source routing should be enabled only if there are source-routing bridges on this ring through which you want to bridge IP, IPX, and AppleTalk Phase 2 packets. Source routing must also be enabled so that LLC test response messages can be returned.

Syntax:

```
source-routing          enable
                           disable
```

Example:

```
source-routing disable
```

IP-Encapsulation (for Ethernet ATM Forum-Compliant LEC only)

Use the **IP-encapsulation** command to select Ethernet (Ethernet type X'0800') or IEEE 802.3 (Ethernet 802.3 with SNAP). Specify either type **Ethernet** or **IEEE-802.3**.

Syntax:

```
IP-encapsulation      Ethernet
                        IEEE-802.3
```

List

Use the **list** command to list the LE client configuration.

Syntax:

```
list
```

QoS

Use the **qos-configuration** command to get you to the LEC QoS Config> prompt from which you can configure Quality of Service as described in LE Client QoS Configuration Commands in *Using and Configuring Features*.

Syntax:

```
qos-configuration
```

Set

Use the **set** command to set LE Client parameters.

Syntax:

set

arp-aging-time
arp-cache-size
arp-queue-depth
arp-response-time
auto-config
best-effort-peakrate
bus-connect-retries
conn-completion-time
control-timeout
elan-name
esi-address
flush-timeout
forward-delay
forward-disconnect-timeout
frame-size
initial-control-timeout
lecs-atm-address
les-atm-address
mac-address
multicast-send-avg
multicast-send-peak
multicast-send-type
multiplier-control-timeout
path-switch-delay
reconfig-delay-min
reconfig-delay-max
retry-count
selector
trace
unknown-count
unknown-time
vcc-timeout

arp-aging-time

Sets ARP aging time. This is the maximum time that a LEC will maintain an entry in its LE_ARP cache in the absence of a verification of that relationship. A larger aging time may result in a faster session setup time, but may also use more memory and reacts slower to changes in network configuration.

Configuring Forum LE Clients

Valid Values:

An integer number of seconds in the range of 10 to 300.

Default Value:

300

Example:

```
LEC Config> set arp-aging-time 200
```

arp-cache-size

Sets the number of entries in the ARP cache. The size of the ARP cache limits the number of simultaneous data direct VCCs. Larger ARP caches require more memory, but permit the client to simultaneously converse with a larger number of destinations.

Valid Values:

An integer number in the range of 10 to 65535.

Default Value:

5000

Example:

```
LEC Config> set arp-cache-size 10
```

arp-queue-depth

Sets the maximum number of queued frames per ARP cache entry. The LEC enqueues frames when switching the data path from the Multicast Send VCC to a Data Direct VCC. Frames passed to the LEC for transmission will be discarded if the queue is full. A larger queue requires more memory, but results in fewer discarded frames during the data path switch.

Valid Values:

An integer number in the range of 0 to 10.

Default Value:

5

Example:

```
LEC Config> set arp-queue-depth 10
```

arp-response-time

Sets expected ARP response time. This value controls how frequently an unanswered LE ARP request is retried. Larger values result in fewer LE ARPs, which causes less traffic and possibly increase the amount of time before a Data Direct VCC is established.

Valid Values:

An integer number of seconds in the range of 1 to 30.

Default Value:

1 second

Example:

```
LEC Config> set arp-response-time 20
```

auto-config

Specifies whether this LEC uses LECS auto-config mode. Specify YES or NO. The LEC may contact the LECS to obtain the address of its LES and various other configuration parameters.

Valid Values:

If YES, then you do not have to configure the ATM address of the LES.

If NO, then you *must* configure the ATM address of the LES using the **set les-atm-address** command as described on page 313.

Default Value:

NO

Example:

```
LEC Config> set auto-config yes
```

best-effort-peakrate

Sets the Best Effort Peak Rate. Used when establishing best effort multicast send connections.

The maximum peak rate depends on the maximum data rate of the ATM device.

Specify an integer from 1 to the maximum peak rate in Kbps (the definition is the maximum data rate) as follows:

- If ATM maximum data rate is 25 Mbps, the maximum peak rate is 25,000 Kbps.
- If ATM maximum data rate is 155 Mbps, the maximum peak rate is 155,000 Kbps.

Valid Values:

An integer number in the range of 1 - device maximum data rate.

Default Value:

155000

Example:

```
LEC Config> set best-effort-peakrate 24000
```

bus-connect-retries

This parameter sets the maximum number of times that the LEC will attempt to reconnect to the BUS before returning to the initial state.

Valid Values:

0 - 2

Default Value:

1

connection-completion-time

Sets the connection completion time. This is the time interval in which data or a READY_IND message is expected from a calling party.

When a Data Direct VCC is established to the client, the LEC expects data or a READY_IND message within this time period. The LEC will not transmit frames over a Data Direct VCC established to it until receiving data or a READY_IND. This parameter value controls the amount of time which passes before the LEC issues a READY QUERY (in hopes of receiving a READY_IND). Smaller values lead to faster response times, but also to unnecessary transmissions.

Valid Values:

An integer number of seconds in the range of 1 to 10.

Configuring Forum LE Clients

Default Value:

4

Example:

```
LEC Config> set connection-completion-time 5
```

control-timeout

This parameter sets the maximum cumulative control timeout of a request.

A current timeout value is initialized to the value of *initial-control-timeout*. If a response to a request is not received within the current timeout value, the current timeout is multiplied by the value of the *multiplier-control-timeout* and the request is reissued. Each time the current timeout value expires, this process is repeated until the current timeout value exceeds the value of *control-timeout*.

Valid Values:

An integer number of seconds in the range of 10 to 300.

Default Value:

30

Example:

```
LEC Config> set control-timeout 100
```

elan-name

Specifies name of the ELAN that the LEC wishes to join. This is the ELAN name sent to the LECS in the configure request (if the LEC autoconfigures) or to the LES in the join request. The LECS or LES may return a different ELAN name in the response.

Valid Values:

Any character string length of 0 - 32 bytes.

Default Value:

Blank

Note: A blank name (0 length string) is valid.

Example:

```
LEC Config> set elan-name FUZZY
```

esi-address

Sets the ESI portion of the LEC's ATM address.

Specify the ESI portion (octets 13 through 19) of the LEC's ATM address. The ESI and selector combination of the LEC must be unique among all LAN emulation components on the device.

Valid Values:

Any 12 hexadecimal digits.

Default Value:

Burned-in ESI

Example:

```
set esi
Select ESI
(1) Use burned in ESI
(2) 11.22.33.44.55.66

Enter selection [1]?
```

flush-timeout

Sets the flush timeout. This is the time limit to wait to receive the LE_FLUSH_RESPONSE after the LE_FLUSH_REQUEST has been sent before taking recovery action. During recovery, any queued frames are dropped and a new flush request is sent.

When switching from the multicast send to a data direct data path, the client sends a flush request over the multicast send VCC. Until a flush response is received, or until the path switch delay expires, frames are queued for the destination.

Valid Values:

An integer number of seconds in the range of 1 to 4.

Default Value:

4

Example:

```
LEC Config> set flush-timeout 3
```

forward-delay

Sets the forward delay. Entries in the LE ARP cache must be periodically re-verified. The forward delay time is the maximum amount of time a remote entry may remain in the cache during a network topology change. Larger aging times may result in stale (invalid) entries, but also cause less re-verification traffic.

Valid Values:

An integer number of seconds in the range of 4 to 30.

Default Value:

15

Example:

```
LEC Config> set forward-delay 10
```

forward-disconnect-timeout

This parameter sets the amount of time that a LEC will wait after losing its last Multicast Forward VCC from the BUS before returning to the initial state. This delay permits the BUS to attempt to reconnect to the client without returning to the initial state.

Valid Values:

10 - 300 seconds

Default Value:

60

frame-size

Sets the frame size.

The value specified for frame-size must be equal to or less than the value specified for ATM max-frame using the ATM INTERFACE> **set max-frame** command as described on page 292.

Valid Values:

1516

4544

9234

18190

Configuring Forum LE Clients

Default Value:

If the ELAN type is token ring, the default is 4544. If the ELAN type is Ethernet, the default is 1516.

Example:

```
LEC Config> set frame-size 4544
```

initial-control-timeout

This parameter sets the value of the initial control timeout used in the control timeout algorithm described in 312.

Valid Values:

1 - 10

Default Value:

5

Example:

```
LEC Config> set initial-control-timeout 10
```

lecs-atm-address

Specifies the ATM address of the LECS.

If the client is set to auto configure, it attempts to connect to a LECS. If it is unable to connect to a LECS, then it may try another LECS ATM address. The LECS ATM addresses that are tried, in order, are:

1. This configured LECS address
2. Any LECS address obtained through ILMI
3. The well-known LECS address defined by the ATM Forum.

No default is provided.

Note: This command should be entered on one command line. It is shown here on two lines because of spacing.

Example:

```
LEC Config> set lecs-atm-address  
39.84.0F.00.00.00.00.00.00.00.01.10.00.5A.00.DE.AD.01
```

les-atm-address

Sets the LES ATM address. This command may be optional or required depending upon the setting of lecs-auto-config as described in the **set auto-config** command on page 310.

- If auto-config is YES, the les-atm-address is not configurable.
- If auto-config is NO, then the les-atm-address is required.

Specify the ATM address of the LES. No default is provided.

Note: This command should be entered on one command line. It is shown here on two lines because of spacing.

Example:

```
LEC Config> set les-atm-address  
39.84.0F.00.00.00.00.00.00.00.00.01.10.00.5A.00.DE.AD.02
```

mac-address

Sets the MAC address for this LE client. You *may* specify that the client use the burned-in MAC address of the ATM interface, or you may specify a

different MAC address. If you have two clients that are bridged together, they should use different MAC addresses.

This MAC address is registered with the LES when the client joins the ELAN.

Valid Values:

Any valid MAC address.

Default Value:

none

Example:

```
LEC Config> set mac-address
Use adapter address for MAC? [No]
MAC address []: 10.00.5a.00.00.01
```

multicast-send-avg

Sets the multicast send VCC average rate in Kbps. Used by the LEC for reserving bandwidth on the VCC to the BUS. It specifies the forward and backward sustained cell rate used when setting up a reserved bandwidth multicast send VCC.

This parameter is only applicable when the multicast-send-type is reserved bandwidth. If multicast-send-avg equals multicast-send-peak, then a constant bit rate (CBR) multicast send is signalled. Otherwise, a variable bit rate (VBR) multicast send is signalled. Multicast-send-avg must be less than or equal to multicast-send peak.

A reserved bandwidth multicast send VCC may improve data transfer rates in congested networks, but reserving bandwidth and not using it wastes network resources.

When the multicast-send-type is reserved, then multicast-send-avg and multicast-send-peak must be specified.

Example:

```
LEC Config> set multicast-send-avg 4000
```

multicast-send-peak

Sets the multicast send peak rate in Kbps. Used by LEC for reserving bandwidth on the VCC to the BUS. It specifies the forward and backward peak cell rate used when establishing a reserved bandwidth multicast send VCC.

This parameter is only applicable when the multicast-send-type is reserved bandwidth. If multicast-send-avg equals multicast-send-peak, then a constant bit rate (CBR) multicast send is signalled. Otherwise, a variable bit rate (VBR) multicast send is signalled. Multicast-send-avg must be less than or equal to multicast-send peak.

A reserved bandwidth multicast send VCC may improve data transfer rates in congested networks, but reserving bandwidth and not using it wastes network resources.

When the multicast-send-type is reserved, then multicast-send-avg and multicast-send-peak must be specified.

Example:

```
LEC Config> set multicast-send-peak 155
```

multicast-send-type

Sets the multicast send type. Specifies the method used by the LEC when establishing the multicast send VCC.

Configuring Forum LE Clients

If multicast-send-avg equals multicast-send-peak, then a constant bit rate (CBR) multicast send is signalled. Otherwise, a variable bit rate (VBR) multicast send is signalled. Multicast-send-avg must at least equal multicast-send peak.

A reserved bandwidth multicast send VCC may improve data transfer rates in congested networks, but reserving bandwidth and not using it wastes network resources.

When the multicast-send-type is reserved, then multicast-send-no and multicast-send-peak must be specified.

Valid Values:

Best Effort or Reserved

Default Value:

Best Effort

Example:

```
LEC Config> set multicast-send-type best-effort
```

multiplier-control-timeout

This parameter sets the value of the control timeout multiplier used in the control timeout algorithm described on page 312.

Valid Values:

2 - 5

Default Value:

2

Example:

```
LEC Config> set multiplier-control-timeout 5
```

path-switch-delay

Sets the path switch delay.

The LEC must ensure that all frames sent through the BUS to a destination have arrived at the destination before it can start using a Data Direct VCC. This is accomplished using the flush protocol, or by waiting path-switch-delay seconds after sending the last packet to the BUS. Smaller values improve performance, but may result in out-of-order packets in a heavily congested network.

Valid Values:

An integer number of seconds in the range of 1 to 8.

Default Value:

6

Example:

```
LEC Config> set path-switch-delay 5
```

reconfig-delay-min

This parameter sets the minimum delay time when LEC returns to the initial state. This value must be \leq *reconfig-delay-max*.

Valid Values:

1 - the value of *reconfig-delay-max*

Default Value:

1

Example:

```
LEC Config> set reconfig-delay-min 5
```

reconfig-delay-max

This parameter sets the maximum delay time when LEC returns to the initial state. This value must be \geq *reconfig-delay-min*.

Valid Values:

1 - 10

Default Value:

5

Example:

```
LEC Config> set reconfig-delay-max 9
```

retry-count

Sets the retry count. This is maximum number of times that the LEC retries an LE_ARP_REQUEST for a specific frame's LAN destination. If no ARP response is received after the specified number of retries, then the entry is purged from the LE ARP cache.

Valid Values:

0, 1, or 2

Default Value:

1

Example:

```
LEC Config> set retry-count 2
```

selector

Specifies the selector portion of the client's ATM address. The combination of ESI and selector must be unique among all LANE components on the device. By default, a unique selector is selected for the configured ESI.

Valid Values:

Any octet, in hexadecimal, that is not in use by another LANE component with the same ESI.

Example:

```
LEC Config> set selector 01
```

trace Enables tracing for the LEC. To perform packet tracing, three steps are required:

1. Enable packet tracing system (under ELS)
2. Enable tracing on the LEC subsystem (under ELS)
3. Enable packet tracing on the desired LECs (using this command).

Valid Values:

Enable or Disable

Default Value:

Disable

Example:

```
Token Ring LEC config>set trace  
Trace packets on the LEC? [No]?yes
```

unknown-count

Sets the unknown frame count. This is the maximum number of frames for

Configuring Forum LE Clients

a specific unicast MAC address or route descriptor that may be sent to the BUS within the time specified by the unknown-time parameter. Larger values decrease the number of discarded frames while increasing the load on the BUS.

Valid Values:

An integer number of frames in the range of 1 to 255.

Default Value:

10

unknown-time

Sets the unknown frame time. This is the time interval during which the maximum number of frames for a specific unicast MAC address or route descriptor (specified by the unknown-count parameter) may be sent to the BUS. Larger values increase the number of discarded frames while decreasing the load on the BUS.

Valid Values:

An integer number of seconds in the range of 1 to 60.

Default Value:

1

Example:

```
LEC Config> set unknown-time 5
```

vcc-timeout

Sets the VCC timeout. Data direct VCCs over which no traffic has been sent for this period of time should be released.

Valid Values: 0 to 31536000 seconds (1 year).

Default Value: 1200

Note: This parameter is meaningful only for SVC connections.

Example:

```
LEC Config> set vcc-timeout 1000
```

Accessing the LEC Monitoring Environment

Use the following procedure to access the LEC monitoring commands. This process gives you access to the LEC *monitoring* process.

1. At the OPCON prompt, enter **talk 5**. (For more detail on this command, refer to "Chapter 4. The OPCON Process" on page 29.) For example:

```
* talk 5  
+
```

After you enter the **talk 5** command, the GWCON prompt (+) displays on the console. If the prompt does not appear when you first enter configuration, press **Return** again.

2. At the + prompt, enter the **network ?** command to display the network interface numbers for which the router is currently configured, and enter the *interface number* for the LEC you wish to monitor. For example:

```
+ network ?  
  
1 : ATM Ethernet LAN Emulation: ETH  
2 : IP Protocol Network
```

```

3 : Bridge Application
5 : CHARM ATM Adapter
Network number [0]? 1
LEC+

```

The LEC monitoring prompt (LEC+), is displayed.

If you know the interface number of the LEC you wish to monitor, enter the **network** command followed by the *interface number* of the LEC.

```

+ network 1
LEC+

```

LEC Monitoring Commands

This section summarizes and then explains the LEC monitoring commands. You can access LEC monitoring commands at the LEC+ prompt. Table 47 shows the commands.

Table 47. LE Config monitoring command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Lists: <ul style="list-style-type: none"> • LEC Address Resolution Table (ARP) • LEC configuration • Data Direct VCC information • LEC statistics • VCC table.
MIB	Displays LEC MIB objects including: <ul style="list-style-type: none"> • LEC MIB Configuration Table • LEC MAC ARP Table • LEC Route Descriptor Table • LEC MIB Server VCC Tables • LEC MIB Statistics Table • LEC MIB Status Table
QoS	Gets you to the LEC x QoS+ prompt from which you can monitor Quality of Service as described in Quality of Service Monitoring Commands in <i>Using and Configuring Features</i> .
Trace	Sets packet tracing on or off.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

List

Use the **list** command to list the LEC Address Resolution Table (ART), list the LEC configuration, list Data Direct VCC information, or list LEC statistics.

Syntax:

```

list                arp-table
                   configuration
                   data-direct-vccs

```

Configuring Forum LE Clients

statistics

vcc-table

arp Lists the LEC Address Resolution Table (entries in the ARP cache).

Example:

LEC+ list arp

LEC Address Resolution (LE ARP Cache) Table

```
Max Table Size      = 10
Free Table Entries  = 10
Current Mac Entries = 0
Current RD Entries  = 0
Arp Aging Time     = 300
Verify Sweep Interval = 60
```

MAC Address	Remote	Conn Handle	Xmit Queue Depth	BUS Frame Count	Arp Retry Count	Aging Timer	Destination	ATM Address
40.00.00.00.00.09	False	652	0	0	0	60	39.99.99.99.99.99.	99.00.00.99.99.30.02.40.00.00.00.00.09.81

Note: The Sweep Interval is always one-fifth of the ARP Aging Timer value.

Max Table Size

The total number of entries available

Free Table Entries

The number of free entries

Current MAC Entries

Current RD Entries

Route Descriptor ATM entries

ARP Aging Time

Time for an entry to be aged out

Verify Sweep Interval

MAC Address

Remote

Connection Handle

Queue Depth

Xmit Frame Count

BUS Retry Count

ARP Aging Timer

Destination ATM Address

configuration

Lists the LEC configuration.

For Ethernet:

Example:

```
IBM LEC+ list config
                        ATM IBM LEC Configuration
Physical ATM interface number = 0
LEC interface number       = 7
Primary ATM address
    ESI address             = Use burned in addr
    Selector byte           = 0x3
Emulated LAN type          = Ethernet IBM
Maximum frame size         = 1523
LE Client MAC address      = Use burned in addr
LE Server ATM address      = 00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
Forward Peak Rate          = 155000
Backward Peak Rate         = 155000
    MAC cache size          = 32
MAC cache aging period     = 60
Route Descriptor cache size = 32
Route Descriptor aging period = 60
LES Registration interval   = 60
LES Registration retry count = 3
LES keep alive count       = 10
Packet trace                = No
IP Encapsulation            = ETHER
```

For Token Ring:

Example:

```
IBM LEC+list config
                        ATM IBM LEC Configuration
Physical ATM interface number = 0
LEC interface number         = 10
Primary ATM address
    ESI address               = Use burned in addr
    Selector byte             = 0x6
Emulated LAN type            = Token Ring IBM
Maximum frame size           = 4551
LE Client MAC address        = Use burned in addr
LE Server ATM address        = 39.84.07.00.00.00.00.00.00.00.00.00.01.10.00.5A.DD.DA.02
Forward Peak Rate            = 155000
Backward Peak Rate           = 155000
    MAC cache size            = 32
MAC cache aging period       = 60
Route Descriptor cache size   = 32
Route Descriptor aging period = 60
LES Registration interval     = 60
LES Registration retry count  = 3
LES keep alive count          = 10
Packet trace                  = No
RIF Aging Timer               = 120
Source Routing                = Enabled
```

Example:

```
LEC+ list config
Physical ATM interface number = 0
LEC interface number         = 9
LEC ATM address              = 39.99.99.99.99.99.00.00.99.99.31.01.09.FC.DD.D0.32.70.0A
LEC MAC address              = 40.00.82.10.17.09
lecConfigMode                 = Manual
lecConfigLanType              = 802.5 - Token Ring
lecConfigMaxDataFrameSize     = 4544
lecConfigLanName              =
lecConfigLesAtmAddress        = 39.99.99.99.99.99.00.00.99.99.31.01.40.00.82.10.17.00.09
lecControlTimeout             = 30
lecMaxUnknownFrameCount      = 10
lecMaxUnknownFrameTime       = 1
lecVccTimeoutPeriod           = 1200
lecMaxRetryCount              = 1
lecAgingTime                  = 300
lecForwardDelayTime           = 15
lecExpectedArpResponseTime    = 1
lecFlushTimeout               = 4
lecPathSwitchingDelay         = 6
lecLocalSegmentId             = 0x0
```

Configuring Forum LE Clients

```

lecMulticastSendType           = 1
lecMulticastSendAvgRate        = 365566
lecMulticastSendPeakRate       = 365566
lecConnectionCompleteTimer     = 4
lecInitialControlTimeout       = 5
lecControlTimeoutMultiplier    = 2
V2 Capable                     = TRUE
lecForwardDisconnectTimeout    = 60
lecMinReconfigDelay            = 1
lecMaxReconfigDelay            = 5
lecMaxBusConnectRetries        = 0
lecElanId                      = 0
ExplorerExclude                 = TRUE
LE ARP queue depth              = 5
LE ARP cache size               = 5000
Forward peakrate                 = 365566
Backward peakrate               = 365566
Packet trace                    = Off
RIF aging timer                 = 120
Source Routing                  = enabled

```

See “Set” on page 308 for a definition of the parameters shown in the above examples.

data Lists the LEC Data Direct VCC information.

Example:

LEC+ list data

```

          LEC Data Direct VCC Table

Max Table Size = 1019      Max no of SVC connections
Current Size   = 0         Currently used
Inactivity Timeout = 1200  No Data Xfer Timeout before connection is
                          closed (seconds)

Sweep Interval = 60
  Conn         Inactive   User
  Handle  VPI  VCI   Timer    Count  Destination ATM Address
-----
    652     0  7241   300      1  39.99.99.99.99.99.00.00.99.99.30.02.
                          40.00.00.00.00.09.81
-----

```

statistics

Lists LEC statistics.

Example:

LEC+ list stat

```

          LEC Statistics

In Octets.high = 0      No of Bytes received
In Octets.low  = 346
In Discards    = 2      Packets discarded
In Errors      = 0      Rx.Errors
In Unknown Protos = 0  Unknown protocols received
Out Octets.high = 0     No of Bytes xmitted.
Out Octets.low  = 0
Out Discards    = 0
Out Errors      = 0     Tx.Errors
In Frames       = 0
Out Frames      = 0
In Bytes        = 0
Out Bytes       = 0

```

VCC table

Lists VCC table.

Example:

LEC+ list vcc

MIB

Use the **mib** command to display MIB objects.

Note: Some of this information may be displayed in a different format using the **list** command.

Syntax:

```
mib                config-table
                   mac-arp-table
                   rd-arp-table
                   server-vcc-table
                   statistics-table
                   status-table
```

config Displays the LEC MIB Configuration Table.

Example:

LEC+ **mib config**

```
lecConfigTable:
lecConfigMode           = Manual
lecConfigLanType        = 802.3 - Ethernet
lecConfigMaxDataFrameSize = 1516
lecConfigLanName        =
lecConfigLesAtmAddress   = 39.84.0F.00.00.00.00.00.11.23.24.24.24.24.55.66.77.88.99.00
lecControlTimeout       = 120
lecMaxUnknownFrameCount = 1
lecMaxUnknownFrameTime  = 0
lecVccTimeoutPeriod     = 1200
lecMaxRetryCount        = 1
lecAgingTime            = 300
lecForwardDelayTime     = 15
lecExpectedArpResponseTime = 1
lecFlushTimeout         = 4
lecPathSwitchingDelay   = 6
lecLocalSegmentId       = 0
lecMulticastSendType    = 1
lecMulticastSendAvgRate = 25000000
lecMulticastSendPeakRate = 25000000

lecConnectionCompleteTimer = 4
```

lecConfigMode

LEC config mode: AUTO or MANUAL. If AUTO, LEC Uses LECS to get the LES ATM address.

lecConfigLanType

LAN type, either Ethernet or token-ring

lecConfigMaxDataFrameSize

Maximum frame size

lecConfigLanName

ELAN Name

lecConfigLesAtmAddress

LE Server ATM address

lecControlTimeout

Timeout for request/response control frame

lecMaxUnknownFrameCount

Maximum number of unknown frames

Configuring Forum LE Clients

lecMaxUnknownFrameTime

Period in which LEC will send a maximum of MaxUnknownFrameCount frames to the BUS for a given unicast LAN Destination, and it must also initiate the address resolution protocol to resolve that LAN Destination.

lecVccTimeoutPeriod

Inactivity timeout of SVC Data Direct VCCs

lecMaxRetryCount

LE ARP retry count

lecAgingTime

Life of unverified entry in the ARP table

lecForwardDelayTime

lecExpectedArpResponseTime

ARP Request/Response cycle time

lecFlushTimeout

LE Flush Request/Flush Reply timeout period

lecPathSwitchingDelay

lecLocalSegmentId

Segment ID of emulated LAN. Only for 802.5 clients

lecMulticastSendType

Signaling parameter used by LEC for multicast send VCC

lecMulticastSendAvgRate

Signaling parameter used by LEC for multicast send VCC

lecMulticastSendPeakRate

Signaling parameter used by LEC for multicast send VCC

lecConnectionCompleteTimer

mac Displays the LEC MAC ARP Table

rd Displays the LEC Route Descriptor Table

server Displays the LEC MIB Server VCC Tables

Example:

LEC+ mib server

```
lecServerVccTable:
lecConfigDirectInterface    = 0
lecConfigDirectVpi         = 0
lecConfigDirectVci         = 0
lecControlDirectInterface   = 1
lecControlDirectVpi        = 0
lecControlDirectVci        = 38
lecControlDistributeInterface = 1
lecControlDistributeVpi    = 0
lecControlDistributeVci    = 37
lecMulticastSendInterface  = 1
lecMulticastSendVpi        = 0
lecMulticastSendVci        = 34
lecMulticastForwardInterface = 1
lecMulticastForwardVpi     = 0
lecMulticastForwardVci     = 33
```

lecConfigDirectInterface

The interface associated with the Configuration Direct VCC

lecConfigDirectVpi

VPI which identifies the above VCC if it exists

lecConfigDirectVci

VCI which identifies the above VCC if it exists

lecControlDirectInterface

The interface associated with the Control Direct VCC

lecControlDirectVpi

VPI which identifies the above VCC if it exists

lecControlDirectVci

VCI which identifies the above VCC if it exists

lecControlDistributeInterface

The interface associated with the Control Distribute VCC

lecControlDistributeVpi

VPI which identifies the above VCC if it exists

lecControlDistributeVci

VCI which identifies the above VCC if it exists

lecMulticastSendInterface

The interface associated with the Multicast Send VCC

lecMulticastSendVpi

VPI which identifies the above VCC if it exists

lecMulticastSendVci

VCI which identifies the above VCC if it exists

lecMulticastForwardInterface

The interface associated with the Multicast Forward VCC

lecMulticastForwardVpi

VPI which identifies the above VCC if it exists

lecMulticastForwardVci

VCI which identifies the above VCC if it exists

statistics

Displays the LEC MIB Statistics Table.

Example:

```
LEC+ mib statistics
```

```
lecStatisticsTable:
  lecArpRequestsOut      = 1
  lecArpRequestsIn      = 0
  lecArpRepliesOut      = 0
  lecArpRepliesIn       = 1
  lecControlFramesOut   = 2
  lecControlFramesIn    = 2
  lecSvcFailures        = 1
```

lecArpRequestsOut

No. of LE ARP requests sent by this LEC

lecArpRequestsIn

No. of LE ARP requests received by this LEC

lecArpRepliesOut

No. of LE ARP responses sent by this LEC

lecArpRepliesIn

No. of LE ARP responses received by this LEC

Configuring Forum LE Clients

lecControlFramesOut

No. of Control Packets sent by this LEC

lecControlFramesIn

No. of Control Packets received by this LEC

lecSvcFailures

The total number of:

- Outgoing LAN Emulation SVCs which this client tried but failed, to open
- Incoming LAN Emulation SVCs which this client tried, but failed to establish
- Incoming LAN Emulation SVCs which this client rejected for protocol or security reasons

status Lists MIB status.

Example:

LEC+ **mib status**

```
lecStatusTable:
  lecPrimaryAtmAddress      = 39.84.0F.00.00.00
  Client ATM address=     = 00.00.00.00.00.01.10.00.5A.00.DE.AD.03
  lecId                     = 1                               Assigned by LES
  lecInterfaceState        = Operational                   State of the LEC
  lecLastFailureRespCode   = None                       Error code from last
                                                                failed Config/Join resp.
  lecLastFailureState      = Initial State                 State of LEC when
                                                                updating above field.
  lecProtocol              = 1                             Protocol specified by
                                                                LEC in Join requests.
  LecVersion               = 1                             LEC Protocol Version
                                                                of above
  lecTopologyChange        = False
  lecConfigServerAtmAddress = 00.00.00.00.00.00.
  lecConfigSource          = Did not use LECS
  lecActualLanType         = 802.3 - Ethernet              Frame format currently
                                                                used by LEC
  lecActualMaxDataFrameSize = 1516
  lecActualLanName         = ETH                           Name of emulated LAN
                                                                that LEC joined.
  lecActualLesAtmAddress   = 39.84.0F.00.00.00.
  lecProxyClient           = False                          Is LES acting like a
                                                                proxy ?
```

QoS Information

Use the **qos-information** command to get to the LEC x QoS+ prompt from which you can monitor Quality of Service as described in Quality of Service Monitoring Commands in *Using and Configuring Features*.

Syntax:

qos-information

Chapter 30. Using Channel Adapters

This chapter describes how to plan for host definition and 2216 ESCON and Parallel Channel Adapter (PCA) support. It includes the following sections:

- “Host Definition Planning”, provides information to help you plan for host definition.
- “Planning for 2216 Support” on page 347, describes considerations for support of the 2216 and channel adapters in a network.
- “Channel Adapter Overview” on page 348, describes channel adapter support:
 - LCS (LAN Channel Station) over which you can run TCP/IP
 - LSA (Link Services Architecture) over which you can run hierarchical SNA, including DLSw, APPN ISR, or APPN HPR
 - MPC+ (Multi-Path Channel) over which you can run APPN HPR, TCP/IP, and HPDT UDP (UDP+)

Note: UDP+ is not supported on a Parallel Channel Adapter (PCA).

- “Configuring the Channel Adapter Interface” on page 365
- “Channel Adapter Configuration Commands” on page 368

Host Definition Planning

This section provides information to help you plan for host definition. It includes information for system definition from the host perspective and information for definition from the 2216 perspective.

Before you can attach the 2216 to a channel, the host system must be configured correctly. The following series of steps is required to define the 2216 connection to the host. These definition steps should be done by your system programmer.

1. Define the 2216 to the host channel subsystem using either the host Input/Output Configuration Program (IOCP) or Hardware Configuration Definition (HCD) program.
2. Define the 2216 as a control unit to the host operating system.
3. Define the 2216 and configuration to the host program (TCP/IP or VTAM).

After the host definitions are complete, you must configure the 2216 channel interfaces using the command line interface, or using the configuration program described in *Configuration Program User's Guide*, GC30-3830. Many of the parameters which you provide when you configure the 2216 must match corresponding parameters in the host definition.

Finally, the stations will need to be configured to communicate through the 2216 to the host applications.

The following sections describe host definition and provide sample host configuration statements.

IOCP Definition for the 2216

The following sections describe examples of IOCP definitions for the 2216 with channel adapters. The output of the IOCP device definitions (I/O Configuration Data Set or IOCDS) can be generated using MVS, VM, VSE, or in a stand-alone environment. Refer to the *ES/9000 and ES/3090 Input/Output Configuration Program User's Guide Volume A04, GC38-0097*, for details.

Example IOCP Definition for the ESCON Channel

Figure 20 shows an example of an ESCON configuration. The S/390 host is divided into two logical partitions (LP): LPA and LPB. A connection on path 30 is configured between LPA and 2216A through ESCD switch 00. LPA is attached to ESCD port C0 and 2216A is attached to port C1. The connection between port C0 and C1 is dynamic. LPA is attached to ESCD port C0 and 2216A is attached to port C1. The connection between port C0 and C1 is dynamic.

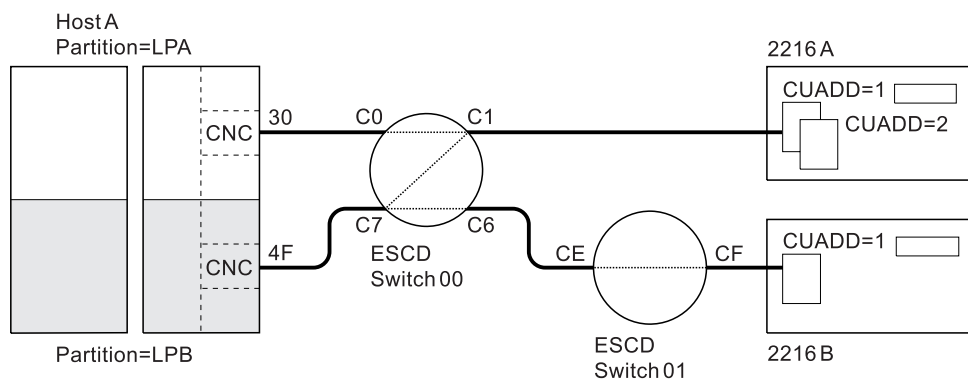


Figure 20. ESCON Channel Configuration Example

LPB on path 4F has a connection with 2216A through ESCD switch 00, and a connection with 2216B through ESCD switches 00 and 01. The connection between ports C7 and C6 is dynamic; the connection between ESCD ports CE and CF is dedicated.

The following example definitions match Figure 20:

Channel path definitions:

```
CHPID    PATH=((30)),TYPE=CNC,PART=(LPA),SWITCH=00
CHPID    PATH=((4F)),TYPE=CNC,PART=(LPB),SWITCH=00
```

Control unit and device definition for the 2216, with logical addressing = 1 for 2216A:

```
CNTLUNIT  CUNUMBR=500,PATH=30,UNIT=3172,LINK=C1,      X
           UNITADD=(00,32),CUADD=1
IODEVICE  ADDRESS=(500,32),CUNUMBR=500,UNIT=3172,    X
           UNITADD=00
```

Control unit and device definition for the 2216 with logical addressing = 2 for 2216A:

```
CNTLUNIT  CUNUMBR=600,PATH=4F,UNIT=3172,LINK=C1,      X
           UNITADD=(00,32),CUADD=2
IODEVICE  ADDRESS=(600,32),CUNUMBR=600,UNIT=3172,    X
           UNITADD=00
```

Control unit and device definition for the 2216, with logical addressing = 1 for 2216B:

CNTLUNIT	CUNUMBR=620,PATH=4F,UNIT=3172,LINK=C6, UNITADD=(20,32),CUADD=1	X
IODEVICE	ADDRESS=(620,32),CUNUMBR=620,UNIT=3172, UNITADD=20	X

The IOCP macroinstructions in the example:

- Assign a CHPID to logical partitions LPA and LPB.
- Define channel path 30 to the 2216 for partition LPA and channel path 4F for partition LPB.
- Identify channel type as an ESCON channel (CNC).
- Assign the two CHPIDs to ESCD switch number 00.
- Associate control unit numbers 500 and 600 to logical addresses 1 and 2 on 2216A and control unit number 620 to logical address 1 on 2216B.
- Assign link address C1 to control units 500 and 600 and link address C6 to control unit 620.
- Define unit addresses (subchannels) 00 through 1F to control units 500 and 600 and unit addresses 20 through 3F to control unit 620.
- Identify each control unit as a 3172 device.

Considerations:

1. The allowable device address range is 00 through FF. The 2216 address range is limited to 32 addresses, and only requires that the addresses defined at the host computer map to the address or addresses configured in the 2216. The address range can extend beyond the addresses actually used, but cannot overlap addresses of other control units cabled to the same CHPID or channel.
2. The ESCON channel mode of operation can be type CNC for basic ESCON channel mode or CVC if there is an ESCON Converter attached.
3. The IODEVICE UNIT parameter should be set to 3172.
4. The LINK number specifies the link address (ESCD port number) to which the 2216 is connected. When two ESCDs are connected in series, the link address must be the port number of the ESCD that has the dynamic connection and to which the 2216 is attached.
5. The logical address (CUADD) must be unique for a given path between a host channel and a 2216.

Example IOCP Definition for the EMIF Host

Figure 21 on page 330 shows an example of an ESCON configuration using the ESCON Multiple Image Facility (EMIF). The S/390 host is divided into two logical partitions (LP): LPA and LPB. Both LPA and LPB are connected on path 30 to 2216 A through switch 00.

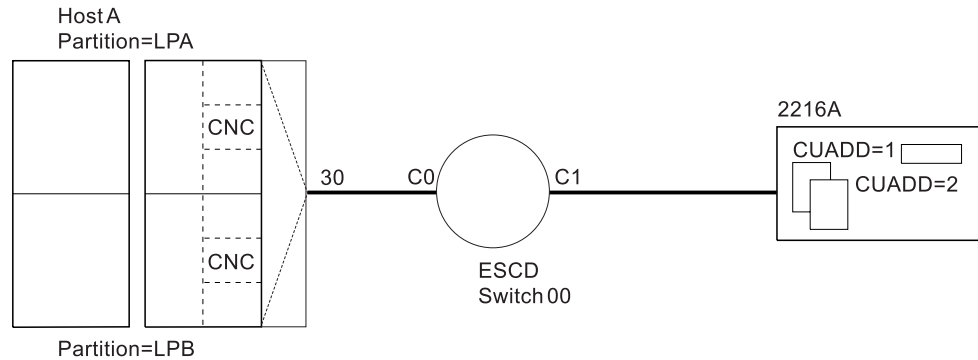


Figure 21. EMIF Host Configuration Example

The following example definitions match Figure 21:

Channel path definitions:

```
CHPID      PATH=((30)),TYPE=CNC,PART=(LPA,LPB),SWITCH=00
```

Control unit and device definition for the 2216, with logical addressing = 1 for 2216A:

```
CNTLUNIT  CUNUMBR=500,PATH=30,UNIT=3172,LINK=C1,      X
           UNITADD=(00,32),CUADD=1
IODEVICE   ADDRESS=(500,32),CUNUMBR=500,UNIT=3172,    X
           UNITADD=00
```

Control unit and device definition for the 2216, with logical addressing = 2 for 2216A:

```
CNTLUNIT  CUNUMBR=620,PATH=30,UNIT=3172,LINK=C1,      X
           UNITADD=(20,32),CUADD=2
IODEVICE   ADDRESS=(620,32),CUNUMBR=620,UNIT=3172,    X
           UNITADD=20
```

The IOCP macroinstructions in the example:

- Assign a CHPID to logical partitions LPA and LPB
- Define channel path 30 to the 2216 to be shared by partition LPA and partition LPB.
- Identify channel type as an ESCON channel (CNC)
- Assign the CHPID to ESCD switch number 00
- Associate control unit numbers 500 to logical address 1 and 620 to logical address 2 on 2216A
- Assign link address C1 to control units 500 and 620
- Define unit addresses (subchannels) 00 through 1F to control unit 500 and 20 through 3F to control unit 620
- Identify each control unit as a 3172 device.

Considerations:

1. The allowable device address range is 00 through FF. The 2216 address range is limited to 32 addresses, and only requires that the addresses defined at the host computer map to the address or addresses configured in the 2216. The address range can extend beyond the addresses actually used for the 2216, but cannot overlap addresses of other control units cabled to the same CHPID or channel.
2. The ESCON channel mode of operation can be type CNC for basic ESCON channel mode or CVC if there is an ESCON Converter attached.
3. The IODEVICE UNIT parameter should be set to 3172.

4. The LINK number specifies the link address (ESCD port number) to which the 2216 is connected. When two ESCDs are connected in series, the link address must be the port number of the ESCD that has the dynamic connection and to which the 2216 is attached.
5. The logical address (CUADD) must be unique for a given path between a host channel and a 2216.
6. Each partition must have a unique logical address defined on the 2216.

Example IOCP Definition for the Parallel Channel Adapter (PCA)

Figure 22 shows an example of a simple Parallel Channel Adapter configuration where the channel type is identified as a block multiplexer channel, TYPE=BL, on path 5.

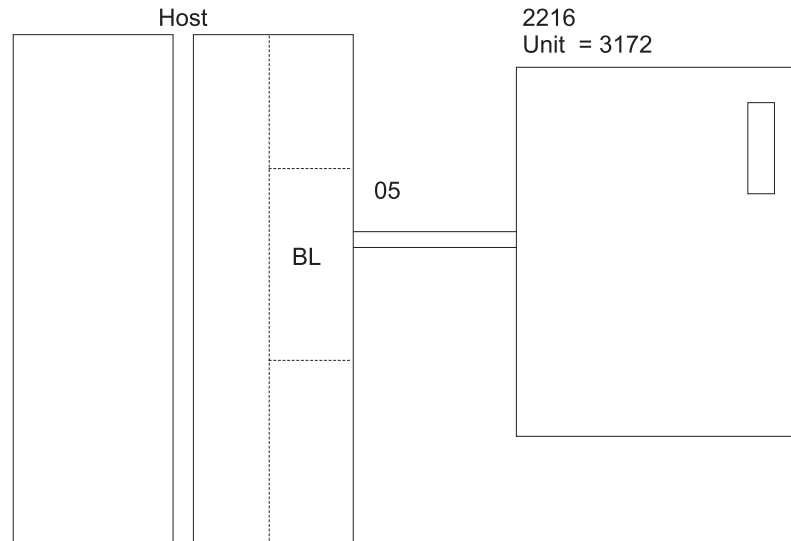


Figure 22. Parallel Channel Adapter Configuration Example

The IBM 2216 I/O device unit appears to the host as 3172 and must be defined as a 3172.

The following example definitions match Figure 22:

```

CHPID      PATH=((05)),TYPE=BL
CNTLUNIT   CUNUMBR=640,PATH=05,                               X
           PROTOCL=S4,UNIT=3172,                               X
           SHARED=N,UNITADD=((40,32))
IODEVICE   UNIT=3172,ADDRESS=((640,32)),                       X
           STADET=N,CUNUMBER=640,TIMEOUT=Y

```

The IOCP macroinstructions in the example:

- Identify channel type as a block multiplexer channel (BL).
- Name channel path 05 to which the PCA is attached.
- Assign the control unit number 640 to the PCA.
- Specify that the host channel supports up to 4.5 MB data-streaming (S4).
- Identify the control unit as type 2 where multiple I/O request are supported concurrently (SHARED=N).
- Define unit addresses 40 through 5F to the PCA (a range of 32 addresses).
- Identify the PCA control unit as a 3172-type device.

Considerations:

1. The address range for each PCA must be contiguous pairs of addresses for TCP/IP, a single address for VTAM and at least one read subchannel and one write subchannel for MPC+.

The allowable device address range is 00 through FF. Each 2216 PCA can support a maximum of 32 subchannels. The 2216 PCA does not require a range of 32 addresses, it only requires that the addresses defined at the host computer map to the address or addresses configured for the 2216 PCA. The addresses used cannot overlap addresses used by other control units or PCAs cabled to the same CHPID or channel.

2. The PROTOCL parameter can be set to the following values, depending on your host system capability:

- D** Direct-Coupled Interlock (DCI) mode
- S** Maximum 3.0 MBps data streaming speed
- S4** Maximum 4.5 MBps data streaming speed

The transfer mode and channel transfer speed specified for the PROTOCL parameter must conform with the PCA setting for transfer mode and channel transfer speed.

3. The UNIT parameter on the CNTLUNIT and IODEVICE statements must be set to 3172.
4. When an ESCON Converter is the channel path, the CHPID TYPE parameter must be set to FX, otherwise it is set to BL.

Defining the 2216 to the Operating System

The following definitions apply to a 2216 with a channel adapter.

2216 Definition for VM/SP

The 2216 must be defined to a VM/SP operating system. This definition is accomplished by updating the real I/O configuration file (DMKRIO) with entries for the 2216 in the RDEVICE and the RCTLUNIT macros. In the following example, 640 is the base unit address and the size of the address range is 32.

```
RDEVICE ADDRESS=(640,32),DEVTYPE=3088
RCTLUNIT ADDRESS=640,CUTYPE=3088,FEATURE=32-DEVICE
```

2216 Definition for VM/XA and VM/ESA

The 2216 must be defined to a VM/Extended Architecture (VM/XA or VM/ESA) operating system. This definition is accomplished by updating the real I/O configuration file (HCPRIO) with an entry for the 2216 in the RDEVICE macro. In the following examples, 640 and 2A0 are base control unit addresses. The address range size, as defined in the UCW or IOCP, is 8 in both examples.

The following example is a VM/XA HCPRIO definition:

```
RDEVICE ADDRESS=(640,8),DEVTYPE=CTCA
```

The following example is a VM/ESA HCPRIO definition:

```
RDEVICE ADDRESS=(2A0,8),DEVTYPE=CTCA
```


2216 Definition for MVS/XA and MVS/ESA without HCD

Note: To define a 2216 on an MVS/ESA system with HCD, see “2216 Definition for MVS/ESA with HCD”

The 2216 must be defined to an IBM Multiple Virtual Storage/Extended Architecture (MVS/XA) or MVS/ESA operating system. This definition is accomplished by updating the MVS Control Program with an entry for the 2216 in the IODEVICE macro.

For ESCON channels, an example IODEVICE macro is:

```
IODEVICE UNIT=3172,ADDRESS(540,8)
```

For parallel channels, an example IODEVICE macro is:

```
IODEVICE UNIT=CTC,ADDRESS(640,8)
```

The base control unit addresses are 640 and 540. The address range size, as defined in the UCW or IOCP, is 8 in both examples.

2216 Definition for MVS/ESA with HCD

The hardware configuration definition (HCD) component of MVS/ESA SP Version 4.2 and 4.3 with APAR #OY67361 offers an improved method of defining system hardware configuration for 2216. Several complex steps required for entering hardware configuration data can be accomplished using an interactive dialog with HCD.

The required configuration data for the 2216 is:

1. When using HCD, with APAR #OY67361, the 2216 is defined as (UNIT=3172).

```
IODEVICE UNIT=3172,ADDRESS(740,8)
```

2. Without HCD, the 2216 is defined for:

- Parallel channels as a 3088 device (UNIT = 3088 or CTC)

```
IODEVICE UNIT=CTC,ADDRESS(840,8)
```

- ESCON channels as a serial CTC device (UNIT = SCTC)

```
IODEVICE UNIT=SCTC,ADDRESS(A40,8)
```

Notes:

1. If you are using HCD for MVS Version 4 to define your ESCON host connection, you will need APAR #OY67361 to obtain the UIM support for the device definition (UNIT=3172).
2. When migrating your IOCP definition and operating system definitions to the HCD environment, it is important that all 2216 device statements be changed to device type (UNIT=3172).

2216 Definition for VSE/ESA

The 2216 must be defined to a VSE/ESA operating system. This definition is accomplished by supplying an ADD statement for each channel unit address at initial program load (IPL) time. Code the device type on the ADD statement as CTCA,EML as shown in the following example:

```
ADD 640,CTCA,EML
```

The base control unit address is 640 in the example. For the number of channel unit addresses added, increment the IOTAB storage macro by this count.

Defining the 2216 to Host Programs

The section has configuration definitions with samples of host definitions required to connect to the 2216 channel adapter.

Configuring the Host for TCP/IP

TCP/IP can connect to the 2216 channel adapter using either LCS or MPC+. When using MPC+, TCP/IP in the host goes through VTAM to the 2216.

Note: When referring to MPC+, the host uses the term HPDT MPC while the 2216 uses the term MPC+.

TCP is configured on a host by modifying the TCP/IP profile. The default name for the TCP/IP profile data set is TCPIP.PROFILE.TCPIP for MVS and PROFILE TCPIP for VM. Each channel connection requires:

- A DEVICE statement for each subchannel pair or group.
- A LINK statement for each LCS interface on the 2216. Multiple LINKs can be defined for a single DEVICE.
- A LINK statement for each IP address supported over an MPC+ Group. Only one LINK can be defined for a single DEVICE.
- An entry in the HOME statement for each LINK statement.
- Entries in the GATEWAY statement for the link to be used (if ROUTED is not being used)
- A START command for each device

See the OS/390 TCP/IP OpenEdition publications for more information on configuring TCP/IP.

Configuring the Host for TCP/IP using LCS: These are the statements required to configure TCP/IP on the host when using LCS:

DEVICE and LINK statements: The format of the DEVICE and LINK statements are:

```
DEVICE devicename LCS subchannel  
LINK   iplinkname LANtype LANnumber devicename
```

where:

devicename

is a local name to distinguish devices. You need a START statement for this device name at the end of the TCP/IP profile as shown in “Example of TCP/IP Commands when Using LCS” on page 336.

LCS subchannel

is the even subchannel of the two LCS subchannels that this connection to the 2216 will use.

iplinkname

is a local name to distinguish links. This name can help you identify which link is being configured.

LANtype

is the type of link.

LANnumber

is obtained from the 2216 by using the LIST NETS command of the appropriate NETWORK submenu.

HOME Command: Specify IP addresses for each channel connection using the following format:

```
HOME hostipadd iplinkname
```

where:

hostipadd

is the host's IP address for this connection to the TCP/IP network.

Note: This IP address must be a unique address in the same IP subnetwork as the corresponding IP address coded in the 2216.

iplinkname

is the link name defined by the LINK statement as described in "DEVICE and LINK statements" on page 334.

GATEWAY Command: Specify routing information if you are not using the ROUTED server.

```
GATEWAY network first hop driver packet size subn mask subn value
```

where:

network

is the IP address for the network. The default value is DEFAULTNET, which specifies a default routing entry for any network not explicitly routed.

first hop

Specify one of the following:

An equal sign (=) meaning that messages are routed directly to destinations on that network or directly to that host. This is not supported for DEFAULTNET.

The Internet address of a gateway or router that you can reach directly, and that forwards messages for the destination network or host.

driver is the *iplinkname* defined by the LINK statement as described in "DEVICE and LINK statements" on page 334.

packet size

is the maximum transmission unit in bytes for the network or host.

subn mask

is a bit mask that defines the bits of the host field that make up the subnet field.

subn value

is the value of the subnet field.

START Command: Start all the interfaces:

```
START devicename
```

where:

devicename

is the parameter defined by the DEVICE statement as described in "DEVICE and LINK statements" on page 334.

Example of TCP/IP Commands when Using LCS:

```
DEVICE LCS1 LCS 108
LINK TR1 IBMTR 0 LCS1
HOME
    16.51.136.199 TR1 1
GATEWAY
    16.51.136.201 = TR1 4000 HOST 2
    DEFAULTNET 16.51.136.201 TR1 4000 0
START LCS1
```

1 16.51.136.199 is in the same IP subnetwork as the 2216 LCS interface's IP address.

2 16.51.136.201 is the 2216 LCS interface's IP address.

Configuring the Host for TCP/IP using MPC+: These are the statements required to configure TCP/IP on the host when using MPC+:

DEVICE and LINK statements:

```
DEVICE devicename MPCPTP
LINK iplinkname MPCPTP devicename
```

where:

devicename

is the name of the TRL that this connection to the 2216 will use. See "Sample 2216 Definition to TCP/IP for MVS or VM for MPC+" on page 339 for additional information.

MPCPTP

specifies an MPC point-to-point link.

iplinkname

is a link name to distinguish links. This name can help you identify which link is being configured.

HOME Command: Specify IP addresses for each channel connection using the following format:

```
HOME hostipadd iplinkname
```

where:

hostipadd

is the host's IP address for this connection to the TCP/IP network.

Note: This IP address must be a unique address in the same IP subnetwork as the corresponding IP address coded in the 2216.

iplinkname

is the link name defined by the LINK statement as described in "DEVICE and LINK statements".

GATEWAY Command: Specify routing information if you are not using the ROUTED server.

```
GATEWAY network first hop driver packet size subn mask subn value
```

where:

network

is the IP address for the network. The default value is *defaultnet*, which specifies a default routing entry for any network not explicitly routed.

first hop

Specify one of the following:

An equal sign (=) meaning that messages are routed directly to destinations on that network or directly to that host. This is not supported for DEFAULTNET.

The Internet address of a gateway or router that you can reach directly, and that forwards messages for the destination network or host.

driver is the *iplinkname* defined by the LINK statement as described in “DEVICE and LINK statements” on page 336.

packet size

is the maximum transmission unit in bytes for the network or host.

subn mask

is a bit mask that defines the bits of the host field that make up the subnet field.

subn value

is the value of the subnet field.

START Command: Start all the interfaces:

```
START devicename
```

where:

devicename

is the parameter defined by the DEVICE statement as described in “DEVICE and LINK statements” on page 336.

Example of TCP/IP Commands when Using MPC+: For MPC+:

```
DEVICE IPTRL1 MPCPTP
LINK LINK1 MPCPTP IPTRL1
HOME
  198.10.70.199 LINK1 1
GATEWAY
  198.10.70.203 = LINK1 16000 HOST 2
DEFAULTNET 198.10.70.203 LINK1
START IPTRL1
```

1 198.10.70.199 is in the same IP subnetwork as one of the 2216 MPC+ interface's IP addresses.

2 198.10.70.203 is one of the 2216 MPC+ interface's IP addresses.

Sample 2216 Definition to TCP/IP for MVS or VM for LCS

The following is an example of TCP/IP definitions that would be provided to the host computer in the TCP/IP Profile data set to configure an LCS device. The default name for the TCP/IP profile data set is TCPIP.PROFILE.TCPIP for MVS and PROFILE TCPIP for VM.

First, 2216 devices and links are defined to TCP/IP.

There is a DEVICE statement for each subchannel pair that is used to access 2216s. The first address specified must be an *even* address. In this example, two devices (subchannel pairs) are defined: one at address 640 and one at address 642. These devices could be in the same or different 2216s. A device type of LCS (LAN Channel Station) is used to define these devices to TCP/IP.

There is a LINK statement for each LAN adapter that is accessible from these devices. In this example, one Ethernet/802.3 Adapter is assigned to the device using subchannels 640 and 641, two Token-Ring adapters are assigned to the device using 642 and 643, and one FDDI adapter using 644 and 645. These two Token-Ring adapters are in the same 2216 because they are associated with the same device. The LINK number for each adapter (0 and 1 in this example) is assigned by the 2216 when you add an adapter to a profile.

Note: Two subchannel addresses are required for sending and receiving (for example, 640 and 641), but only the first address is defined.

```

DEVICE LCS1 LCS 640
LINK ETH1 ETHERor802.3 0 LCS1
DEVICE LCS2 LCS 642
LINK TR1 IBMTR 0 LCS2
LINK TR2 IBMTR 1 LCS2
DEVICE LCS3 LCS 644
LINK FD1 FDDI 0 LCS3

```

Note: In this example, 0 and 1 are the LAN numbers for these connections.

This section of the example TCP/IP profile defines the local host internet addresses:

```

HOME
193.5.2.1      ETH1
130.50.75.1   TR1
130.50.76.1   TR2
195.10.70.1   FD1

```

This section of the example TCP/IP profile represents the LAN/WAN gateway definition:

```

GATEWAY
Network  First hop  Driver  Packet Size  Subnet mask  Subnet value
193.5.2  =          ETH1    1500          0             0.0.75.0
130.50   =          TR1     2000          0.0.255.0    0.0.76.0
130.50   =          TR2     2000          0.0.255.0    0.0.76.0
195.10   =          FD1     4000          0.0.255.0    0.0.70.0

```

This section of the example TCP/IP profile activates the LCS devices:

```

START LCS1
START LCS2
START LCS3

```

The following examples illustrate various ways that LAN adapters can be specified and linked to subchannel pairs in the TCP/IP profile.

Two LCS devices for the two subchannel pairs 40,41 and 42,43 and four LAN adapters are defined in the 2216 as follows:

```

DEVICE LCS1 LCS 640
LINK ETH1 ETHERNET 0 LCS1
LINK ETH2 ETHERNET 1 LCS1
DEVICE LCS2 LCS 642
LINK TRN1 IBMTR 0 LCS2
LINK TRN2 IBMTR 1 LCS2

```

Four LCS devices for the four subchannel pairs 40,41; 42,43; 44,45; and 46,47 and four LAN adapters are defined in the 2216 as follows:

```

DEVICE LCS1 LCS 640
LINK ETH1 ETHERNET 0 LCS1
DEVICE LCS2 LCS 642
LINK ETH2 ETHERNET 1 LCS2
DEVICE LCS3 LCS 644
LINK TRN1 IBMTR 0 LCS3
DEVICE LCS4 LCS 646
LINK FD1 FDDI 0 LCS4

```

One LCS device for the subchannel pair 40,41 and four LAN adapters are defined in the 2216 as follows:

```
DEVICE LCS1 LCS 640
LINK ETH1 ETHERNET 0 LCS1
LINK ETH2 ETHERNET 1 LCS1
LINK ETH3 ETHERNET 2 LCS1
LINK ETH4 ETHERNET 3 LCS1
```

Sample 2216 Definition to TCP/IP for MVS or VM for MPC+

The following is an example of TCP/IP definitions that would be provided to the host computer in the TCP/IP Profile data set to configure an MPC+ device. The default name for the TCP/IP profile data set is TCPIP.PROFILE.TCPIP for MVS and PROFILE TCPIP for VM.

First, in the VTAM host, define a TRL over which TCP/IP should run.

```
IPTRL VBUILD TYPE=TRL
IPTRL1 TRLE LNCTL=MPC,
      MAXBFRTU=6,
      READ=(06),
      WRITE=(07)
      REPLYTO=3.0
```

Notes:

1. Multiple TCP/IP stacks can use the same TRL.
2. See “Configuring the VTAM Host for MPC+ for IP” on page 346 for more details.

There is a DEVICE statement for each TRL that is to be used by TCP/IP.

```
DEVICE IPTRL1 MPCPTP
```

There is a LINK statement for each TCP/IP local host internet address using the TRL. For a given TCP/IP stack, there can only be one LINK statement per TRL.

```
LINK LINK1 MPCPTP IPTRL1
```

This section of the example TCP/IP profile defines the local host internet addresses and associates the addresses with a link:

```
HOME
198.10.70.199 LINK1
```

198.10.70.199 is in the same IP subnetwork as one of the 2216 MPC+ interface's IP addresses.

This section of the example TCP/IP profile represents the LAN/WAN gateway definition:

```
GATEWAY
Network      First hop      Driver  Packet Size  Subnet mask  Subnet value
198.10.70.203 =          LINK1  16000        HOST         0
DEFAULTNET   198.10.70.203 LINK1  16000        0
```

198.10.70.203 is one of the 2216 MPC+ interface's IP addresses.

This section of the example TCP/IP profile activates the MPC+ device:

```
START IPTRL1
```

Note: Prior to activating the device, activate the associated TRL if it is not already active.

Configuring the Host for HPDT UDP:

Important!

Before you configure your S/390 host for HPDT UDP, you **must** have APAR #OW31305 installed.

HPDT UDP can connect to the 2216 only through an ESCON Channel Adapter using MPC+.

Notes:

1. The 2216 refers to HPDT UDP as UDP+.
2. UDP+ is not supported on a Parallel Channel Adapter (PCA).

HPDT UDP is configured and run using OS/390 TCP/IP OpenEdition (OE) on the host. Therefore, OS/390 TCP/IP OpenEdition must be installed on the host.

HPDT UDP commands are used to configure and control HPDT UDP resources. See *OS/390 TCP/IP Update Guide* for details on installing and using OE for HPDT UDP.

To configure and activate an HPDT UDP connection on the 2216, issue the **oeifconfig** command, shown in the following example.

```
oeifconfig interface_name source_IP_address destination_IP address mtu nnnn
```

where:

interface_name

is the name of the TRL for the HPDT UDP connection.

This will cause the TRL to be activated if it is not already active.

Note: See “Configuring the VTAM Host for MPC+ for IP” on page 346 for information about TRLs.

source_IP_address

is the local IP address in the host for HPDT UDP connection.

This local IP address must be in the same IP subnetwork as the IP address coded for the UDP+ MPC+ network handler in the 2216.

destination_IP_address

is the destination IP address in the 2216 for this HPDT UDP connection.

This destination IP address must equal the IP address coded on the UDP+ MPC+ network handler in the 2216.

mtu nnnn

where nnnn is the maximum transmission unit size for the HPDT UDP connection.

This mtu size must be equal to Maxdata coded on the UDP+ MPC+ network handler in the 2216. If the values are not equal, then the HPDT UDP connection will not come up.

Note: Because this is a point-to-point connection, there is no need to code the netmask parameter on this command.

Sample 2216 Definition to HPDT UDP for MVS or VM

First, in the VTAM host, define a TRL over which HPDT UDP should run.

```
UDPTRL VBUILD TYPE=TRL
TRL1   TRLE LNCTL=MPC,
        MAXBFRU=9,
        READ=(EA0),
        WRITE=(EA1),
        REPLYTO=3.0
```

Note: See “Configuring the VTAM Host for MPC+ for IP” on page 346 for more details.

Next, go to the OE environment and issue the following command:

```
oeifconfig trl1 198.10.60.199 198.10.60.203 mtu 16384
```

VTAM Control Blocks Used to Configure LSA at the Host

Configuring the VM or MVS host requires entries in two VTAM control blocks:

- External communication adapter (XCA) major node definition file
- Switched major node configuration file

For more information on configuring VTAM, refer to *VTAM Resource Definition Reference*.

XCA Major Node Definition File - Sample: Defining an XCA major node requires coding VTAM definition statements to define the following characteristics:

- Node type (VBUILD definition statement)
- Port used by the LAN (PORT definition statement)
- Switched lines attached through the 2216 channel adapter (GROUP, LINE, and PU definition statements)

You must code a VBUILD definition statement and a PORT definition statement for the major node, and code GROUP, LINE, and PU definition statements for minor nodes.

You must also assign service access points (SAPs) to be used for each virtual channel to a LAN or emulated LAN.

Switched Major Node Definition File - Sample: The switched major node definition file defines the workstations that VTAM will be able to access through the 2216 channel adapter, and identifies:

- Node type (VBUILD definition statement)
- Network Resources (PU and LU definition statements)

To define the 2216 LAN/WAN gateway to VTAM, the appropriate LAN adapter in the IBM 2216 must be associated with a subchannel address. This association is defined to VTAM in a major node definition that is supported by VTAM Version 3 Release 4 and VTAM Version 4 Release 1.

Configuring an LSA Direct Connection at the VTAM Host

Configuring the VM or MVS host requires entries in two VTAM control blocks, the XCA Major Node Definition File and the Switched Major Node Definition File. See “VTAM Control Blocks Used to Configure LSA at the Host” for a description of the purpose of these control blocks and references to VTAM publications

XCA Major Node Definition File - Sample:

```
ROUTE6B1 VBUILD TYPE=XCA
PORT6B1 PORT CUADDR=0CB,ADAPNO=0,TIMER=60,SAPADDR=08, C
          MEDIUM=RING
GRP6B1 GROUP DIAL=YES
*****
LN06B001 LINE ANSWER=ON,CALL=INOUT,ISTATUS=ACTIVE
PU06B001 PU ISTATUS=ACTIVE
```

Notes:

1. ADAPNO is the LAN number for the 2216 LSA interface.
2. CUADDR is the channel address. This corresponds to the Device Address (three hexadecimal characters defining the channel address) for the 2216 LSA interface.
3. MEDIUM=RING for Token Ring, MEDIUM=CSMACD for Ethernet, and MEDIUM=FDDI for FDDI. This corresponds to the value specified for LANtype for the 2216 interface.

Switched Major Node Definition File - Sample:

```
PS06SW VBUILD TYPE=SWNET
PS06PU PU ADDR=01,IDBLK=05D,IDNUM=54445,MAXOUT=7,PACING=0,VPACING=0, C
          SSCPFM=USSSCS,MAXDATA=4105,MODETAB=LMT3270,MAXPATH=1, C
          ANS=CONT,ISTATUS=ACTIVE,DLOGMOD=B22NNE
PS06LU2 LU LOCADDR=02
PS06LU3 LU LOCADDR=03
PS06LU4 LU LOCADDR=04
PS06LU5 LU LOCADDR=05
```

Configuring an LSA APPN Connection at the VTAM host

Configuring the VM or MVS host requires entries in two VTAM control blocks, the XCA Major Node Definition File and the Switched Major Node Definition File. See "VTAM Control Blocks Used to Configure LSA at the Host" on page 341 for a description of the purpose of these control blocks and references to VTAM publications.

XCA Major Node Definition File - Sample:

```
P15AP63X VBUILD TYPE=XCA
PORT63X PORT CUADDR=0CD,ADAPNO=0,TIMER=60,SAPADDR=04, C
          MEDIUM=CSMACD
GRP63X GROUP DIAL=YES
*****
LN630403 LINE ANSWER=ON,CALL=INOUT,ISTATUS=ACTIVE
PU630403 PU ISTATUS=ACTIVE
```

Notes:

1. ADAPNO is the LAN number for the 2216 LSA interface.
2. CUADDR is the channel address. This corresponds to the Device Address (two hexadecimal characters defining the lower byte of the channel address) for the 2216 interface.
3. MEDIUM=RING for Token Ring and MEDIUM=CSMACD for Ethernet. This corresponds to the value specified for LANtype for the 2216 LSA interface.

Switched Major Node Definition File - Sample:

```
LS601 VBUILD TYPE=SWNET
CS601 PU ADDR=02,CPNAME=C210,MAXOUT=7,PACING=0,VPACING=0, C
          CPCP=YES,MAXDATA=4105,MODETAB=LMT3270,MAXPATH=10, C
          CONNTYPE=APPN,DYNLU=YES
```

Configuring an LSA DLSw Connection at the VTAM Host

Configuring the VM or MVS host requires entries in two VTAM control blocks, the XCA Major Node Definition File and the Switched Major Node Definition File. See “VTAM Control Blocks Used to Configure LSA at the Host” on page 341 for a description of the purpose of these control blocks and references to VTAM publications.

XCA Major Node Definition File - Sample:

```
P15AP60X VBUILD TYPE=XCA
PORT60X PORT CUADDR=0CC,ADAPNO=1,TIMER=60,SAPADDR=04, C
          MEDIUM=CSMACD
GRP60X GROUP DIAL=YES
*****
LN600403 LINE ANSWER=ON,CALL=INOUT,ISTATUS=ACTIVE
PU600403 PU ISTATUS=ACTIVE
LN600404 LINE ANSWER=ON,CALL=INOUT,ISTATUS=ACTIVE
PU600404 PU ISTATUS=ACTIVE
```

Notes:

1. ADAPNO is the LAN number for the 2216 LSA interface.
2. CUADDR is the channel address. This corresponds to the Device Address (two hexadecimal characters defining the lower byte of the channel address) for the 2216 interface.
3. MEDIUM=RING for Token Ring and MEDIUM=CSMACD for Ethernet. This corresponds to the value specified for LANtype for the 2216 LSA interface.

Switched Major Node Definition File - Sample:

```
PSK5SW VBUILD TYPE=SWNET
PSK5PU PU ADDR=03,IDBLK=05D,IDNUM=07251,MAXOUT=7,PACING=0,VPACING=0, C
          DLOGMOD=B22NNE, C
          SSCPFM=USSSCS,MAXDATA=2000,MODETAB=LMT3270
PSK5LU2 LU LOCADDR=02
PSK5LU3 LU LOCADDR=03
PSK5LU4 LU LOCADDR=04
PSK5LU5 LU LOCADDR=05
PSK5LU6 LU LOCADDR=06
```

Configuring an LSA DLSw Local Conversion at the VTAM Host

Configuring the VM or MVS host requires entries in two VTAM control blocks, the XCA Major Node Definition File and the Switched Major Node Definition File. See “VTAM Control Blocks Used to Configure LSA at the Host” on page 341 for a description of the purpose of these control blocks and references to VTAM publications.

XCA Major Node Definition File - Sample:

```
P15AP60X VBUILD TYPE=XCA
PORT60X PORT CUADDR=0CC,ADAPNO=1,TIMER=60,SAPADDR=04, C
          MEDIUM=CSMACD
GRP60X GROUP DIAL=YES
*****
LN600403 LINE ANSWER=ON,CALL=INOUT,ISTATUS=ACTIVE
PU600403 PU ISTATUS=ACTIVE
LN600404 LINE ANSWER=ON,CALL=INOUT,ISTATUS=ACTIVE
PU600404 PU ISTATUS=ACTIVE
```

Notes:

1. ADAPNO is the LAN number for the 2216 LSA interface.
2. CUADDR is the channel address. This corresponds to the Device Address (two hexadecimal characters defining the lower byte of the channel address) for the 2216 interface.

3. MEDIUM=RING for Token Ring and MEDIUM=CSMACD for Ethernet. This corresponds to the value specified for LANtype for the 2216 LSA interface.

Switched Major Node Definition File - Sample:

```
PS06SW VBUILD TYPE=SWNET,MAXDLUR=20
PS06PU PU ADDR=01,IDBLK=05D,IDNUM=54445,MAXOUT=7,PACING=0,VPACING=0, C
      SSCPFM=USSSCS,MAXDATA=4105,MODETAB=LMT3270,MAXPATH=1, C
      ANS=CONT,ISTATUS=ACTIVE,DLOGMOD=B22NNE
PS06LU2 LU LOCADDR=02
PS06LU3 LU LOCADDR=03
PS06LU4 LU LOCADDR=04
PS06LU5 LU LOCADDR=05
PSK5SW VBUILD TYPE=SWNET
PSK5PU PU ADDR=03,IDBLK=05D,IDNUM=07251,MAXOUT=7,PACING=0,VPACING=0, C
      DLOGMOD=B22NNE, C
      SSCPFM=USSSCS,MAXDATA=2000,MODETAB=LMT3270
PSK5LU2 LU LOCADDR=02
PSK5LU3 LU LOCADDR=03
PSK5LU4 LU LOCADDR=04
PSK5LU5 LU LOCADDR=05
PSK5LU6 LU LOCADDR=06
```

The following examples show XCA and SWNET macros that define the LAN major node for a Token-Ring adapter and an Ethernet adapter, respectively. In the examples:

- GROUP1T, GROUP1E, and GROUP1F represent resources connected to the LAN that require a VBUILD TYPE=SWNET.
- GROUP2T, GROUP2E, and GROUP2F represent a connection for the PU 5 node.

The mode table and default mode entries are examples only. Be sure to use the mode tables and mode entries defined in your installation.

```
TRLAN1 VBUILD TYPE=XCA
PORT1 PORT MEDIUM=RING,ADAPNO=0,CUADDR=644,TIMER=60,SAPADDR=4
GROUP1T GROUP DIAL=YES * Switched Attachment
LINE1TA LINE ANSWER=ON,CALL=INOUT,ISTATUS=ACTIVE
PU1TA PU ISTATUS=ACTIVE
LINE1TB LINE ANSWER=ON,CALL=INOUT,ISTATUS=ACTIVE
PU1TB PU ISTATUS=ACTIVE
GROUP2T GROUP DIAL=NO * Leased Definition
LINE2T LINE USER=SNA * Multi-domain Connection
PU2T PU MACADDR=400000000001,TGN=1,SUBAREA=2,SAPADDR=4,PUTYPE=5
```

```
ENLAN2 VBUILD TYPE=XCA
PORT2 PORT MEDIUM=CSMACD,ADAPNO=0,CUADDR=645,TIMER=60,SAPADDR=4
GROUP1E GROUP DIAL=YES * Switched Attachment
LINE1EA LINE ANSWER=ON,CALL=INOUT,ISTATUS=ACTIVE
PU1EA PU ISTATUS=ACTIVE
LINE1EB LINE ANSWER=ON,CALL=INOUT,ISTATUS=ACTIVE
PU1EB PU ISTATUS=ACTIVE
GROUP2E GROUP DIAL=NO * Leased Definition
LINE2E LINE USER=SNA * Multi-domain Connection
PU2E PU MACADDR=400000000002,TGN=2,SUBAREA=2,SAPADDR=4,PUTYPE=5
```

The following examples are the switched major node definitions.

```
LS100SW VBUILD TYPE=SWNET,MAXGRP=400,MAXNO=400
CS100001 PU ADDR=01,PUTYPE=2,MAXPATH=4,ANS=CONT,DLOGMOD=B22NNE,
      ISTATUS=ACTIVE,MAXDATA=521,IRETRY=YES,MAXOUT=7,
      PASSLIM=5,IDBLK=111,IDNUM=00001,MODETAB=LMT3270
      PATH DIALNO=010440000000004,GRPNM=GROUP1T
S00102 LU LOCADDR=2
CS100002 PU ADDR=02,PUTYPE=2,MAXPATH=4,ANS=CONT,DLOGMOD=B22NNE,
      ISTATUS=ACTIVE,MAXDATA=521,IRETRY=YES,MAXOUT=7,
      PASSLIM=5,CPNAME=MYNS2,MODETAB=LMT3270
      PATH DIALNO=010440000000005,GRPNM=GROUP1T
S00200 LU LOCADDR=0,DLOGMOD=LU62MODE
S00202 LU LOCADDR=2
```

```

CS100003 PU  ADDR=03,PUTYPE=2,MAXPATH=4,ANS=CONT,DLOGMOD=B22NNE,
          ISTATUS=ACTIVE,MAXDATA=521,IRETRY=YES,MAXOUT=7,
          PASSLIM=5,IDBLK=111,IDNUM=000003,MODETAB=LMT3270
          PATH DIALNO=0104400000000006,GRPNM=GROUP1E
S00302  LU  LOCADDR=2
CS100004 PU  ADDR=04,PUTYPE=2,MAXPATH=4,ANS=CONT,DLOGMOD=B22NNE,
          ISTATUS=ACTIVE,MAXDATA=521,IRETRY=YES,MAXOUT=7,
          PASSLIM=5,IDBLK=111,IDNUM=000004,MODETAB=LMT3270
          PATH DIALNO=0104400000000007,GRPNM=GROUP1E
S00402  LU  LOCADDR=2

CS100005 PU  ADDR=05,PUTYPE=2,MAXPATH=4,ANS=CONT,DLOGMOD=B22NNE,
          ISTATUS=ACTIVE,MAXDATA=521,IRETRY=YES,MAXOUT=7,
          PASSLIM=5,IDBLK=111,IDNUM=000005,MODETAB=LMT3270
          PATH DIALNO=0104400000000008,GRPNM=GROUP1F
S00502  LU  LOCADDR=2
CS100006 PU  ADDR=06,PUTYPE=2,MAXPATH=4,ANS=CONT,DLOGMOD=B22NNE,
          ISTATUS=ACTIVE,MAXDATA=521,IRETRY=YES,MAXOUT=7,
          PASSLIM=5,IDBLK=111,IDNUM=000006,MODETAB=LMT3270
          PATH DIALNO=0104400000000005,GRPNM=GROUP1F
S00602  LU  LOCADDR=2

```

For more information about VTAM definitions, see:

VTAM V4R4 Network Implementation Guide, SC31-8370

VTAM V4R4 Resource Definition Reference, SC31-8377

Configuring the VTAM Host for MPC+ for APPN

Configuring the VTAM host for MPC+ for APPN requires entries in two VTAM control blocks, the Local SNA Major Node and the Transport Resource List (TRL) Major Node, and a change to the VTAM start-up parameters. A TRL corresponds to an MPC+ Group. For more information on configuring VTAM, refer to *VTAM Resource Definition Reference*.

Local SNA Major Node: Use the following definition statements to configure a local SNA major node in VTAM:

```

UTYLSNA VBUILD TYPE=LOCAL
UTYHCC1 PU      TRLE=UHCC1,XID=YES,CONNTYPE=APPN,CPCP=YES,HPR=YES

```

Transport Resource List (TRL) Major Node:

```

BC4UTRL VBUILD TYPE=TRL
UHCC1   TRLE LNCTL=MPC,
          MAXBFRU=n,
          READ=(xxx1,xxx2,...),
          WRITE=(yyy1,yyy2,...),
          REPLYTO=3.0

```

where:

n is the number of 4K buffer pages VTAM uses to receive data over the channel.

xxx1,xxx2,...
are the read subchannel numbers.¶

yyy1,yyy2,...
are the write subchannel numbers.¶

¶ The subchannels do not need to be contiguous.

The read and write subchannel numbers must be attached to those configured on the 2216 (for example, by way of a message operator mount or an attach command).

Note: A “read” subchannel to VTAM is a “write” subchannel to the 2216 and a “write” subchannel to VTAM is a “read” subchannel to the 2216.

VTAM Start-up Parameters: In the VTAM initialization file ATCSTRxx, where xx is defined by the user, define a network node:

```
NODETYPE=NN
```

Since high-performance routing (HPR) is being used, you also should add to this file:

```
HPR=YES
```

Note: Only APPN HPR is supported across the MPC+ interface. APPN ISR is not supported.

To activate the APPN PU, activate the associated TRLE (if it is not already active) and then activate the PU.

See *VTAM Operation* for information about VTAM Commands.

Configuring the VTAM Host for MPC+ for IP

Note: UDP+ is not supported on a Parallel Channel Adapter (PCA).

Configuring the VTAM host for MPC+ for TCP/IP or for HPDT UDP requires an entry in the VTAM Transport Resource List (TRL) Major Node control block. A TRL corresponds to an MPC+ Group. For more information on configuring VTAM, refer to *VTAM Resource Definition Reference*.

Transport Resource List (TRL) Major Node:

```
TRL      VBUILD TYPE=TRL
TRL1     TRLE LNCTL=MPC,                C
          MAXBFRU=n,                    C
          READ=(xxx1,xxx2,...),         C
          WRITE=(yyy1,yyy2,...),        C
          REPLYTO=3.0
```

where:

n is the number of 4K buffer pages VTAM uses to receive data over the channel.

Note: For both TCP/IP and HPDT UDP, MAXBFRU*4K must be greater than Maxdata coded on the MPC+ network handler in the 2216.

See *OS/390 TCP/IP OpenEdition* and *OS/390 Update Guide* for additional restrictions regarding MAXBFRU.

xxx1,xxx2,...
are the read subchannel numbers. ¶

yyy1,yyy2,...
are the write subchannel numbers. ¶

¶ The subchannels do not need to be contiguous.

The read and write subchannel numbers must match those configured on the 2216 (for example, by way of a message operator mount or an attach command).

Note: A “read” subchannel to VTAM is a “write” subchannel to the 2216 and a “write” subchannel to VTAM is a “read” subchannel to the 2216.

Planning for 2216 Support

This section describes considerations for support of the 2216 and channel adapter in a network. Analyzing and resolving a communications problem between a channel adapter and a host or LAN may require you to initiate problem resolution procedures for the 2216.

The problem can be:

- A configuration or host definition problem
- A 2216 hardware or software problem
- A channel problem between the 2216 and the host
- A host program, resource, or hardware problem
- A LAN adapter, access unit, or other hardware malfunction
- A LAN workstation program or resource problem
- A communication problem between the 2216 and the LAN
- A problem using hardware or software

Indications of problems come from user reports, or indicators and displayed codes on the 2216 and other devices, or messages displayed by programs. These indications help you determine whether the problem is a hardware, software, or user problem. They also help you isolate the location (2216, LAN, host) and component (device, adapter, channel, or program) of the network that has the problem.

Determining the nature of the problem often indicates which procedures, tools, or additional information may be needed for resolution. The same tools, procedures, and information can also indicate the need to call for service. Problem resolution and service interfaces (NetView, SNMP Client) are available to the customer.

2216 Channel Adapter Problem Analysis and Resolution

The 2216 ESCON channel adapter and PCA problem isolation procedures described in *2216 Nways Multiaccess Connector Service and Maintenance Manual*, SY27–0350 should help you correct the problem, if possible, and determine when to call for service.

Reconfiguration

Whenever your network grows, shrinks, or rearranges, you may need to reconfigure host programs and 2216 profiles to:

- Balance network traffic and workload
- Migrate to new versions or releases of host programs
- Migrate to new versions or releases of the 2216
- Change host SYSGENS

Channel Adapter Overview

The ESCON Channel Adapter and PCA provides the 2216 with access to SNA and TCP/IP host applications from LANs, WANs, and ATM.

Figure 23 shows a 2216 connected to a VTAM host through a channel adapter. Each channel adapter provides up to 32 subchannels and up to 16 associated virtual network handlers that can support LAN Channel Station (LCS), Link Services Architecture (LSA), and Multi-Path Channel (MPC+) protocols. Each 2216 can contain up to four channel adapters.

Each ESCON Channel Adapter can provide connections to up to:

- 16 hosts or logical host images using LCS or MPC+ (when used with an ESCON Director)
- 32 hosts or logical host images using LSA (when used with an ESCON Director)
- 15 logical host images in EMIF-capable processors in logically partition mode when no ESCON director is present.

Each PCA can provide connection to one host or one logical host image.

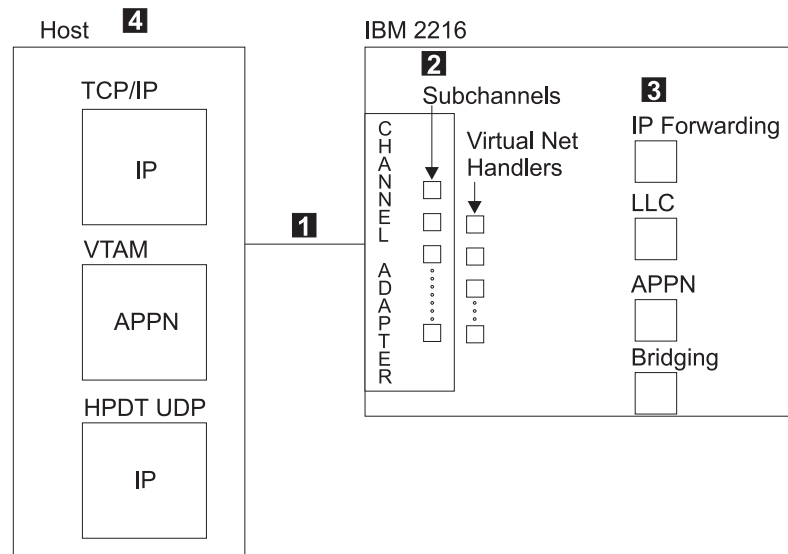


Figure 23. 2216 Connected to a Host through an ESCON/PCA Channel Adapter - Logical View

1 At the physical level, the ESCON Channel Adapter provides a flexible fiber optic connection to communication channels at the host processor. The physical level of the PCA is considerably more complex, requiring a pair of very large copper cables and a set of one to three (depending on configuration) smaller twisted pair copper cables to provide final connection to the PCA.

2 At the logical level, the channel adapter provides up to 32 *subchannels* and up to 16 associated *virtual network handlers*.

Each virtual network handler supports one of the following protocols:

LCS LAN Channel Station

LSA Link Services Architecture

MPC+ Multi-Path Channel+

For each LCS virtual network handler, you must define two subchannels, one for read and one for write; you can define up to 16 LCS virtual network handlers for each channel adapter.

For each LSA virtual network handler, you must define at least one subchannel up to a maximum of 32 subchannels. You can define up to 16 LSA virtual network handlers for each channel adapter.

For MPC+, you can define up to 32 subchannels. You must have at least one read subchannel and at least one write subchannel. You can define up to 16 MPC+ virtual network handlers for each channel adapter.

Notes:

1. You can configure LCS and LSA on the same channel adapter.
2. For migration purposes, MPC+ may be configured on the same channel adapter as LCS/LSA. This is not recommended as a long term solution. MPC+ combined with another type of virtual interface (LCS/LSA) on the same adapter could impact the performance benefits provided by the MPC+ interface.

3 The 2216 channel adapter provides services for IP Forwarding, Logical Link Control (LLC), Advanced Peer-to-Peer Networking (APPN), and bridging.

4 The virtual net handlers provide connections for transmitting and receiving packets of information for host applications as shown in Figure 24 on page 350 and Figure 25 on page 350.

Once the channel adapter is installed and configured for LCS, LSA, and MPC+, it can provide:

- Hierarchical SNA, including DLSw traffic, and APPN ISR and HPR traffic running over LSA connections. (DLSw and APPN require LLC loopback.)
- TCP/IP traffic running over LCS and MPC+.
- APPN HPR traffic running over MPC+.
- HPDT UDP traffic running over MPC+.

Note: UDP+ is not supported on a Parallel Channel Adapter (PCA).

Figure 24 on page 350 shows the basic flow for a channel adapter with LCS and LSA configured, and Figure 25 on page 350 shows the basic flow for a channel adapter for which MPC+ is configured.

Planning for 2216 Support

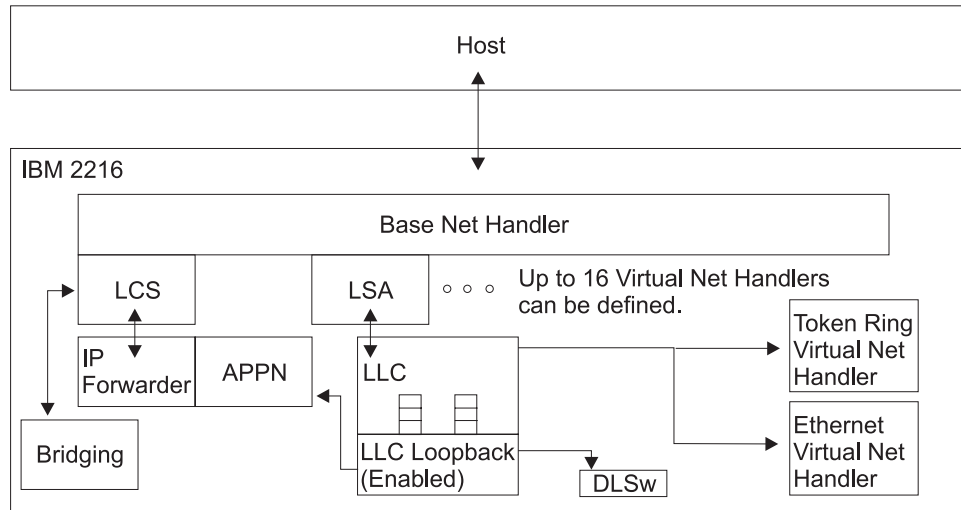


Figure 24. 2216 Virtual Net Handlers for LCS and LSA

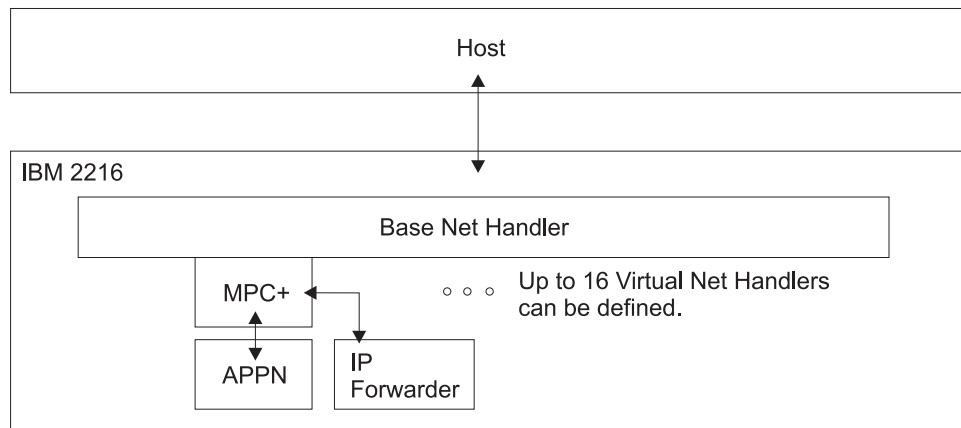


Figure 25. 2216 Virtual Net Handlers for MPC+

LAN Channel Station (LCS) Support

Figure 26 on page 351 shows how TCP/IP data flows from the host, through LCS and other 2216 software components, and out to the LANs/WANs.

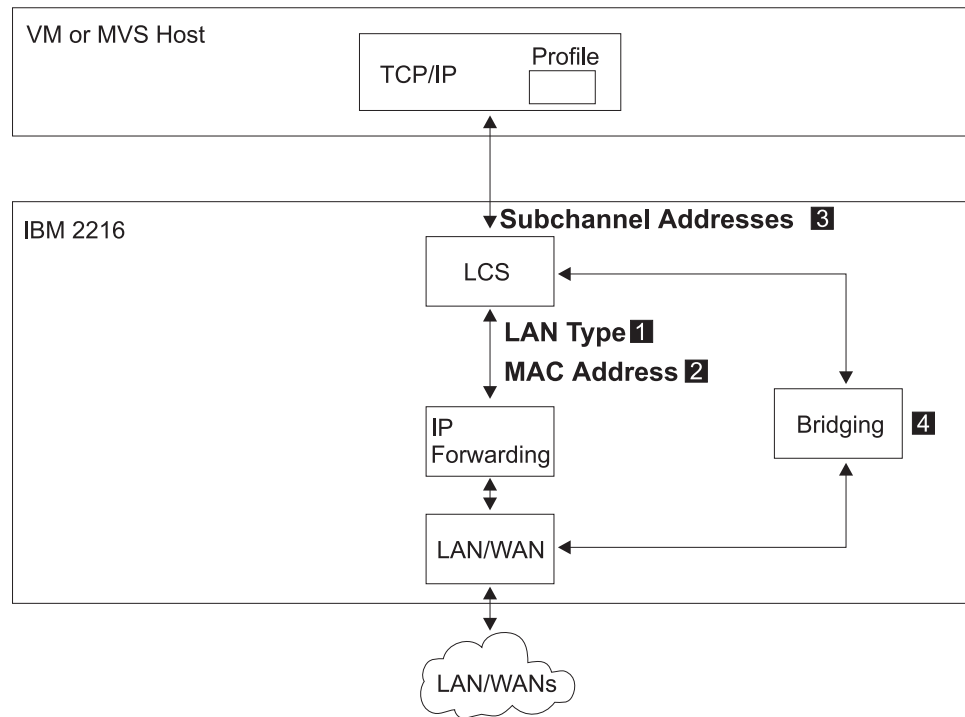


Figure 26. Configuring LAN Channel Station (LCS) Virtual Net Handlers. This figure shows LCS flow and highlights key parameters at the host and in the 2216.

Configuring the 2216 for LCS

Figure 26 shows an LCS connection. To configure the 2216 for LCS:

1. Configure the LAN type (1), either Ethernet, Token Ring, or FDDI, for the connection. This is the frame type that the host expects to send and receive.
2. Configure a unique MAC address (2) for this virtual interface.

Note: If the LAN type is Ethernet, then the MAC address must be in canonical format.

3. Configure the subchannel pair (3) used by this connection as described in “Configuring an LCS Subchannel” on page 370.
4. (4) If you want to route IP, configure an IP address and mask on the LCS virtual network handler. Refer to Configuring IP chapter in the *Protocol Configuration and Monitoring Reference Volume 1* for information on configuring IP routing. If you want to bridge IP, configure bridging on the LCS virtual network handler. Bridging IP on the LCS virtual network handler is called *TCP/IP Passthru*. See “TCP/IP Passthru” on page 352 for more information on configuring bridging.

You must configure an IP address and mask. Refer to *Protocol Configuration and Monitoring Reference Volume 1*.

There are optional parameters:

maxdata

Maximum size of data handled by this virtual network.

acklen

The size (in bytes) of acknowledgment frames over this interface.

Planning for 2216 Support

blktimer

The maximum time (in milliseconds) to wait before sending an unfull data block to the host.

For information on the corresponding host definitions, see “Configuring the Host for TCP/IP” on page 334.

TCP/IP Passthru

TCP/IP Passthru bridges, rather than routes, IP frames received on an LCS virtual network handler to a LAN or WAN interface. To use this feature, you must configure bridging on the LCS virtual network handlers and the LAN and WAN interfaces you wish interconnect. See Configuring and Monitoring Bridging in *Protocol Configuration and Monitoring Reference Volume 1* for more information on configuring bridging. The type of bridging you will configure depends on the LAN type of the LCS virtual network interfaces. The following table shows the appropriate bridging parameters for each LCS LAN type.

LCS LAN Type	Bridging Type	Forward STE Frames
Token-Ring	Source Routing, Transparent, or both	Enabled
Ethernet	Transparent	N/A
FDDI	Transparent	N/A

Note: The Spanning Tree protocol is automatically disabled on the LCS virtual network handler.

Attention: You cannot configure both an IP address and bridging for an LCS. If you specify both, the configuration program operates as if you had specified only the IP address option. If you want to bridge IP frames, do not specify an IP address.

Link Services Architecture (LSA) Support

Link Services Architecture (LSA) permits the VTAM host to communicate with the channel adapter in the 2216.

Figure 27 on page 353 shows the four types of LSA connections. Their configuration is described in:

- “Configuring an LSA Direct Connection at the 2216” on page 354
- “Configuring an LSA APPN Connection at the 2216” on page 355
- “Configuring an LSA DLSw Connection at the 2216” on page 356
- “Configuring an LSA DLSw Local Conversion at the 2216” on page 358

For information on the corresponding host definitions, see “VTAM Control Blocks Used to Configure LSA at the Host” on page 341.

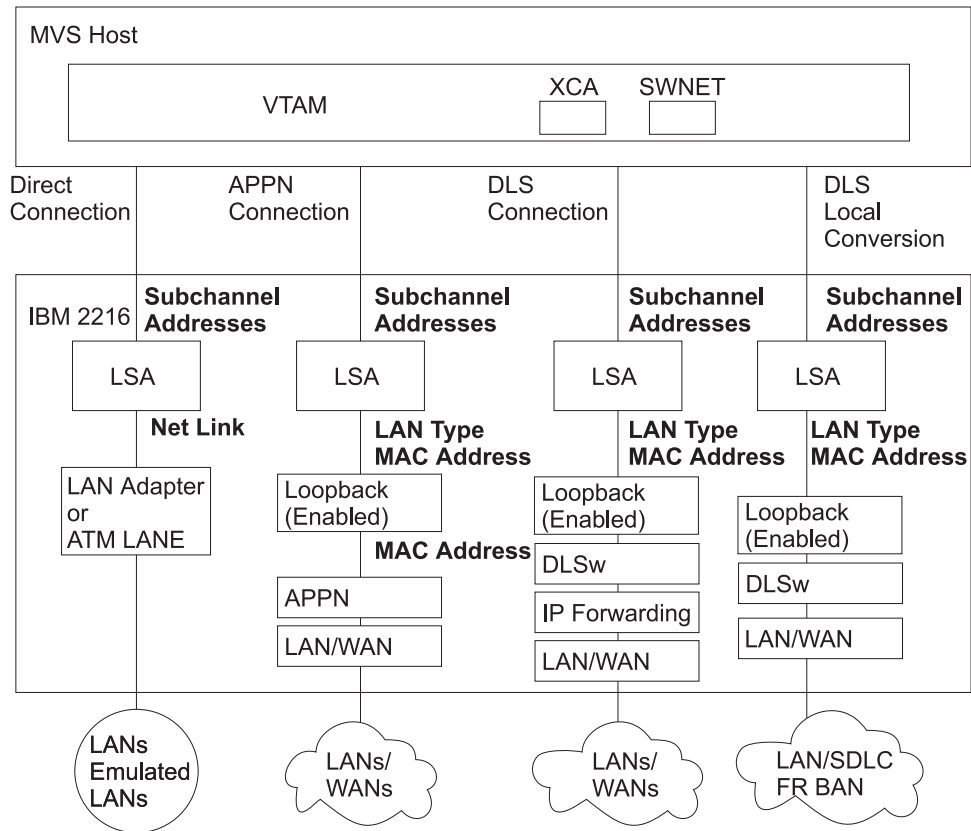


Figure 27. Configuring Link Services Architecture (LSA) Virtual Net Handlers

Configuring an LSA Direct Connection at the 2216

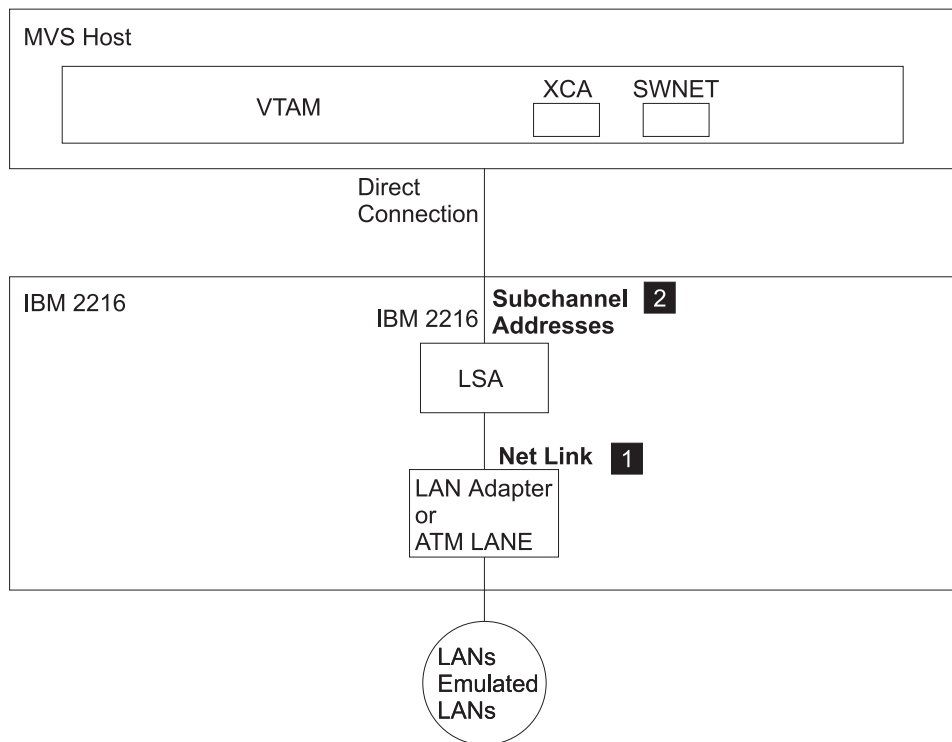


Figure 28. Configuring Virtual Net Handlers for LSA Direct Connection

Figure 28 shows an LSA direct connection. To configure the LSA connection:

1. Configure the net link (1). This is the network interface number of the LAN adapter to which the LSA network is linked. This is the interface used by the 2216 to transmit data from the host to the network.
2. Configure the subchannel or subchannels (2) used by this connection as described in “Configuring an LSA Subchannel” on page 374.

There are optional parameters:

maxdata

Maximum size of data handled by this virtual network.

acklen

The size (in bytes) of acknowledgment frames over this interface.

blktimer

The maximum time (in milliseconds) to wait before sending an unfull data block to the host.

Note: The LSA net will read its MAC address from the 2216 interface configured with the Net Link command.

For information on the corresponding host definitions, see “Configuring an LSA Direct Connection at the VTAM Host” on page 341.

Configuring an LSA APPN Connection at the 2216

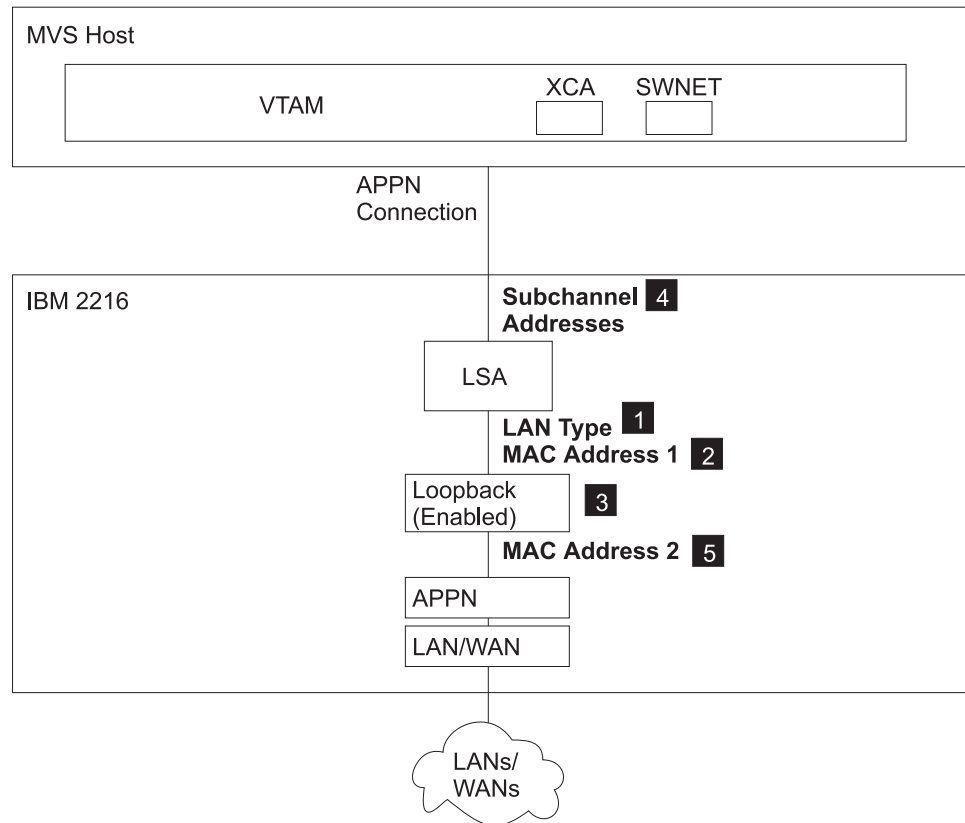


Figure 29. Configuring Virtual Net Handlers for LSA APPN Connection

Figure 29 shows an LSA APPN connection. To configure the 2216 for an LSA APPN connection:

1. Enable LSA loopback (3) using the **enable** command.
2. Configure the LAN type (1), either Ethernet or Token Ring

Note: You must configure the same LAN type for both the LSA net and the Loopback net.

3. Configure a unique MAC address (2) to identify the host (VTAM) end of the loopback connection.

Note: If the LAN type is Ethernet, then the MAC address must be in canonical format.

4. Configure the subchannel or subchannels (4) used by this connection as described in “Configuring an LSA Subchannel” on page 374.

There are optional parameters:

maxdata

Maximum size of data handled by this virtual network.

acklen

The size (in bytes) of acknowledgment frames over this interface.

blktimer

The maximum time (in milliseconds) to wait before sending an unfull data block to the host.

Planning for 2216 Support

5. Configure APPN to use the APPN loopback net. The APPN port must be configured on the APPN loopback net. To then configure an APPN link station over this APPN port, the destination MAC address of the link station definition should be that of the LSA net.
6. Configure MAC Address 2 (2), a unique MAC address to identify the 2216 (APPN) end of the loopback connection.

Note: If the LAN type is Ethernet, then the MAC address must be in canonical format.

For information on the corresponding host definitions, see “Configuring an LSA APPN Connection at the VTAM host” on page 342.

Configuring an LSA DLSw Connection at the 2216

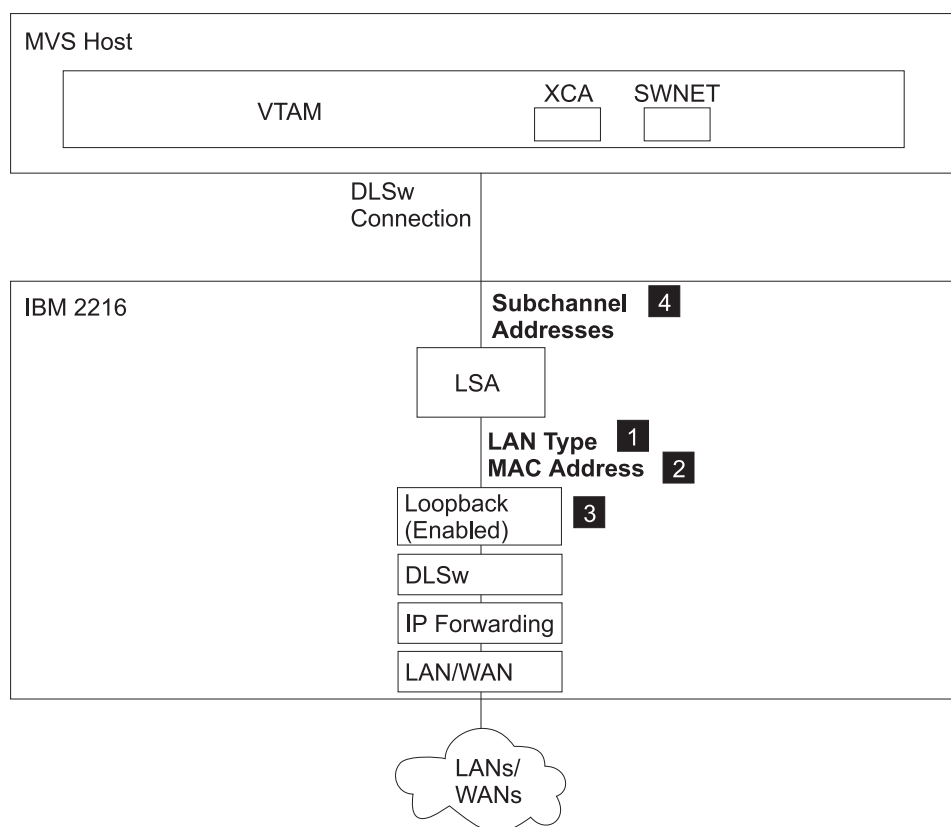


Figure 30. Configuring Virtual Net Handlers for LSA DLSw Connection

Figure 30 shows an LSA DLSw connection. To configure an LSA DLSw connection:

1. Enable LSA loopback (3) using the **enable** command.
2. Configure the LAN type (1), either Ethernet or Token Ring. This is the frame type that the host expects to send and receive.
3. Configure a unique MAC address (2) to identify the host (VTAM) end of the loopback connection.

Note: If the LAN type is Ethernet, then the MAC address must be in canonical format.

4. Configure the subchannel or subchannels (4) used by this connection as described in “Configuring an LSA Subchannel” on page 374.
5. Configure DLSw. Configuring DLSw involves enabling DLSw, setting the DLSw segment number, adding the remote DLSw TCP partner and opening the service access points (SAPs) associated with the loopback interface that will be used for DLSw. Configure DLSw from the `config>` prompt.

Enable DLSw, using the `enable dls` command.

Set the DLSw segment number using the `set srb` command. The DLSw segment number must be unique.

Add the remote DLSw TCP partner using the `add tcp` command.

Open the SAPs that will be used with the LSA loopback interface using the `open` command. The `open` command will prompt for an interface number. Input the interface number assigned to the LSA loopback interface that is defined for use with DLSw.

For a description of the DLSw configuration parameters, refer to the chapter entitled “Using and Configuring DLSw” in the *Protocol Configuration and Monitoring Reference Volume 1*.

There are optional parameters:

maxdata

Maximum size of data handled by this virtual network.

acklen

The size (in bytes) of acknowledgment frames over this interface.

blktimer

The maximum time (in milliseconds) to wait before sending an unfull data block to the host.

For information on the corresponding host definitions, see “Configuring an LSA DLSw Connection at the VTAM Host” on page 343.

Configuring an LSA DLSw Local Conversion at the 2216

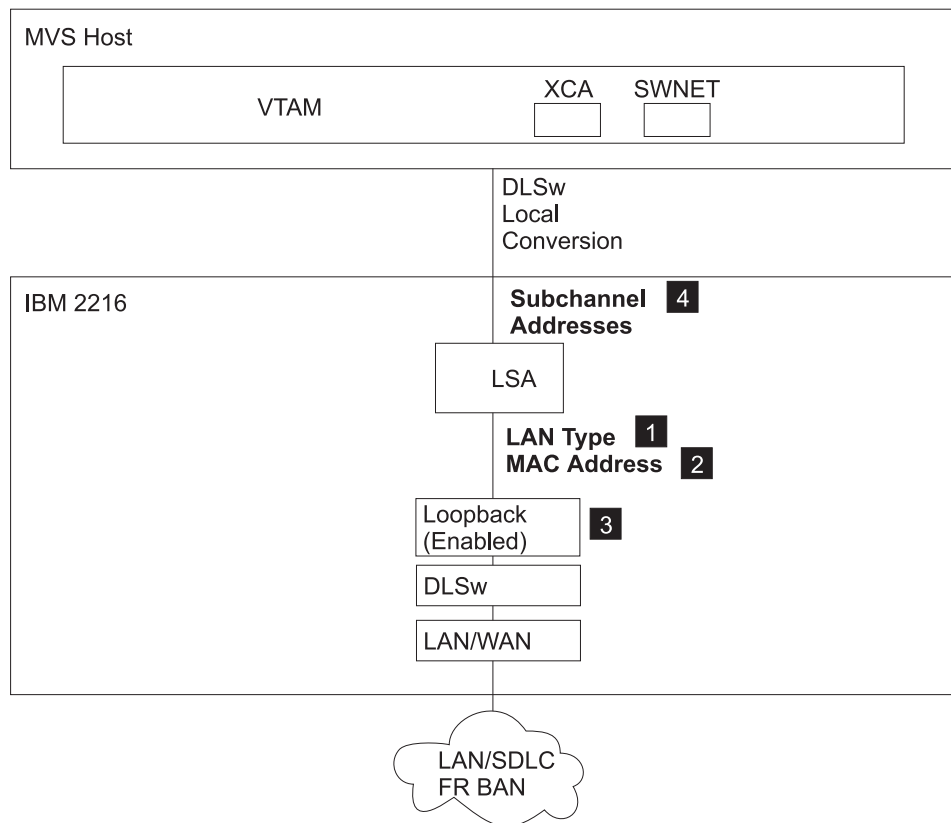


Figure 31. Configuring Virtual Net Handlers for LSA DLSw Local Conversion

Figure 31 shows a configuration that supports LSA DLSw local conversion. To configure a 2216 for LSA DLSw conversion:

1. Enable LSA loopback (3) using the **enable** command.
2. Configure the LAN type (1), either Ethernet or Token Ring. This is the frame type that the host expects to send and receive.
3. Configure a unique MAC address (2) to identify the host (VTAM) end of the loopback connection.

Note: If the LAN type is Ethernet, then the MAC address must be in canonical format.

4. Configure the subchannel or subchannels (4) used by this connection as described in “Configuring an LSA Subchannel” on page 374.
5. Configure DLSw. Configuring DLSw involves enabling DLSw, setting the DLSw segment number, adding the local DLSw TCP partner and opening the service access points (SAPs) associated with the loopback interface that will be used for DLSw. Configure DLSw from the `config>` prompt.

Enable DLSw, using the `enable dls` command.

Set the DLSw segment number using the `set srb` command. The DLSw segment number must be unique. The DLSw segment number must be different from segment numbers assigned to other interfaces.

Add the local DLSw TCP partner using the `add tcp` command.

Planning for 2216 Support

Open the SAPs that will be used with the LSA loopback interface using the open command. The open command will prompt for an interface number. Input the interface number assigned to the LSA loopback interface that is defined for use with DLSW.

Opening SAPs and configuring bridging on the local LAN/WAN interfaces might be required. Opening the SAPs and configuring bridging permits incoming frames to be forwarded to DLSw.

Note: Each LSA interface can support up to 10240 LLC link stations per SAP. An LSA interface can support multiple SAPs.

For a description of the DLSw configuration parameters, refer to the chapter entitled "Using and Configuring DLSw" in the *Protocol Configuration and Monitoring Reference Volume 1*.

There are optional parameters:

maxdata

Maximum size of data handled by this virtual network.

acklen

The size (in bytes) of acknowledgment frames over this interface.

blktimer

The maximum time (in milliseconds) to wait before sending an unfull data block to the host.

Multi-Path Channel+ (MPC+) Support

Multi-Path Channel+ (MPC+) permits the VTAM host to communicate with the channel adapter in the 2216. An MPC+ Group is a set of subchannels, containing at least one read and one write subchannel, whose end points converge at a common MPC+ image in the VTAM Host.

Planning for 2216 Support

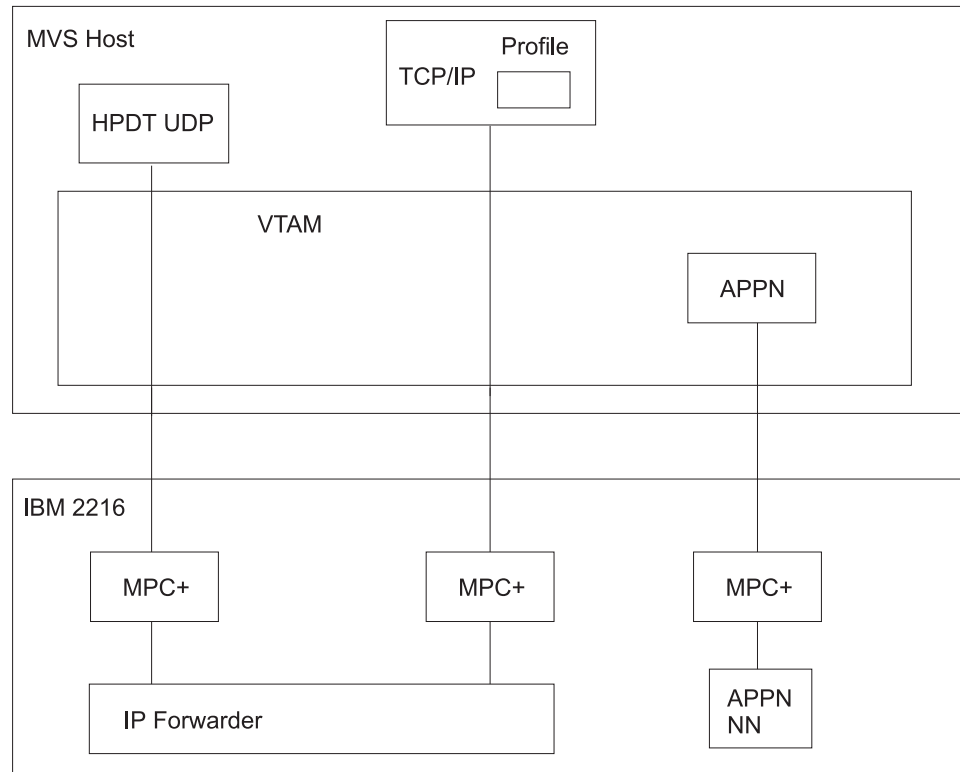


Figure 32. Different types of MPC+ Connections.

Note: UDP+ is not supported on a Parallel Channel Adapter (PCA).

Figure 32 shows the three types of MPC+ connections. The following sections describe the types in more detail:

- “Configuring the 2216 for APPN over MPC+” on page 361
- “Configuring the 2216 for UDP+ Over MPC+ (ESCON Channel Adapter Only)” on page 362
- “Configuring the 2216 for TCP/IP Over MPC+” on page 363

For information on the corresponding host definitions, see “Defining the 2216 to Host Programs” on page 334.

To configure an MPC+ Group in the 2216, configure an MPC+ interface on a base ESCON or PCA interface.

- An MPC+ connection to HPDT UDP in the host requires a dedicated MPC+ Group. An MPC+ Group that is dedicated cannot be shared by any other users or protocols.

Note: UDP+ is not supported on a Parallel Channel Adapter (PCA).

- An MPC+ Group that is not dedicated can be shared by multiple TCP/IPs and by APPN.
- There can be multiple MPC+ Groups on a single channel adapter.

Configuring the 2216 for APPN over MPC+

Figure 33 shows MPC+ flow and highlights key parameters at the host and in the 2216.

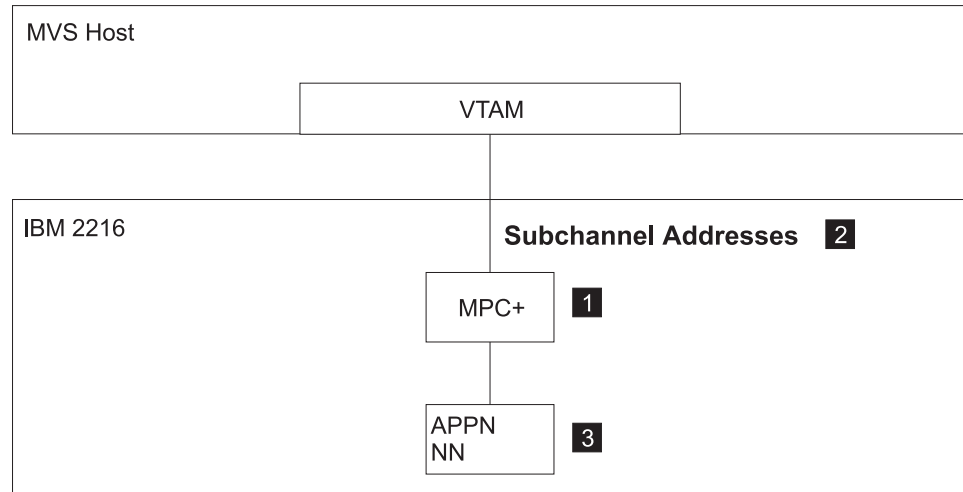


Figure 33. Configuring Virtual Net Handlers for APPN over Multi-Path Channel+ (MPC+)

Figure 33 shows the parameters required to configure MPC+ for APPN.

1 Configure the MPC+ Virtual Interface as described in “Configuring an MPC+ Virtual Interface” on page 376.

2 Configure subchannels for read and write connections to the host as described in “Configuring an MPC+ Subchannel” on page 377.

Note: Do not enable UDP+ exclusive use on the MPC+ interface. Ignore the disable outbound protocol data blocking parameter. It does not apply and has no effect for APPN.

There are optional parameters:

reply timeout

Timer for XID2/Disconnect timeout in milliseconds.

This is the amount of time that the MPC+ Group waits to hear from across the channel during XID2 and DISC exchanges before deciding that the other end of the channel is not answering and that this side should continue with the bring up or bring down of the MPC+ Group.

sequencing interval timer

Sequencing Interval Timer in milliseconds.

This timer is used to determine whether connection-oriented data is flowing smoothly across the connection on an MPC+ Group. The MPC+ control flows flow connection-oriented. Since these commands must have guaranteed delivery at the link level they flow connection-oriented and the Sequencing Interval timer is used to determine whether enough time has passed that checking of the delivery of connection-oriented traffic should be done.

maxdata

Maximum size of data handled by this virtual network handler.

Planning for 2216 Support

acklen

The size (in bytes) of acknowledgment frames over this interface.

blktimer

The maximum time (in milliseconds) to wait before sending an unfull data block to the host.

3 With the following exceptions, APPN is configured over the MPC+ interface as it is over other interface types:

- On the APPN “add port” command, specify link type MPC+.
- On the APPN “add port” command, you may specify the MPC+ sequencing interval timer.

For information on the corresponding host definitions, see “Configuring the VTAM Host for MPC+ for APPN” on page 345.

Configuring the 2216 for UDP+ Over MPC+ (ESCON Channel Adapter Only)

Figure 34 graphically illustrates a UDP+ configuration over MPC+.

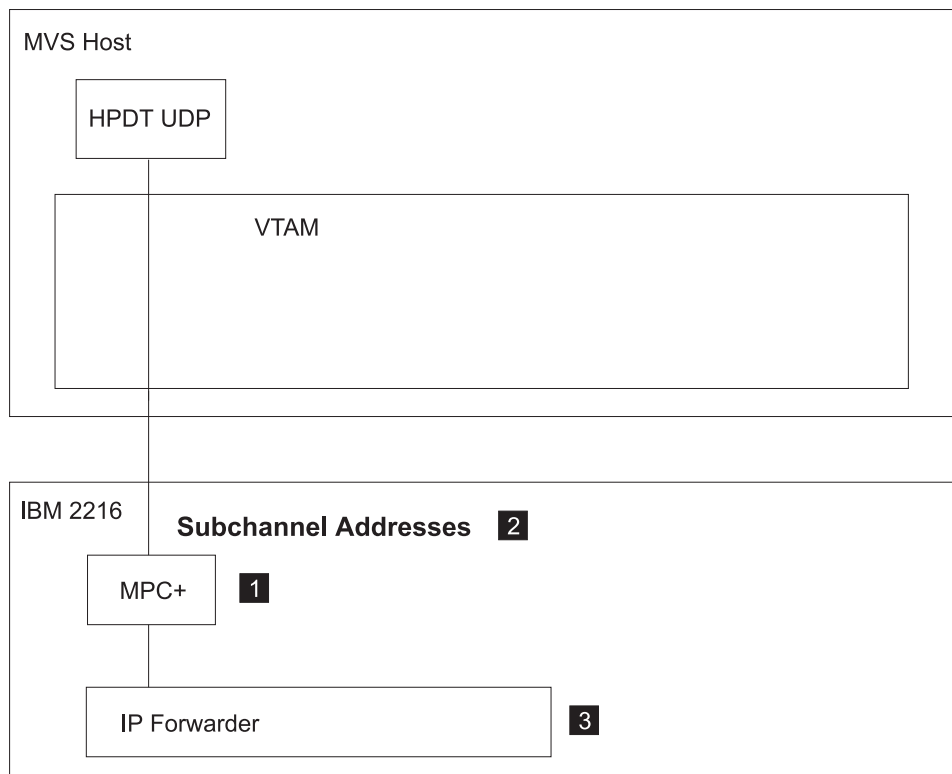


Figure 34. Configuring Virtual Net Handlers for UDP+ over MPC+

1 Configure the MPC+ Virtual Interface as described in “Configuring an MPC+ Virtual Interface” on page 376.

Enable UDP+ exclusive use on the MPC+ interface.

There are optional parameters:

reply timeout

Timer for XID2/Disconnect timeout in milliseconds.

This is the amount of time that the MPC+ Group waits to hear from across the channel during XID2 and DISC exchanges before deciding that the other end of the channel is not answering and that this side should continue with the bring up or bring down of the MPC+ Group.

sequencing interval timer

Sequencing Interval Timer in milliseconds.

This timer is used to determine whether connection-oriented data is flowing smoothly across the connection on an MPC+ Group. The MPC+ control flows are connection-oriented. Since these commands must have guaranteed delivery at the link level they flow connection-oriented and the Sequencing Interval timer is used to determine whether enough time has passed that checking of the delivery of connection-oriented traffic should be done.

maxdata

Maximum size of data handled by this virtual network handler.

Note: This value must equal the MTU coded for HPDT UDP in the host.

acklen

The size (in bytes) of acknowledgment frames over this interface.

blktimer

The maximum time (in milliseconds) to wait before sending an unfull data block to the host.

outbound protocol blocking

Generally this parameter should be left enabled. See “Configuring an MPC+ Virtual Interface” on page 376 for details.

2 Configure subchannels for read and write connections to the host as described in “Configuring an MPC+ Subchannel” on page 377.

3 IP is configured over the MPC+ interface in the same manner that it is configured over other interface types; however:

- Only one IP address should be configured for a UDP+ MPC+ interface. This address must be equal to the destination_IP_address coded for HPDT UDP in the host.

Note: If more than one IP address is configured, the last one configured is the one that is used.

- The source_IP_address coded for HPDT UDP in the host must be in the same IP subnetwork as the IP address configured in the 2216 on the UDP+ MPC+ interface.

For information on the corresponding host definitions, see “Configuring the Host for HPDT UDP:” on page 340.

Configuring the 2216 for TCP/IP Over MPC+

Figure 35 on page 364 graphically illustrates a TCP/IP configuration over MPC+.

Planning for 2216 Support

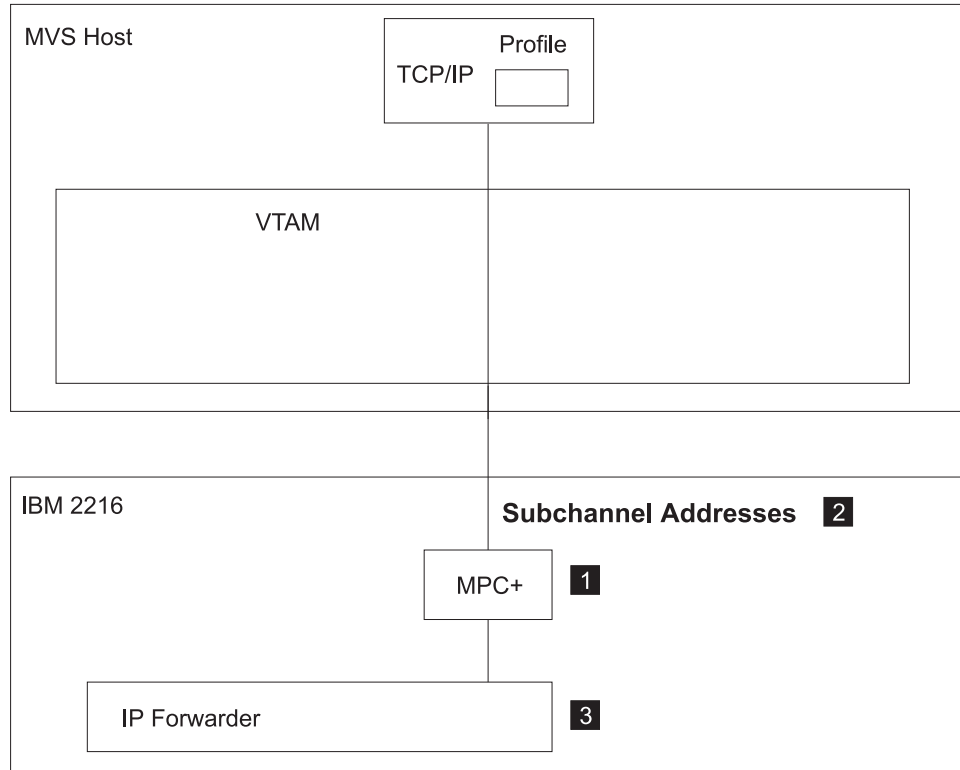


Figure 35. Configuring Virtual Net Handlers for TCP/IP over MPC+

1 Configure the MPC+ Virtual Interface as described in “Configuring an MPC+ Virtual Interface” on page 376.

Note: Do not enable UDP+ exclusive use on the MPC+ interface. TCP/IP is configured on an MPC+ interface by virtue of configuring IP addresses for the MPC+ network handler and having the MPC+ interface not be configured for the exclusive use of UDP+.

There are optional parameters:

reply timeout

Timer for XID2/Disconnect timeout in milliseconds.

This is the amount of time that the MPC+ Group waits to hear from across the channel during XID2 and DISC exchanges before deciding that the other end of the channel is not answering and that this side should continue with the bring up or bring down of the MPC+ Group.

sequencing interval timer

Sequencing Interval Timer in milliseconds.

This timer is used to determine whether connection-oriented data is flowing smoothly across the connection on an MPC+ Group. The MPC+ control flows flow connection-oriented. Since these commands must have guaranteed delivery at the link level they flow connection-oriented and the Sequencing Interval timer is used to determine whether enough time has passed that checking of the delivery of connection-oriented traffic should be done.

maxdata

Maximum size of data handled by this virtual network handler.

Notes:

1. This value must be less than or equal to the maximum amount of data the host can handle receiving over the channel (that is, $MAXBFURU * 4K$, where $MAXBFURU$ is from the VTAM TRLE corresponding to this MPC+ interface in the 2216).
2. The 2216 will never send an IP packet longer than $maxdata$ across the MPC+ Group. However, depending upon the values for $maxdata$ configured for other virtual network handlers using the same base channel interface as this MPC+ interface, the 2216 may actually accept a larger IP packet from the host.

acklen

The size (in bytes) of acknowledgment frames over this interface.

blktimer

The maximum time (in milliseconds) to wait before sending an unfull data block to the host.

outbound protocol blocking

Generally this parameter should be left enabled. See “Configuring an MPC+ Virtual Interface” on page 376 for details.

2 Configure subchannels for read and write connections to the host as described in “Configuring an MPC+ Subchannel” on page 377.

3 IP is configured over the MPC+ interface in the same manner that it is configured over other interface types; however:

- Multiple TCP/IP over MPC+ interface connections can be established over a single MPC+ interface.
- In order to establish a TCP/IP over MPC+ connection, the TCP/IP HOME IP address must be in the same IP subnetwork as one of the IP addresses configured in the 2216 on the MPC+ interface.
- If multiple TCP/IP instances in the host are in the same IP subnetwork as configured for the 2216 MPC+ interface, multiple TCP/IP over MPC+ connections will be set up using the same 2216 IP address.

For information on the corresponding host definitions, see “Configuring the Host for TCP/IP” on page 334.

Configuring the Channel Adapter Interface

The following steps are required to configure the ESCON or PCA interface:

1. Access the ESCON or PCA interface as described in “Accessing the Channel Interface” on page 367. This will cause the base interface to be defined.
2. Configure the virtual net handlers as described in:
 - “Configuring an LCS Virtual Interface” on page 369
 - “Configuring an LSA Virtual Interface” on page 372
 - “Configuring an MPC+ Virtual Interface” on page 376
3. Configure the subchannels:
 - “Configuring an LCS Subchannel” on page 370
 - “Configuring an LSA Subchannel” on page 374

Planning for 2216 Support

“Configuring an MPC+ Subchannel” on page 377

Once the 2216 ESCON or PCA configuration is complete,

- Configure the protocols.
- Save the configuration.
- Reboot the 2216 to activate changes.

Chapter 31. Configuring and Monitoring the ESCON and Parallel Channel Adapters

This chapter describes the Enterprise Systems Connection (ESCON) and Parallel Channel Adapter configuration and operational commands. It includes the following sections:

- “Accessing the Channel Interface”
- “Channel Adapter Configuration Commands” on page 368
- “Accessing the Channel Interface Monitoring Process” on page 386
- “Channel Interface Monitoring Commands” on page 387
- “Channel Adapter LCS Interface Monitoring Commands” on page 390
- “Channel Adapter LSA Interface Monitoring Commands” on page 392
- “Channel Adapter MPC+ Interface Monitoring Commands” on page 393

For additional monitoring information, refer to *Software User's Guide*.

Note About Examples

Throughout this following sections there are examples of ESCON and PCA interface configurations. In areas where there is a significant difference between ESCON and PCA, there will be multiple examples.

Accessing the Channel Interface

To access the channel adapter interface:

1. At the OPCON prompt, enter **talk 6**. For example:

```
* talk 6
Config>
```

After you enter the **talk 6** command, the CONFIG prompt (Config>) displays on the console. If the prompt does not appear, press **Return** again.

2. Enter the **list devices** command to display the network interface numbers that are currently configured.
3. Record the interface numbers.
4. Create a channel interface by either:

- Entering the **add device esc** command at the Config> prompt to create an ESCON channel.

```
Config> add dev esc
Device Slot x(1-8) 1?
Adding ESCON Adapter device in slot 1 port 1 as interface x
```

Note: x is the assigned interface number.

Note: The 2216 has eight slots, numbered 1 to 8.

- Entering the **add device pca** command at the Config> prompt.

```
Config> add dev pca
Device Slot x(1-8) 1?
Adding PCA device in slot 1 port 1 as interface x
```

Note: x is the assigned interface number.

Note: The 2216 has eight slots, numbered 1 to 8.

5. Enter the **network** command and the number of the interface you obtained in step 4. For example, if interface 0 is an ESCON interface:

```
Config> network 0
ESCON Config>
```

The ESCON configuration prompt (ESCON Config>), is displayed.

6. Configure the channel adapter virtual net handlers and associated subchannels using the commands in Table 48.

Channel Adapter Configuration Commands

The following commands can be entered at a channel adapter configuration prompt (either ESC Config> or PCA Config>):

Table 48. Channel Interface Configuration Commands

Command	Description
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
add	Adds a virtual net handler for one of the base protocols or adds APPN loopback : <ul style="list-style-type: none">• LCS - LAN Channel Station Support• LSA - Link Services Architecture• MPC+ - Multi-Path Channel+• APPN loopback Each protocol provides a unique set of parameters which can be used to configure the virtual net handlers.
delete	Deletes an interface on the channel adapter.
list	Lists the channel adapter configuration and optionally lists subchannels. You can also list the transfer mode and channel transfer speed for a PCA.
mod	Changes the configuration of an interface on the channel adapter.
set	Sets the transfer mode and channel transfer speed for a parallel channel adapter (PCA). Note: You can only access this command when configuring a PCA interface.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Add

Use the **add** command to add virtual network handlers for LCS, LSA, and MPC+, and to enable loopback for APPN.

Syntax:

```
add                lcs
                   lsa
                   mpc
```

Channel Adapter Configuration Commands (Talk 6)

appn loopback

Configuring an LCS Virtual Interface

Use the **add lcs** command to add an LCS virtual interface and get to the ESCON Add Virtual> or PCA Add Virtual> prompt from which you can enter other interface and subchannel parameters.

Note: Although LCS requires two subchannels, it is only necessary to specify one subchannel. An adjacent subchannel will be chosen such that the two subchannels will form a sequential pair with the write subchannel (device address is even) before the read subchannel (device address is odd).

After entering the **add lcs**, you will receive either the ESCON Add Virtual> or PCA Add Virtual> prompt. At this prompt you can enter the following commands:

Command	Description
---------	-------------

<u>acklen</u> <i>bytes</i>	The size (in bytes) of acknowledgment frames over this interface.
----------------------------	---

Note: The default value of 10 causes acknowledgment frames to be blocked. This value gives the best performance in heavy traffic networks if it is used with the default *blktimer* value. For IP interactive traffic and bulk data transfer, set **acklen** to 100.

Valid values: 1 to 500 bytes

Default value: 10

<u>blktimer</u> <i>milliseconds</i>	The maximum time (in milliseconds) to wait before sending an unfull data block to the host.
-------------------------------------	---

Note: The default value is set to give the best performance in heavy traffic networks. Set **blktimer** to 10 for IP interactive traffic and bulk data transfer.

Valid values: 1 to 20

Default value: 5

<u>lantype</u> <i>type</i>	LAN type, either Ethernet, Token Ring, or FDDI
----------------------------	--

Example: Specifying LAN Type for an LCS interface on an ESCON interface

```
ESCON Add Virtual>lan
Please select one of the following LAN types:
  E Ethernet
  T Token Ring
  F FDDI
LCS LAN Type: [E]?
```

<u>mac</u> <i>address</i>	MAC Address of the virtual net handler
---------------------------	--

<u>maxdata</u> <i>bytes</i>	Maximum size of data handled by this virtual network handler.
-----------------------------	---

Valid Values: 516 to 17749 for Token Ring, 1500 for Ethernet, 4478 for FDDI

Default: 2052 for Token Ring, 1500 for Ethernet, 4478 for FDDI

Channel Adapter Configuration Commands (Talk 6)

subchannels *command*

Places you at the next prompt based on the value of *command*. *Command* can be one of the following:

- add
- list
- mod

See “Configuring an LCS Subchannel” for the commands you can enter at these prompts and their description.

Configuring an LCS Subchannel

Entering subchannels *command* places you at the next prompt based on the value of *command*. *Command* can be one of the following:

- add
- list
- mod
- exit

Command	Description
<u>add</u>	Adds a subchannel pair and displays the ESCON Config LCS Subchannel> or PCA Config LCS Subchannel> prompt from which you can add Device Address, LPAR number, Link Address, and CU Logical Address.

Notes:

1. You only need to specify the device address for PCA interfaces.
2. You must add or configure one subchannel for an LCS virtual interface. Although LCS requires two subchannels, it is only necessary to specify one subchannel. An adjacent subchannel will be chosen such that the two subchannels will form a sequential pair with the write subchannel (device address is even) before the read subchannel (device address is odd).

device *address*

The unit address transmitted on the channel path to select a 2216 device. It is also referred to as subchannel number in S/370 I/O architecture. It is a two-digit hexadecimal value that can range from X'00' to X'FF'. This value is defined in the host IOCP by the UNITADD statement on the CNTLUNIT macro instruction for the real device.

Valid Values: X'00' to X'FF'

Default: None

Important

The following parameters do not apply for PCA.

lpar *number*

Logical partition number. This allows multiple logical host partitions (LPARs) to share one ESCON channel.

This value is defined in the host Input/Output Configuration Program (IOCP) by the RESOURCE macro instruction.

Channel Adapter Configuration Commands (Talk 6)

If the host is not using EMIF, use the default of 0 for the LPAR number.

Valid Values: X'0' - X'F'

Default: X'0'

link address

If one ESCON Director (ESCD) is in the communication path, the link address is the ESCD port number that is attached to the host.

If two ESCDs are in the path, it is the host-side port number of the ESCD defined with the dynamic connection.

When no ESCD is in the communication path, this value must be set to X'01'.

Valid Values: X'01' - X'FE'

Default: X'01'

cu address

The Control Unit address defined in the host for the 2216. This value is defined in the host Input/Output Configuration Program (IOCP) by the CUADD statement on the CNTLUNIT macro instruction.

The Control Unit Address must be unique for each logical partition defined on the same host.

Valid Values: X'0' - X'F'

Default: X'0'

Example: Adding a subchannel for an LCS interface for an ESCON interface

```
ESCON Add Virtual>sub add
Please add or configure one subchannel for an LCS virtual interface.
Although LCS requires two subchannels, it is only necessary to specify
one subchannel. An adjacent subchannel will be chosen such that the two
subchannels will form a sequential pair with the write subchannel (device
address is even) before the read subchannel (device address is odd).
ESCON Config LCS Subchannel>d 4
ESCON Config LCS Subchannel>e
```

list

Lists information for the LCS subchannels.

Example: Listing subchannels for an ESCON LCS interface

```
ESCON Add Virtual>sub lis
Read Subchannels:
Sub 0 Device address : 5 LPAR number : 0
      Link address   : 1 CU Logical Address : 0
Write Subchannels:
Sub 1 Device address : 4 LPAR number : 0
      Link address   : 1 CU Logical Address : 0
```

Example: Listing subchannels for an PCA LCS interface

```
PCA Add Virtual>sub lis
Read Subchannels:
Sub 2 Device address : 3
Write Subchannels:
Sub 3 Device address : 2
```

mod

Modifies a configured LCS subchannel pair. It lists the configuration for the configured LCS subchannels and allows you to modify one of them by specifying the "sub" number from the list. Once you have selected the subchannel, you can change the device address,

Channel Adapter Configuration Commands (Talk 6)

LPAR number, Link Address, and CU Logical Address as described in “Configuring an LCS Subchannel” on page 370 .

Notes:

1. You can only change the device address for PCA.
2. For ESCON or PCA, if there is only one subchannel configured, you can only modify the subchannel, not delete it.

Configuring an LSA Virtual Interface

Use the **add lsa** command to add an LSA virtual interface and get to the ESCON Add Virtual> or PCA Add Virtual> prompt from which you can enter the following commands:

Command	Description
---------	-------------

[enable or disable]	
----------------------------	--

Enables or disables loopback on an LSA interface.

Note: Only *one* of these parameters can be entered, depending on the state of the loopback function. If the loopback is disabled, you can enable it; if it is enabled, you can disable it.

Valid Values: enable or disable

Default: disable

acklen bytes	The size (in bytes) of acknowledgment frames over this interface.
---------------------	---

Note: The default value of 10 causes acknowledgment frames to be blocked. This value gives the best performance in heavy traffic networks if it is used with the default blktimer value. Set **acklen** to 100 for IP bulk data transfer and interactive traffic.

Valid values: 1 to 500 bytes

Default value: 10

blktimer milliseconds	
------------------------------	--

The maximum time (in milliseconds) to wait before sending an unfull data block to the host.

Note: The default value is set to give the best performance in heavy traffic networks. Set **blktimer** to 10 for IP bulk data transfer and interactive traffic over Ethernet and token-ring LANs.

Valid values: 1 to 20

Default value: 10

lantype type	LAN type, either Ethernet, or Token-Ring.
---------------------	---

mac address	A unique MAC address to identify this virtual interface. This parameter is available only when loopback is enabled. It is the MAC
--------------------	---

Channel Adapter Configuration Commands (Talk 6)

address of the LSA/VTAM side of the loopback connection. The MAC address of the APPN side of the loopback connection is specified using ADD APPN.

maxdata bytes

Maximum size of data handled by this virtual network handler.

Valid Values: 516 to 17749 for Token Ring, 1500 for Ethernet

Default: 2052 for Token Ring, 1500 for Ethernet

net interface#

This parameter is available only when loopback is disabled. It is used to indicate the LAN adapter over which this LSA net will communicate. The LAN adapter must have been previously configured and can only be Token-Ring, Ethernet (including emulated LANs), or FDDI.

subchannels

Places you at the next prompt based on the value of *command*. *Command* can be one of the following:

- add
- delete
- list
- mod

See “Configuring an LSA Subchannel” on page 374 for the commands you can enter at these prompts and their description.

There are four types of LSA connections, as shown in Figure 27 on page 353. They are:

- “Configuring an LSA Direct Connection at the 2216” on page 354
- “Configuring an LSA APPN Connection at the 2216” on page 355
- “Configuring an LSA DLSw Connection at the 2216” on page 356
- “Configuring an LSA DLSw Local Conversion at the 2216” on page 358

The example shows adding two LSA interfaces. The first one uses loopback and the second one is a direct connection.

Example 1: Adding an ESCON LSA interface with loopback

```
ESCON Config>add lsa
ESCON Add Virtual>enable
Enabling loopback through network 2.
Please set the MAC address using the "MAC" command
ESCON Add Virtual>mac 40:00:00:00:22:16
ESCON Add Virtual>lan
Please select one of the following LAN types:
  E Ethernet
  T Token Ring
LSA LAN Type: [E]? e
ESCON Add Virtual>sub add
ESCON Add LSA Subchannel>link c5
ESCON Add LSA Subchannel>d 8
ESCON Add LSA Subchannel>e
ESCON Add Virtual>e
ESCON Config>list all
Net: 2 Protocol: LSA LAN type: LSA Ethernet LAN number: 0
Maxdata: 1500
Loopback is enabled.
MAC address: 400000002216
Block timer: 10 ms ACK length: 10 bytes
Sub 0 Dev addr: 8 LPAR: 0 Link addr: C5 CU addr: 0
```

Example 2: Adding a PCA LSA interface with direct connection

Channel Adapter Configuration Commands (Talk 6)

```
PCA Config>add 1sa
PCA Add Virtual>net 0
PCA Add Virtual>sub add
PCA Add LSA Subchannel>d 7
PCA Add LSA Subchannel>e
PCA Add Virtual>e
PCA Config>list all
Net: 6 Protocol: LSA LAN type: Token Ring LAN number: 0
      Maxdata: 2052
      Loopback is not enabled.
      MAC address: Obtained from net 0
      Block timer: 10 ms ACK length: 10 bytes
      Sub 0 Dev addr: 7
PCA Config>
```

Configuring an LSA Subchannel

Entering **subchannels** *command* places you at the next prompt based on the value of *command*. *Command* can be one of the following:

- add
- delete
- list
- mod
- exit

Command	Description
<u>add</u>	Adds a subchannel and displays the ESCON Add LSA Subchannel> or PCA Add LSA Subchannel> prompt from which you can add:

device *address*

The unit address transmitted on the channel path to select a 2216 device. It is also referred to as subchannel number in S/370 I/O architecture. It is a two-digit hexadecimal value that may range from 00-FF. This value is defined in the host IOCP by the UNITADD statement on the CNTLUNIT macro instruction for the real device.

Valid Values: X'00' to X'FF'

Default: None

Important

The following parameters do not apply for PCA.

lpar *number*

Logical partition number. This allows multiple logical host partitions, (LPARs) to share one ESCON channel.

This value is defined in the host Input/Output Configuration Program (IOCP) by the RESOURCE macro instruction.

If the host is not using EMIF, use the default of 0 for the LPAR number.

Valid Values: X'0' - X'F'

Default: X'0'

link *address*

If one ESCON Director (ESCD) is in the communication path, the link address is the ESCD port number that is attached to the host.

Channel Adapter Configuration Commands (Talk 6)

If two ESCDs are in the path, it is the host-side port number of the ESCD defined with the dynamic connection.

When no ESCD is in the communication path, this value must be set to X'01'.

Valid Values: X'01' - X'FE'

Default: X'01'

cu address

The Control Unit address defined in the host for the 2216. This value is defined in the host Input/Output Configuration Program (IOCP) by the CUADD statement on the CNTLUNIT macro instruction. The Control Unit Address must be unique for each LPAR defined on the same host.

Valid Values: X'0' - X'F'

Default: X'0'

Enter **exit** to return to the previous prompt.

Example: Adding a subchannel for an ESCON LSA interface

```
ESCON Add Virtual>sub add
ESCON Add LSA Subchannel>link f7
ESCON Add LSA Subchannel>device 0
ESCON Add LSA Subchannel>cu 0
ESCON Add LSA Subchannel>lpar 0
ESCON Add LSA Subchannel>exit
```

Example: Adding a subchannel for a PCA LSA interface

```
PCA Add Virtual>sub add
PCA Add LSA Subchannel>device 2
PCA Add LSA Subchannel>exit
```

delete

Deletes a configured LSA subchannel. It lists the configuration for the configured LSA subchannels and allows you to delete one of them by specifying the “sub” number from the list.

list

Lists information for the LSA subchannels.

Example: Listing subchannels for an ESCON LSA interface

```
ESCON Config Virtual>sub list
Sub 0 Device address : 42 LPAR number : 0
      Link address : C5 CU Logical Address : 0
Sub 1 Device address : 43 LPAR number : 0
      Link address : C5 CU Logical Address : 0
Sub 2 Device address : 44 LPAR number : 0
      Link address : C5 CU Logical Address : 0
```

Example: Listing subchannels for a PCA LSA interface

```
PCA Config Virtual>sub list
Sub 0 Device address : B
Sub 1 Device address : 12
Sub 2 Device address : 10
Sub 3 Device address : A
Sub 4 Device address : C
Sub 5 Device address : E
```

mod

Modifies a configured LSA subchannel. It lists the configuration for the configured LSA subchannels and allows you to modify one of them by specifying the “sub” number from the list. Once you have selected the subchannel, you can change the device address, LPAR number, Link Address, and CU Logical Address as described in “Configuring an LSA Subchannel” on page 374.

Channel Adapter Configuration Commands (Talk 6)

Notes:

1. You can only change the device address for PCA.
2. For ESCON or PCA, if there is only one subchannel configured, you can only modify the subchannel, not delete it.

Configuring an MPC+ Virtual Interface

Use the **add mpc** command to add an MPC+ virtual interface and get to the ESCON Add Virtual> or PCA Add Virtual> prompt from which you can enter other interface and subchannel parameters:

Command	Description
---------	-------------

<u>acklen</u> <i>bytes</i>	The size (in bytes) of acknowledgment frames over this interface.
----------------------------	---

Note: The default value of 10 causes acknowledgment frames to be blocked. This value gives the best performance in heavy traffic networks if it is used with the default blktimer value.

Valid values: 1 to 500 bytes

Default value: 10

<u>blktimer</u> <i>milliseconds</i>	The maximum time (in milliseconds) to wait before sending an unfull data block to the host.
-------------------------------------	---

Note: The default value is set to give the best performance in heavy traffic networks.

Valid values: 1 to 20

Default value: 5

<u>disable_outbound</u> protocol blocking	Prevents the MPC+ Group from blocking multiple protocol packets within a single MPC+ packet when sending data to the host.
--	--

Note: This parameter affects UDP+ and TCP/IP traffic. Enabling this parameter gives better performance in heavy traffic networks. Enable is the default.

<u>disable udp+</u> exclusive use	To undedicate the MPC+ interface to UDP+.
--	---

Notes:

1. This parameter applies to ESCON interfaces only.
2. This means that only HPDT UDP in the host will be able to establish a connection across this MPC+ Group. UDP+ can never share an MPC+ Group with other protocols (for example, APPN, TCP/IP).

<u>enable_outbound</u> protocol blocking	Enables the MPC+ Group to block multiple protocol packets within a single MPC+ packet when sending data to the host.
---	--

Note: This parameter affects UDP+ and TCP/IP traffic. Enabling this parameter gives better performance in heavy traffic networks. Enable is the default.

Channel Adapter Configuration Commands (Talk 6)

enable udp+ **exclusive use**

To dedicate the MPC+ interface to UDP+.

Notes:

1. This parameter applies to ESCON interfaces only.
2. This means that only HPDT UDP in the host will be able to establish a connection across this MPC+ Group. UDP+ can never share an MPC+ Group with other protocols (for example, APPN, TCP/IP).

maxdata *bytes*

Maximum size of data handled by this virtual network handler.

Valid Values: 512 to 32 768

Default: 2 048

reply timeout *milliseconds*

Timer for XID2/Disconnect timeout in milliseconds.

Valid Values: 1 to 50 000

Default: 45 000

sequencing interval timer *milliseconds*

Sequencing Interval Timer in milliseconds.

Valid Values: 1 to 50 000

Default: 3000

subchannels

Places you at the next prompt based on the value of *command*. *Command* can be one of the following:

- addr
- addw
- delete
- list
- mod
- exit

See “Configuring an MPC+ Subchannel” for the commands you can enter and their description.

Configuring an MPC+ Subchannel

Note: A subchannel defined as a read subchannel to VTAM is a write subchannel to the 2216 and a subchannel defined as a write subchannel to VTAM is a read subchannel to the 2216.

Entering subchannels *command* places you at the next prompt based on the value of *command*. *Command* can be one of the following:

- addr
- addw
- delete
- list
- mod
- exit

Commands	Description
-----------------	--------------------

Channel Adapter Configuration Commands (Talk 6)

addr

Adds a read subchannel and displays the ESCON Add MPC+ Read Subchannel> or PCA Add MPC+ Read Subchannel> prompt from which you can enter the following commands:

Command	Description
---------	-------------

<u>device address</u>	
-----------------------	--

The unit address transmitted on the channel path to select a 2216 device. It is also referred to as subchannel number in S/370 I/O architecture. It is a two-digit hexadecimal value that may range from 00-FF. This value is defined in the host IOCP by the UNITADD statement on the CNTLUNIT macro instruction for the real device.

Valid Values: X'00' to X'FF'

Default: None

Important

The following parameters do not apply for PCA.
--

<u>lpar number</u>	
--------------------	--

Logical partition number. This allows multiple logical host partitions, (LPARs) to share one ESCON channel.

This value is defined in the host Input/Output Configuration Program (IOCP) by the RESOURCE macro instruction.

If the host is not using EMIF, use the default of 0 for the logical partition number.

Valid Values: X'0' - X'F'

Default: X'0'

<u>link address</u>	
---------------------	--

If one ESCON Directors (ESCD) is in the communication path, the link address is the ESCD port number that is attached to the host.

If two ESCDs are in the path, it is the host-side port number of the ESCD defined with the dynamic connection.

When no ESCD is in the communication path, this value must be set to X'01'.

Valid Values: X'01' - X'FE'

Default: X'01'

<u>cu address</u>	
-------------------	--

The Control Unit address defined in the host for the 2216. This value is defined in the host Input/Output Configuration Program (IOCP) by the CUADD statement on the CNTLUNIT macro instruction.

The Control Unit Address must be unique for each LPAR defined on the same host.

Valid Values: X'0' - X'F'

Default: X'0'

Channel Adapter Configuration Commands (Talk 6)

Enter **exit** to return to the ESCON Add Virtual> prompt.

Example: Adding read subchannels for a PCA MPC+ interface

```
PCA Add Virtual>sub addr
PCA Add MPC+ Read Subchannel>d 8
PCA Add MPC+ Read Subchannel>e
PCA Add Virtual>sub addr
PCA Add MPC+ Read Subchannel>d 9
PCA Add MPC+ Read Subchannel>e
```

addw

Adds a write subchannel and displays the ESCON Add MPC+ Write Subchannel> or PCA Add MPC+ Write Subchannel> prompt from which you can enter the following commands:

Command **Description**

device *address*

The unit address transmitted on the channel path to select a 2216 device. It is also referred to as subchannel number in S/370 I/O architecture. It is a two-digit hexadecimal value that may range from 00-FF. This value is defined in the host IOCP by the UNITADD statement on the CNTLUNIT macro instruction for the real device.

Valid Values: X'00' to X'FF'

Default: None

Important

The following parameters do not apply for PCA.

lpar *number* Logical partition number. This allows multiple logical host partitions, (LPARs) to share one ESCON channel.

This value is defined in the host Input/Output Configuration Program (IOCP) by the RESOURCE macro instruction.

If the host is not using EMIF, use the default of 0 for the LPAR number.

Valid Values: X'0' - X'F'

Default: X'0'

link *address* If one ESCON Director (ESCD) is in the communication path, the link address is the ESCD port number that is attached to the host.

If two ESCDs are in the path, it is the host-side port number of the ESCD defined with the dynamic connection.

When no ESCD is in the communication path, this value must be set to X'01'.

Valid Values: X'01' - X'FE'

Default: X'01'

cu *address* The Control Unit address defined in the host for the 2216. This value is defined in the host Input/Output

Channel Adapter Configuration Commands (Talk 6)

Configuration Program (IOCP) by the CUADD statement on the CNTLUNIT macro instruction.

The Control Unit Address must be unique for each logical partition defined on the same host.

Valid Values: X'0' - X'F'

Default: X'0'

Example: Adding write subchannels for an ESCON MPC+ interface

```
ESCON Add Virtual>sub addw
ESCON Add MPC+ Write Subchannel>d 10
ESCON Add MPC+ Write Subchannel>e
ESCON Add Virtual>sub addw
ESCON Add MPC+ Write Subchannel>d 11
ESCON Add MPC+ Write Subchannel>e
```

delete

Deletes a configured MPC+ subchannel. It lists the configuration for the configured MPC+ subchannels and allows you to delete one of them by specifying the "sub" number from the list.

list

Lists information for the MPC+ subchannels.

Example: Listing subchannels for an ESCON MPC+ interface

```
ESCON Add Virtual>sub 1is
Read Subchannels:
Sub 0 Device address : 8 LPAR number : 0
      Link address  : 1 CU Logical Address : 0
Sub 1 Device address : 9 LPAR number : 0
      Link address  : 1 CU Logical Address : 0
Write Subchannels:
Sub 2 Device address : 10 LPAR number : 0
      Link address  : 1 CU Logical Address : 0
Sub 3 Device address : 11 LPAR number : 0
      Link address  : 1 CU Logical Address : 0
```

Example: Listing subchannels for a PCA MPC+ interface

```
PCA Add Virtual>sub 1is
Read Subchannels:
Sub 0 Device address : 12
Sub 1 Device address : 13
Write Subchannels:
Sub 2 Device address : 14
Sub 3 Device address : 15
```

mod

Modifies a configured MPC+ subchannel. It lists the configuration for the configured MPC+ subchannels and allows you to modify one of them by specifying the "sub" number from the list. Once you have selected the subchannel, you can change the device address, LPAR number, Link Address, and CU Logical Address as described in "Configuring an MPC+ Subchannel" on page 377 .

Note: You can only change the device address for PCA.

Once you have returned to the previous prompt, you can list the entire MPC+ configuration as shown in the following example:

Example: Listing and changing an ESCON MPC+ configuration

```
ESCON Config>list all
Net: 1 Protocol: MPC+ LAN type: MPC+ LAN number: 0
Maxdata: 2048
Reply TO: 45000 Sequencing Interval Timer: 3000
MPC Group is for exclusive use of UDP+
Outbound protocol data blocking is enabled
Block timer: 5 ms ACK Length: 10 bytes
Read Subchannels:
Sub 0 Dev addr: 40 LPAR: 0 Link addr: F5 CU addr: 0
Write Subchannels:
Sub 1 Dev addr: 41 LPAR: 0 Link addr: F5 CU addr: 0
```


Channel Adapter Configuration Commands (Talk 6)

```
Net: 2 Protocol: MPC+ LAN type: MPC+ LAN number: 1
Maxdata: 2048
Reply TO: 45000 Sequencing Interval Timer: 3000
Outbound protocol data blocking is enabled
Block timer: 5 ms ACK Length: 10 bytes
Read Subchannels:
Sub 0 Dev addr: 42 LPAR: 0 Link addr: F5 CU addr: 0
Write Subchannels:
Sub 1 Dev addr: 43 LPAR: 0 Link addr: F5 CU addr: 0

Net: 3 Protocol: MPC+ LAN type: MPC+ LAN number: 2
Maxdata: 2048
Reply TO: 45000 Sequencing Interval Timer: 3000
Outbound protocol data blocking is enabled
Block timer: 5 ms ACK Length: 10 bytes
Read Subchannels:
Sub 0 Dev addr: 44 LPAR: 0 Link addr: F5 CU addr: 0
Write Subchannels:
Sub 1 Dev addr: 45 LPAR: 0 Link addr: F5 CU addr: 0
```

```
ESCON Config>mod 3
ESCON Config Virtual>?
REply timeout
SEquencing int timer
MAXdata
SUBchannels
Exit
ESCON Config Virtual>rep 3100
ESCON Config Virtual>exit
ESCON Config>list all
Net: 1 Protocol: MPC+ LAN type: MPC+ LAN number: 0
Maxdata: 2048
Reply TO: 45000 Sequencing Interval Timer: 3000
MPC Group is for exclusive use of UDP+
Outbound protocol data blocking is enabled
Block timer: 5 ms ACK Length: 10 bytes
Read Subchannels:
Sub 0 Dev addr: 40 LPAR: 0 Link addr: F5 CU addr: 0
Write Subchannels:
Sub 1 Dev addr: 41 LPAR: 0 Link addr: F5 CU addr: 0

Net: 2 Protocol: MPC+ LAN type: MPC+ LAN number: 1
Maxdata: 2048
Reply TO: 45000 Sequencing Interval Timer: 3000
Outbound protocol data blocking is enabled
Block timer: 5 ms ACK Length: 10 bytes
Read Subchannels:
Sub 0 Dev addr: 42 LPAR: 0 Link addr: F5 CU addr: 0
Write Subchannels:
Sub 1 Dev addr: 43 LPAR: 0 Link addr: F5 CU addr: 0

Net: 3 Protocol: MPC+ LAN type: MPC+ LAN number: 2
Maxdata: 2048
Reply TO: 3100 Sequencing Interval Timer: 3000
Outbound protocol data blocking is enabled
Block timer: 5 ms ACK Length: 10 bytes
Read Subchannels:
Sub 0 Dev addr: 44 LPAR: 0 Link addr: F5 CU addr: 0
Write Subchannels:
Sub 1 Dev addr: 45 LPAR: 0 Link addr: F5 CU addr: 0

ESCON Config>
```

Configuring APPN Loopback

Important: You only need to configure APPN loopback once for each physical 2216. If you configure APPN loopback on an ESCON channel, you do not need to enable it on a PCA channel in the same 2216.

Notes:

1. APPN loopback cannot be added unless loopback has been enabled on an LSA virtual net as described in “Configuring an LSA Virtual Interface” on page 372.
2. You can only add APPN loopback once on a given IBM 2216.

Channel Adapter Configuration Commands (Talk 6)

Use the **add appn** command to add APPN loopback. You will get either the ESCON Add Virtual> or PCA Add Virtual> prompt where you can enter the following commands:

Commands	Description
lan <i>type</i>	Ethernet or Token Ring
mac <i>address</i>	A unique MAC address to identify the APPN side of the loopback connection in the 2216. This address must be different from the MAC address given to the host (VTAM) side of the loopback connection when configuring the LSA interface.

Example: Adding APPN loopback to an ESCON interface

```
ESCON Config>add appn
ESCON Add Virtual>
ESCON Add Virtual>lan
Please select one of the following LAN types:
  E Ethernet
  T Token Ring
APPN LAN Type: [T]?
ESCON Add Virtual>mac
MAC address in 00:00:00:00:00:00 form [000000000000]?
  40:00:22:16:00:09
ESCON Add Virtual>e
ESCON Config>1i a11
Net: 9 Protocol: APPN Loopback LAN type: Token-Ring/802.5
      APPN loopback MAC address: 400022160009

Net: 5 Protocol: LSA LAN type: Token Ring LAN number: 0
      Maxdata: 2052
      Loopback is enabled.
      MAC address: 400022160005
      Block timer: 10 ms ACK length: 10 bytes
      Sub 0 Dev addr: 0 LPAR: 0 Link addr: 1 CU num: 0

Net: 6 Protocol: LSA LAN type: Token Ring LAN number: 1
      Maxdata: 2052
      Loopback is not enabled.
      MAC address: Obtained from net 3
      Block timer: 10 ms ACK length: 10 bytes
      Sub 0 Dev addr: 1 LPAR: 0 Link addr: 1 CU num: 0

Net: 7 Protocol: LCS LAN type: LCS Ethernet 802.3 LAN number: 0
      Maxdata: 1500
      MAC address: 400022160007
      Block timer: 5 ms ACK length: 10 bytes
      Read Subchannels:
      Sub 0 Dev addr: 5 LPAR: 0 Link addr: 1 CU num: 0
      Write Subchannels:
      Sub 1 Dev addr: 4 LPAR: 0 Link addr: 1 CU num: 0
ESCON Config>e
```

Notes:

1. The APPN port would be configured on net 9 of the example.
2. Configure APPN link stations that will connect to VTAM over the ESCON channel to use the MAC address of the LSA net as the destination MAC address. Do not use the APPN loopback net for this purpose.
3. Any LSA nets connection to APPN must have the same LAN type as the APPN loopback net.

Delete

Use the **delete** command to delete an interface on the channel adapter. If you know the interface number you wish to delete, you can specify it; otherwise, if you do not enter an interface number, the configuration is listed and you will be prompted to enter an interface number.

Channel Adapter Configuration Commands (Talk 6)

Syntax:

delete *interface_number*
(no parameter)

interface_number

Deletes the configuration for the specified interface number.

(no parameters)

Lists the configured interfaces for the channel adapter and prompts you for the interface number you wish to delete.

Example: Deleting an interface (no parameters given)

```
PCA Config>del
Net: 5 Protocol: APPN Loopback LAN type: Token-Ring/802.5
      APPN loopback MAC address: 400000000406
Net: 2 Protocol: LSA LAN type: Token Ring LAN number: 0
      Maxdata: 2052
      Loopback is enabled.
      MAC address: 400000000403
      Block Timer: 10 ms ACK length: 10 bytes
Net: 3 Protocol: LSA LAN type: Token Ring LAN number: 1
      Maxdata: 2052
      Loopback is not enabled.
      MAC address: Obtained from net 1
      Block Timer: 10 ms ACK length: 10 bytes
Net: 4 Protocol: MPC+ LAN type: MPC+ LAN number: 0
      Maxdata: 2048
      Reply TO: 3100 Sequencing Interval Timer: 3000
      Outbound protocol data blocking is enabled
      Block Timer: 5 ms ACK length: 10 bytes
Virtual net number to delete: [2]? 3
Are you sure?(Yes or [No]): y
```

Mod

Use the **mod** command to modify a configured interface on the channel adapter. If you know the interface number you wish to modify, you can specify it; otherwise, if you do not enter an interface number, the configuration is listed and you will be prompted to enter an interface number.

Syntax:

modify *interface_number*
(no parameters)

interface_number

Modifies the configuration for the specified interface number.

(no parameters)

Lists the configured interfaces for the channel adapter and prompts you for the interface number you wish to modify.

Example:

Channel Adapter Configuration Commands (Talk 6)

```
ESCON Config> mod
Net: 1 Protocol: MPC+ LAN type: MPC+ LAN number: 0
      Maxdata: 2048
      Reply TO: 45000 Sequencing Interval Timer: 3000
      MPC Group is for exclusive use of UDP+
      Outbound protocol data blocking is enabled
      Block timer: 5 ms ACK length: 10 bytes
Net: 2 Protocol: MPC+ LAN type: MPC+ LAN number: 1
      Maxdata: 2048
      Reply TO: 45000 Sequencing Interval Timer: 3000
      Outbound protocol data blocking is enabled
      Block timer: 5 ms ACK length: 10 bytes
Virtual net number to configure: [1]? 2
ESCON Config Virtual> ?
Reply timeout
SEQuencing int timer
MAXdata
SUBchannels
Exit
ESCON Config Virtual>re
Reply Time Out (range 1-50000 milliseconds): [45000]? 30003
ESCON Config Virtual>sub list
Read Subchannels:
Sub 0 Device address : 7 LPAR number : 0
      Link address : F4 CU Logical Address : 0
Write Subchannels:
Sub 1 Device address : 6 LPAR number : 0
      Link address : F4 CU Logical Address : 0
ESCON Config Virtual>sub addr
ESCON Add MPC+ Read Subchannel> ?
LINK address (ESCD Port)
LPAR number
CU logical address
Device address
Exit
ESCON Add MPC+ Read Subchannel>d 5
ESCON Add MPC+ Read Subchannel>? e
ESCON Config Virtual>sub list
Read Subchannels:
Sub 0 Device address : 7 LPAR number : 0
      Link address : F4 CU Logical Address : 0
Sub 1 Device address : 5 LPAR number : 0
      Link address : F4 CU Logical Address : 0
Write Subchannels:
Sub 2 Device address : 6 LPAR number : 0
      Link address : F4 CU Logical Address : 0
ESCON Config Virtual>sub ?
ADDRead subchannel
ADDWrite subchannel
MODify subchannel
DELete subchannel
LIst subchannels
ESCON Config Virtual>sub del
Read Subchannels:
Sub 0 Device address : 7 LPAR number : 0
      Link address : F4 CU Logical Address : 0
Sub 1 Device address : 5 LPAR number : 0
      Link address : F4 CU Logical Address : 0
Write Subchannels:
Sub 2 Device address : 6 LPAR number : 0
      Link address : F4 CU Logical Address : 0
Subchannel number to delete: [0]? 0
Are you sure?(Yes or [No]): y
ESCON Config Virtual>sub list
Read Subchannels:
Sub 0 Device address : 5 LPAR number : 0
      Link address : F4 CU Logical Address : 0
Write Subchannels:
Sub 1 Device address : 6 LPAR number : 0
      Link address : F4 CU Logical Address : 0
```

Channel Adapter Configuration Commands (Talk 6)

```
ESCON Config Virtual>sub mod
  Read Subchannels:
  Sub 0 Device address : 5 LPAR number : 0
        Link address  : F4 CU Logical Address : 0
  Write Subchannels:
  Sub 1 Device address : 6 LPAR number : 0
        Link address  : F4 CU Logical Address : 0
Subchannel number to modify: [0]? 1
ESCON Modify MPC+ Subchannel>d 2
ESCON Modify MPC+ Subchannel>e
ESCON Config Virtual>sub list
  Read Subchannels:
  Sub 0 Device address : 5 LPAR number : 0
        Link address  : F4 CU Logical Address : 0
  Write Subchannels:
  Sub 1 Device address : 2 LPAR number : 0
        Link address  : F4 CU Logical Address : 0
ESCON Config Virtual> exit
ESCON Config>
```

List (ESCON)

Use the **list** command to list the channel adapter configuration and also (with **list all**) list a subchannel summary.

Syntax:

list (no parameters)

(no parameters)

Lists the channel adapter configuration.

Example: Listing an ESCON configuration

```
ESCON Config>li
Net: 5 Protocol: LSA LAN type: Token Ring LAN number: 0
Maxdata: 2052
Loopback is enabled.
MAC address: 400022160005
Block timer: 10 ms ACK length: 10 bytes
```

all Lists the channel configuration with a subchannel summary. Two examples are provided. The first is for a channel adapter with LSA and LCS subchannels. The second is for a channel adapter with MPC+ subchannels.

Example for LSA and LCS: Listing an ESCON configuration with subchannel summary

```
ESCON Config>li all
Net: 2 Protocol: LCS LAN type: LCS FDDI LAN number: 0
Maxdata: 4478
MAC address: 400000002216
Block Timer: 5 ms ACK Length: 10 bytes
Sub 0 Dev addr: 8 LPAR: 0 Link addr: C5 CU addr: 0

Net: 5 Protocol: LSA LAN type: Token Ring LAN number: 0
Maxdata: 2052
Loopback is enabled.
MAC address: 400022160005
Block timer: 10 ms ACK length: 10 bytes
Sub 0 Dev addr: 0 LPAR: 0 Link addr: 1 CU addr: 0
```

Example for MPC+: Listing an ESCON configuration with subchannel summary

```
Net: 1 Protocol: MPC+ LAN type: MPC+ LAN number: 0
Maxdata: 2048
Reply TO: 45000 Sequencing Interval Timer: 3000
MPC Group is for exclusive use of UDP+
Outbound protocol data blocking is enabled
Block Timer: 5 ms ACK Length: 10 bytes
Read Subchannels:
Sub 0 Dev addr: 40 LPAR: 0 Link addr: F5 CU addr: 0
```

Channel Adapter Configuration Commands (Talk 6)

```
Write Subchannels:
Sub 1 Dev addr: 41 LPAR: 0 Link addr: F5 CU addr: 0
Net: 2 Protocol: MPC+ LAN type: MPC+ LAN number: 1
Maxdata: 2048
Reply TO: 45000 Sequencing Interval Timer: 3000
Outbound protocol data blocking is enabled
Block Timer: 5 ms ACK Length: 10 bytes
Read Subchannels:
Sub 0 Dev addr: 42 LPAR: 0 Link addr: F5 CU addr: 0
Write Subchannels:
Sub 1 Dev addr: 43 LPAR: 0 Link addr: F5 CU addr: 0
```

List (PCA)

Use the **list** command to list the transfer mode and channel transfer speed configured or the virtual interfaces configured.

Syntax:

```
list                               base
                                       virtual
```

base Lists the transfer mode and channel transfer speed configured.

virtual [all or (no parameter)]

Lists a summary of the configuration for the virtual interfaces or the configuration of all virtual interfaces and their subchannels (**all**).

Set (PCA Only)

Use the **set** command to set the transfer mode and channel transfer speed for a parallel channel adapter (PCA).

Syntax:

```
set                               tmode value
tmode value
```

Specifies the mode of transfer that the 2216 uses to transfer data to the host, either DC interlock or Data Streaming and the channel transfer speed when using data streaming.

Valid values:

- D** Specifies Direct-coupled (DC) Interlock mode. This mode is the standard I/O interface that requires a response to a demand.
- S** Specifies speeds less than or equal to a 3.0 MB data streaming mode.
- S4** Specifies speeds less than or equal to a 4.5 MB data streaming mode.

Default value: D

Accessing the Channel Interface Monitoring Process

To access the ESCON or PCA interface:

1. At the OPCON prompt, enter **talk 5**. For example:
* **talk 5**
+

Channel Adapter Configuration Commands (Talk 6)

- To display the monitoring prompt for the channel interface or any of the channel adapter's virtual interfaces, enter the **network** command followed by the interface number of the interface.

If you do not know the interface number, use the **configuration** command at the + prompt to display a list of interface numbers configured on the router.

Multiprotocol Access Services

2216-MAS Feature 2822 V3.2 Mod 0 PTF 0 RPQ 0 MAS.EF9 cc4_2a

```

Num Name Protocol
0 IP DOD-IP
3 ARP Address Resolution
11 SNMP Simple Network Management Protocol
23 ASRT Adaptive Source Routing Transparent Enhanced Bridge
28 APPN Advanced Peer-to-Peer Networking [HPR]
29 NHRP Next Hop Routing Protocol
30 APPN Advanced Peer-to-Peer Networking [ISR]

```

```

Num Name Feature
2 MCF MAC Filtering
7 CMPRS Data Compression Subsystem
8 NDR Network Dispatching Router
10 AUTH Authentication

```

```

31 Networks:
Net Interface MAC/Data-Link Hardware State
0 TKR/0 Token-Ring/802.5 Token-Ring Up
1 Eth/0 Ethernet/IEEE 802.3 Ethernet Up
2 PCA/0 Parallel Channel Parallel Channel Up
3 LCS/0 LCS Parallel Channel Up
4 MPC/0 MPC Parallel Channel Up
5 LSA/0 LSA Parallel Channel Up
6 TKR/1 Token-Ring/802.5 APPN Loopback Up
7 ESCON/0 ESCON ESCON Channel Up
8 MPC/1 MPC ESCON Channel Up
9 LCS/1 LCS ESCON Channel Up
10 LSA/1 LSA ESCON Channel Up

```

Channel Interface Monitoring Commands

The following commands can be entered at the channel adapter monitoring prompt (ESCON> or PCA>):

Table 49. Channel Interface Monitoring Commands

Command	Description
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
List	Lists subchannels or lists nets.
Net	Lists a specific network interface.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

List

Use the **list** command to list all subchannels or to list all network interfaces. You can also list the speed of a PCA interface.

Syntax:

```

list base (PCA only)
      nets
      subchannels

```

Channel Interface Monitoring Commands (Talk 5)

base Lists the transfer mode and channel transfer speed of the channel adapter.

nets Lists network interfaces.

Example: List networks

```
PCA>li ne
+ net 1
PCA Base Monitoring
PCA> li nets
Net: 2  Type: LSA  LAN Type: Token-Ring/802.5  LAN Number: 0
      Net state: Up
Net: 4  Type: LSA  LAN Type: Token-Ring/802.5  LAN Number: 1
      Net state: Up
Net: 5  Type: LCS  LAN Type: FDDI              LAN Number: 0
      Net state: Down
```

Type Type of virtual interface: LCS, LSA, or MPC+

LAN Type

LAN type, either Token-Ring/802.5, Ethernet/802.3, Ethernet/V2, Ethernet or FDDI.

Note: This field is not displayed for subchannels that are part of an MPC+ interface.

LAN Number

Interface number of the LAN

Note: This field is not displayed for subchannels that are part of an MPC+ interface.

Group Number

The group number is used internally by the device to identify a virtual MPC+ net interface on the channel adapter.

Net State

State of the network: Up, Down, Disabled, Not Present, HW Mismatch, or Testing.

Up Indicates that the link is up.

Down Indicates that the link is down.

Disabled

Indicates that the operator has disabled the link.

Not Present

Indicates that the network interface's adapter is not present.

HW Mismatch

An adapter other than a channel adapter is located in the slot or the physical channel adapter installed is not the same type as the configured channel adapter.

Note: Only base nets will have the states "Not present" and "HW mismatch."

Testing

The system is attempting to determine if a network connection exists

subchannels

Lists subchannels

```
ESCON> li sub
The following subchannels are defined:
      Local address: 00  Device address: 00  CU Logical Address: 00
      Link: C5  LPAR: 00
      Type: LSA
```


Channel Interface Monitoring Commands (Talk 5)

```
The following lantypes/lannums are using this subchannel:
LAN type: Token-Ring/802.5 LAN number: 0
Local address: 01 Device address: DD CU Logical Address: 0B
Link: 5C LPAR: 02
Type: LSA
The following lantypes/lannums are using this subchannel:
LAN type: Token-Ring/802.5 LAN number: 0
Local address: 02 Device address: 07 CU Logical Address: 00
Link: C5 LPAR: 00
Type: LSA
The following lantypes/lannums are using this subchannel:
LAN type: Token-Ring/802.5 LAN number: 1
Local address: 03 Device address: 02 CU Logical Address: 00
Link: C5 LPAR: 00
Type: LCS
The following lantypes/lannums are using this subchannel:
LAN type: FDDI LAN number: 0
Local address: 04 Device address: 03 CU Logical Address: 00
Link: C5 LPAR: 00
Type: LCS
The following lantypes/lannums are using this subchannel:
LAN type: FDDI LAN number: 0
```

Local Address

The subchannel address index used internally by the device.

Device Address

The unit address transmitted on the channel path to select a device. It is also referred to as subchannel number in S/370 I/O architecture. It is a two-digit hexadecimal value that may range from X'00' to X'FF'. This value is defined in the host IOCP by the UNITADD statement on the CNTLUNIT macro instruction for the real device.

Note: CU Logical Address, Link Address, and LPAR are only displayed for ESCON adapters.

CU Logical Address

The Control Unit address defined in the host for the device. This value is defined in the host Input/Output Configuration Program (IOCP) by the CUADD statement on the CNTLUNIT macro instruction.

The Control Unit Address must be unique for each LPAR defined on the same host.

Link Address

If one ESCON Director (ESCD) is in the communication path, the link address is the ESCD port number that is attached to the host.

If two ESCDs are in the path, the link address is the host-side port number of the ESCD defined with the dynamic connection.

When no ESCD is in the communication path, this value must be set to 0x01.

LPAR Logical partition number. This allows multiple partitions in a logically partitioned (LPAR) host to share one ESCON fiber.

This value is defined in the host Input/Output Configuration Program (IOCP) by the RESOURCE macro instruction.

If the host is not using EMIF, the LPAR number is 0 (zero).

Type Type of virtual interface: LCS, LSA, or MPC+

LAN Type

LAN type, either Token-Ring/802.5, Ethernet/802.3, Ethernet/V2, Ethernet or FDDI.

Channel Interface Monitoring Commands (Talk 5)

Note: This field is not displayed for subchannels that are part of an MPC+ interface.

LAN Number

Interface number of the LAN

Note: This field is not displayed for subchannels that are part of an MPC+ interface.

Group Number

The group number is used internally by the device to identify a virtual MPC+ net interface on the channel adapter.

Net

Use the **net** command to get to the monitoring environment for one of the virtual interfaces as described in:

- “Channel Adapter LCS Interface Monitoring Commands”
- “Channel Adapter LSA Interface Monitoring Commands” on page 392
- “Channel Adapter MPC+ Interface Monitoring Commands” on page 393

Syntax:

net *net_number*

Channel Adapter LCS Interface Monitoring Commands

The following commands can be entered at the LCS monitoring prompt (LCS>):

Table 50. Channel Adapter LCS Interface Monitoring Commands

Command	Description
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Lists subchannels or lists nets.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

List

Use the **list** command to display information for an LCS interface.

Syntax:

list

Example:

```
LCS> list
LCS Virtual Adapter
LCS Information for Net 4
---
LAN Type: Token-Ring/802.5      LAN Number: 0
Local Read Subchannel number: 7
```

Channel Interface Monitoring Commands (Talk 5)

Local Write Subchannel number: 6
MAC Address: 400022160001
Local IP Address: 9.192.200.1
Status: Down

LAN Type

LAN type, either Token-Ring/802.5, Ethernet/802.3, Ethernet/V2, Ethernet or FDDI.

Note: This field is not displayed for subchannels that are part of an MPC+ interface.

LAN Number

Interface number of the LAN

Note: This field is not displayed for subchannels that are part of an MPC+ interface.

Read Subchannel

The local subchannel from which the device receives data.

Write Subchannel

The local subchannel through which the device transmits data.

MAC Address

A unique MAC address to identify this virtual interface.

Local IP address

IP Address that was assigned to this network interface. If you have not configured an IP address, this line will not be displayed.

LCS Bridging

This is only displayed when bridging is configured. (Not shown in the example.)

Status

Status of the network: Up, Down, Disabled, Not Present, HW Mismatch, or Testing

Up The network connection is established.

Down The network connection can not be determined.

Disabled

Device is disabled and diagnostic testing can be performed

Not Present

Indicates that the network interface's adapter is not present.

HW Mismatch

An adapter other than a channel adapter is located in the slot or the physical channel adapter installed is not the same type as the configured channel adapter.

Note: Only base nets will have the states "Not present" and "HW mismatch."

Testing

The system is attempting to determine if a network connection exists

Channel Adapter LSA Interface Monitoring Commands

The following commands can be entered at the LSA monitoring prompt (LSA>):

Table 51. Channel Adapter LSA Interface Monitoring Commands

Command	Description
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
List	Lists information for adapters, SAPs, or link stations.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

List

Use the **list** command to display information for adapters, SAPs, and link stations.

Syntax:

```
list          adapter
              sap
              link stations
```

adapter

Lists virtual adapters for LSA.

Example: List Virtual Adapter for LSA

```
LSA> list ad
LSA Virtual Adapter
LSA Information for Net 2
-----
LAN Type: Token-Ring/802.5      LAN Number: 0
MAC Address: 4000000000CF
Downstream network: Loopback - Net 2
Status: Host connected

#SAPs Open: 1      #Link Stations Open: 1
Maximum frame size: 2052 (0x804)
Host User ID      Subchannel
-----
00000000          0
```

1 host user(s)

#SAPs Open

Number of SAPs opened by VTAM on this LSA interface

#Link Stations Open

Number of link stations open for all SAPs on this LSA interface

Maximum Frame Size

Maximum frame size supported over this LSA interface

Host User ID

A unique ID generated by VTAM to identify the host user on a given subchannel

Subchannel

The local subchannel being used by this host user.

sap Lists Service Access Points (SAPS) for LSA

Example: List SAP for LSA

Channel Interface Monitoring Commands (Talk 5)

```
LSA> list sap
SAP      Provider      User      Max Link      Open Link
Number   SAP ID          SAP ID    Stations      Stations
-----
4        02000000      00000001 1              1
1 SAPs currently open
```

SAP Number

Identifies the SAP to LLC

Provider SAP ID

A unique ID generated by VTAM to identify this SAP

User SAP ID

A unique ID generated by device to identify this SAP

Max Link Stations

Maximum number of link stations VTAM can open on this SAP

Open Link Stations

Number of link stations currently open on this SAP

link Lists link information for LSA

Example: List link for LSA

```
LSA> list link
Please specify a SAP number (0-236): [4]? 4
Link Stations on SAP 4
```

Station ID	Destination MAC Address	Destination SAP Number	Link Status	Frames Sent	Frames Received
02000001	40000000ABCD	4	Connected	9	9

1 link station(s) open on SAP 4

Station ID

A unique ID generated by device to identify this link station

Destination MAC Address

MAC address of the remote LLC link station

Destination SAP Number

SAP value of the remote LLC link station

Link Status

Current status of the LLC connection

Frames Sent

Number of packets sent to VTAM for this link station

Frames Received

Number of packets received from VTAM for this link station

Channel Adapter MPC+ Interface Monitoring Commands

The following commands can be entered at the MPC+ monitoring prompt (MPC+>):

Table 52. Channel MPC+ Interface Monitoring Commands

Command	Description
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
List	Lists subchannels.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Channel Interface Monitoring Commands (Talk 5)

Remote Virtual Circuit Token

Token in the host representing this virtual circuit. This field is blank if not known.

Protocol

The upper layer protocol that this virtual circuit is using.

States for the Virtual Circuit

The states for the virtual circuit are:

Reset The virtual circuit is currently inactive.

Active-other side

The other side is currently accepting calls (connections) for this virtual circuit.

Active-this side

This side is currently accepting calls (connections) for this virtual circuit.

Active-both sides

Both sides of the virtual circuit are accepting calls (connections) for this virtual circuit.

Not accepting new calls

This connection is not accepting new calls (connections). However, connections that are already running on the virtual circuit will stay up.

The information shown for the connection is the local and remote connection tokens and the current state. For IP protocols (that is, UDP+ and TCP/IP), the local and destination IP addresses associated with the connection will also be shown, if known.

Local Connection Token

The token in the device representing this connection.

Remote Connection Token

The token in the host representing this connection. This field is blank if not known.

States for the Connection

The states for the connection are:

Reset The connection is currently inactive

Pending Active - callee

This side is about to respond to the call request from the other side.

Pending Active - caller

This side has called out to the other side and is waiting for the other side to response to the call.

Pending Active - awaiting datastart

The connection is waiting for both sides to be ready to start allowing user data to flow.

Active Active and usable

Local IP address

The IP address on the MPC+ interface in the device that is associated with this connection. This field will be displayed only for IP protocols.

Channel Interface Monitoring Commands (Talk 5)

Destination IP Address

The IP address in the host that is associated with this connection.
This field will be displayed only for IP protocols.

Example: List, active connections for MPC+

```
MPC+>1i conn
MPC+ Connections
Virtual Circuit Token = 090144C22C00000000
Remote Registration Token(s) = 05000101A5
Protocol = APPN, State = Active-both sides
                Local Connection Token = 090144C3300000000E
                Remote Connection Token = 05000101A6
                State = Active

Protocol = TCP/IP, State = Active-both sides
                Local Connection Token = 090144C4400000000F
                Remote Connection Token = 05000101B0
                State = Active
                Local IP address = 100.0.0.1
                Destination IP address = 100.0.0.2
```

Example: List, no connections active for MPC+

```
MPC+>1i conn
No User Connections on this MPC+ Group
```

mpc

Displays information about the MPC+ Group. It displays the local and remote registration token, if known, and the current state of the MPC+ Group. Also, if the MPC+ is for the exclusive use of UDP+, that will be indicated. If the MPC+ Group is not for the exclusive use of UDP+, exclusive use will not be mentioned in the display.

Note: UDP+ is not supported on a Parallel Channel Adapter (PCA).

Example:

```
MPC+>1i mpc
MPC+ Group
Local registration token = 0901422A3C00000000
Remote registration token = 050001019D
state = Active
This MPC+ Group is for the exclusive use of UDP+.
Outbound protocol data blocking is enabled for the MPC+ Group.
```

Local registration token

Token in the device representing this MPC+ Group.

Remote registration token

Token in the host representing this MPC+ Group. This field is blank if not known.

State The state of the MPC+ Group:

Reset The MPC+ Group is currently inactive.

Pending Active-xid2(00)

In the process of becoming active and currently processing xid2(00)s.

Pending Active-xid2(07)

In the process of becoming active and currently processing xid2(07)s.

Active Active and usable.

Pending Reset

Pending inactive (in other words, in the process of coming down).

Channel Interface Monitoring Commands (Talk 5)

subchannel

Shows information about the subchannels that are part of the MPC+ Group. It shows the local subchannel number, logical partition number, Link address, Control Unit (CU) logical address, Device Address, type of Subchannel (READ or WRITE), and the current state of the subchannel. The type should be the opposite of what is configured at the host.

Example: List subchannels for MPC+

```
MPC+>1i sub
MPC+ Subchannels
Local  Link  CU Log.  Device
number LPAR  addr   address address  type    state
-----
      1    0   F4      0      9     READ   Active
      0    0   F4      0      8     WRITE  Active
```

Note: Only device address is displayed when listing a PCA subchannel.

Local number

The subchannel address index used internally by the device.

Note: CU Logical Address, Link Address, and LPAR are only displayed for ESCON adapters.

LPAR Logical partition number. This allows multiple partitions in a logically partitioned (LPAR) host to share one ESCON fiber.

This value is defined in the host Input/Output Configuration Program (IOCP) by the RESOURCE macro instruction.

If the host is not using EMIF, the LPAR number is 0 (zero).

Link Address

If one ESCON Director (ESCD) is in the communication path, the link address is the ESCD port number that is attached to the host.

If two ESCDs are in the path, the link address is the host-side port number of the ESCD defined with the dynamic connection.

When no ESCD is in the communication path, this value must be set to 0x01.

CU Logical Address

The Control Unit address defined in the host for the device. This value is defined in the host Input/Output Configuration Program (IOCP) by the CUADD statement on the CNTLUNIT macro instruction.

The Control Unit Address must be unique for each logical partition defined on the same host.

Device Address

The unit address transmitted on the channel path to select a device. It is also referred to as subchannel number in S/370 I/O architecture. It is a two-digit hexadecimal value that may range from X'00' to X'FF'. This value is defined in the host IOCP by the UNITADD statement on the CNTLUNIT macro instruction for the real device. It is a two-digit hexadecimal value that may range from X'00' to X'FF'. This value is defined in the host IOCP by the UNITADD statement on the CNTLUNIT macro instruction for the real device.

Type Whether this is a read or write subchannel.

Channel Interface Monitoring Commands (Talk 5)

state The state of the subchannel:

Reset The subchannel is currently inactive.

Pending Active-xid2(00)

The subchannel is becoming active and currently processing xid2(00)s.

Pending Active-xid2(07)

The subchannel becoming active and currently processing xid2(07)s.

Active The subchannel is active and part of an MPC+ Group.

Pending Reset

The subchannel is pending inactive (in other words, in the process of coming down).

Chapter 32. Configuring Serial Line Interfaces

This chapter describes the interface configuration process for a serial interface and includes the following sections:

- “Accessing the Interface Configuration Process”
- “Network Interfaces and the GWCON Interface Command” on page 400

IMPORTANT: To configure Frame Relay, PPP, X.25, V.25bis, SDLC Relay, and SDLC protocols on the serial interface, use the commands in this chapter and then refer to the commands in the chapters that describe the specific protocol.

See “Configuring the Network Interface” on page 18 for a table of protocols and the interfaces that support those protocols.

Accessing the Interface Configuration Process

See “Accessing Network Interface Configuration and Operating Processes” on page 16 for a description of how to add a serial interface. Once you have done that, the following paragraphs describe how to set the data-link of the interface correctly and how to access that data-link’s configuration commands.

To access the interface configuration process for a serial interface, first access the `Config>` prompt and issue the command **set data-link**. Next, at the `Config>` prompt, enter the interface type and number to access the configuration environment for the interface.

For example, to configure a serial interface for X.25, you must access the X.25 `config>` environment by issuing the following commands:

```
Config> set data-link X25 2
Config> network 2
```

From the X.25 `config>` environment, you can complete your configuration of X.25 on the serial interface. See “Chapter 33. Using the X.25 Network Interface” on page 401.

When you are done configuring the serial interface, enter the **restart** command after the `OPCON` prompt (*) and respond **yes** to the prompt to enable the new configuration.

Clocking and Cable Type

This section applies to all uses of a serial port for: FR, PPP, X.25, SDLC Relay, and SDLC.

If a modem or CSU/DSU is attached to the serial port then the router is taking on the DTE role in terms of clocking on the line, so configure a DTE cable type and external clocking.

If you want to attach two routers directly without a modem, CSU/DSU, or modem eliminator, then one of the routers will take on the DCE role in terms of clocking on the line. Connect a direct attach cable to the router that will act as the DCE and configure the following parameters for its serial interface.

Configuring Serial Line Interfaces

1. A DCE cable type
2. Internal clocking
3. The clocking/line speed

The other router will take on the DTE role in terms of clocking and should be configured as if it were attached to a modem or CSU/DSU

Note: Configuring a DTE as opposed to a DCE cable has no impact on whether or not the WAN net handler takes on the peer device. For example, the router always acts as a Frame Relay DTE device and uses a FR UNI interface even when a Frame Relay interface is configured to use a DCE cable.

Network Interfaces and the GWCON Interface Command

While serial line interfaces do not have their own console process for monitoring purposes, routers can display complete statistics for all installed network interfaces when you use the **interface** command from the GWCON environment. For more information on the **interface** command and displaying statistics, see Chapter 10. The Operating/Monitoring Process (GWCON - Talk 5) and Commands.

Chapter 33. Using the X.25 Network Interface

The X.25 network interface connects a router to an X.25 virtual circuit switched network. The X.25 network interface software and hardware allows the router to communicate over a public X.25 network. The X.25 network interface complies with CCITT 1980, CCITT 1984, CCITT 1988 and ISO 8208 1990 specifications for X.25 interfaces offering multiplexed channels and reliable end-to-end data transfer across a wide area network.

This chapter includes the following sections:

- “Basic Configuration Procedures”
- “Null Encapsulation” on page 404
- “Understanding Closed User Groups” on page 405

For information on configuring X.25 Transport Protocol (XTP) for transporting X.25 traffic over TCP/IP, see “Chapter 35. Using XTP” on page 443.

Basic Configuration Procedures

This section outlines the minimal configuration steps required to get the X.25 interface up and running. The X.25 parameters must be consistent with the X.25 network the interface on the router will connect to. For more information, refer to the configuration commands described in this chapter.

Note: You must restart the router for the configuration changes to take effect.

1. At the OPCON prompt (*), type **talk 6**.
The Config> prompt appears.
2. Type **list devices** to display a list of the interfaces from which you can select. Use the appropriate interface number in the following step.
3. Type **set data-link x25**.
The Interface Number [0]? prompt appears.
4. Type the appropriate interface number.
5. Connect to the network by typing **net #** at the Config> prompt.
The X.25 Config [#]> prompt appears.
6. At this prompt, type **set address x.25-node-address**.
The X.25 address is a unique X.121 address that is used during call establishment. For DDN networks, use the **add htf-addr** and the **set htf-addr** commands to convert the protocol address associated with this interface to the X.121 address format required for DDN address translation. Failure to set the network address prevents the X.25 interface from joining the attached network.
7. Type **set equipment-type** and specify whether the frame and packet levels act as DCE or DTE. The default for this command is DTE.
8. Type **set svc** and define the lowest and highest SVCs that you are using. The default is for 1 SVC.
9. Type **add protocol protocol_name** to add the protocols that will be running over the X.25 interface. You will be prompted for window size, default packet size, maximum packet size, circuit idle time, and max VCs.

Using the X.25 Network Interface

Note: You need to add the protocols only once for all X.25 networks on the router.

10. Type **add address** *protocol_name* to add an address translation for each protocol's destination address reachable over this interface.
11. Type **exit** to return to the Config> prompt.
12. Press **Ctrl-P** to return to the OPCON prompt (*).
13. Type **restart** and respond **yes** to the prompt.

Setting the National Personality

Each public data network, such as GTE's Telenet or DDN's Defense Data Network, has its own standard configuration. The term *National Personality* specifies a group of variables used to define a public data network's characteristics. The configuration information in the National Personality provides the router with control information for packets being transferred over the link. The National Personality option defines 27 default parameters for each public data network.

To view the configuration values that are in your X.25 National Personality, execute the X.25 configuration **list detailed** command. Configure each public data network connected to the router by executing the X.25 configuration **national-personality set** command.

The National Personality is a generalized template for network configuration. If necessary, you can individually configure each frame and packet layer parameter.

Understanding the X.25 Defaults

The following tables list the defaults for the various parameters for the X.25 *set*, *national set* and *national enable* commands.

Table 53. Set Command

Parameter	Default
<u>a</u> ddress ...	none
<u>c</u> able	none
<u>c</u> alls-out ...	4
<u>c</u> locking ...	external
<u>d</u> efault-window-size ...	2
<u>e</u> ncoding	NRZ
<u>e</u> quipment-type ...	DTE
<u>h</u> tf addr ...	none
<u>i</u> nter-frame-delay ...	0
<u>m</u> tu	1500
<u>n</u> ational-personality ...	GTE Telenet
<u>p</u> vc ...	low=0 high=0
<u>s</u> peed	9600
<u>s</u> vc	low inbound=0, high inbound=0 low 2-way=1, high 2-way=64 low outbound=0, high outbound=0
<u>t</u> hroughput-class ...	inbound=outbound=2400

Table 53. Set Command (continued)

Parameter	Default
vc-idle ...	30

Table 54. National Enable Parameters

Parameter	DDN Default	GTE Default
accept-reverse-charges	off	on
bi-cug	off	off
bi-cug-with-outgoing-access	off	off
cug	off	off
cug-deletion	off	off
cug-insertion	off	off
cug-with-incoming-access	off	off
cug-with-outgoing-access	off	off
cug-zero-override	off	off
flow-control-negotiation	on	on
frame-ext-seq-mode	off	off
packet-ext-seq-mode	off	off
request-reverse-charges	off	on
suppress-calling-addresses	off	off
throughput-class-negotiation	on	on
truncate-called-addresses	off	off

Table 55. National Set Parameters

Parameter	DDN Default	GTE Default
call-req	20 decaseconds	20 decaseconds
clear-req ...	retries=1	retries=1
	18 decaseconds	18 decaseconds
disconnect-procedure ...	passive	passive
dp-timer	500 milliseconds	500 milliseconds
frame-window-size	7	7
n2-timeouts	20	20
packet-size ...	128, max=256	128, max=256
reset ...	retries=1	retries=1
	18 decaseconds	18 decaseconds
restart ...	retries=1	retries=1
	18 decaseconds	18 decaseconds
min-recall	10 seconds	10 seconds
min-connect	90 seconds	90 seconds
collision-timer	10 seconds	10 seconds
standard-version	1984	1984
t1-timer	4 seconds	4 seconds
t2-timer	0	0

Using the X.25 Network Interface

Table 55. National Set Parameters (continued)

Parameter	DDN Default	GTE Default
truncate-called-addr-size	2	2

Null Encapsulation

Null Encapsulation allows the user to multiplex multiple network layer protocols over one X.25 circuit. This function may be used to avoid using an unreasonable number of virtual circuits.

Limitations

Null Encapsulation is not supported for QLLC. This function is supported for Switched Virtual Circuits (SVCs), but not for Permanent Virtual Circuits (PVCs).

Configuration Changes

The encapsulation option NULL has been added for the following T6 commands:

Under X25 config: add address IP (may input enc type = NULL)

Under X25 config: add address IPX (may input enc type = NULL)

Under X25 config: add address DNA (may input enc type = NULL)

Under X25 config: add address VINES (may input enc type = NULL)

Under X25 config: list addr will show active enc type = NULL if the priority 1 type is NULL.

T5 commands:

Under X25 iint: List SVCS will include enc type = NULL

Configuring Null Encapsulation and Closed User Groups (CUG)

Since More than one Protocol can run over one virtual circuit while using Null Encapsulation, the CUG(s) defined for each protocol over that circuit must be the same. It is strongly suggested that the user configure multiple Protocols same destination as follows:

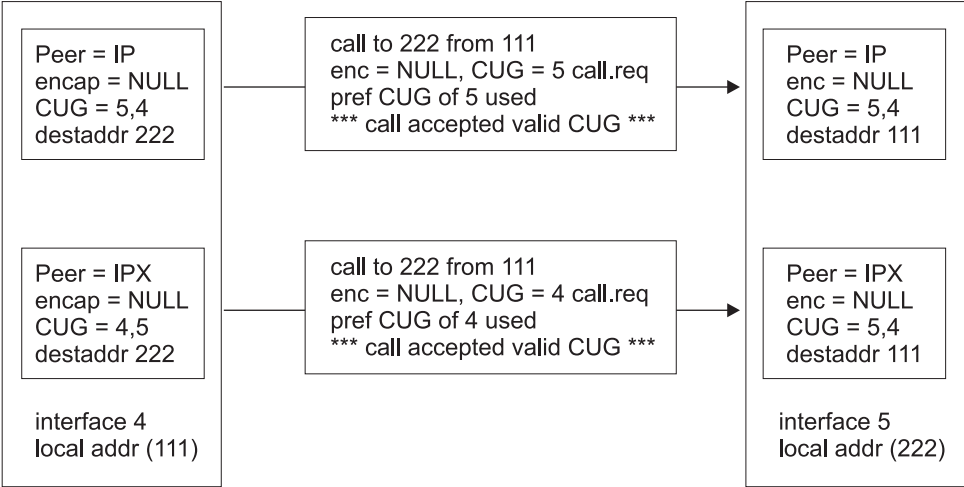
Configure CUG using the add address. The CUG(s) defined must be the same for each protocol defined at the same address.

If the CUG is defined at the add protocol level, The CUG(s) must be the same for all peers. (This method is more restrictive).

Configure CUG at the interface level. This insures all peers have the same CUG values. (This method is the most restrictive)

Any of the above methods may be used as long as any incoming call CUG definition must be valid for all protocols sharing that circuit. Valid means that the CUG was defined for the specific address or was defaulted to use either the protocol or interface circuit definition.

CASE 1: Incoming Closed User Groups (CUG) valid for both peers.



CASE 2: Incoming Closed User Groups (CUG) not valid for both peers.

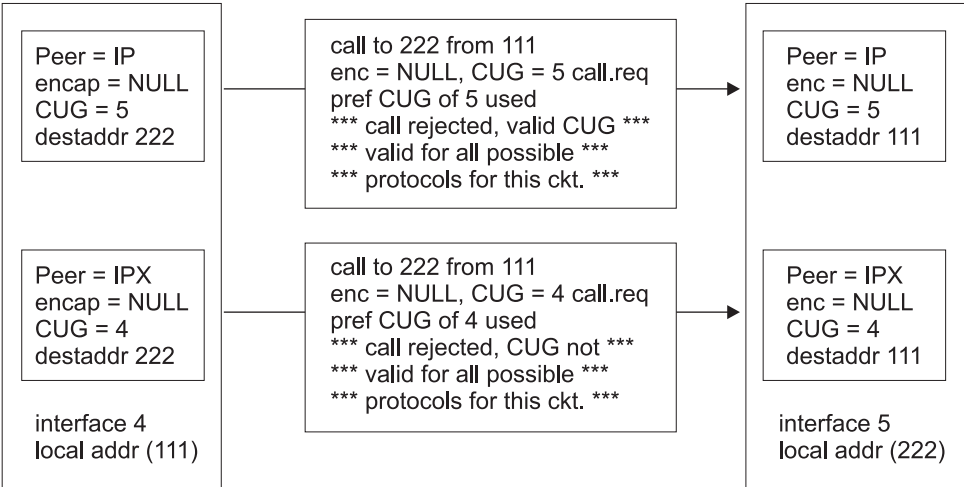


Figure 36. Closed User Group Null Encapsulation

Understanding Closed User Groups

A *closed user group (CUG)* is a group of X.25 DTEs allowed to establish connections with other specific DTEs. CUG numbers are defined by your network provider and you can only use the CUGs the provider assigns you. You can configure an address-specific CUG, a protocol-specific CUG, or an interface-specific CUG. If all of three types of CUG numbers are configured for a DTE, the closed user group facility uses the address-specific destination CUG in a call request when contacting another DTE. If only a protocol-specific and an interface-specific CUG are configured for a DTE, the closed user group facility uses the protocol-specific CUG in a call request when contacting another DTE.

Using the X.25 Network Interface

A single DTE can belong to multiple CUGs. You must specify a preferred CUG for that DTE. The preferred CUG is used when the router initiates calls to other DTEs. A single DTE cannot have more than a total of 5 preferred or normal closed user groups.

Bilateral Closed User Groups

A *bilateral closed user group (BCUG)* is a closed user group consisting of only two DTEs. The DTEs within the BCUG can originate calls to members of the BCUG and any DTEs that are not members of any CUG or BCUG. A single DTE cannot have more than a total of 5 preferred or normal bilateral CUGs.

A DTE uses a BCUG to establish circuits in the same way the DTE uses CUGs to establish circuits (see Table 56), however, if both a BCUG and a CUG is defined for an interface, protocol, or address, the BCUG is used to establish the circuit.

Types of Extended Closed User Groups

The following extensions to closed user groups are supported:

CUG with Outgoing Access

The DTE can belong to one or more CUGs. The DTE can originate calls to members of the CUG and to any DTE belonging to other CUGs with Incoming Access.

CUG with Incoming Access

The DTE can belong to one or more CUGs. The DTE can receive calls from DTEs not belonging to any CUG or from DTEs belonging to other CUGs with Outgoing Access.

BCUG with Outgoing Access

The DTE can belong to one or more BCUGs. The DTE can originate calls to members of the BCUG and to any DTE not belonging to any BCUG.

Establishing X.25 Circuits with Closed User Groups on a Device

When you have enabled the closed user group facility, and a DTE receives a call request, it uses the CUG in the call request to determine whether to accept or reject the call from the DTE. If the CUG in the call request does not match a configured CUG on the interface, protocol, or on the destination associated with the calling DTE, the request is rejected. Table 56 summarizes how X.25 circuits are established based on CUGs, if the interface, protocol, and address CUG numbers are different and incoming access is not enabled.

Table 56. Establishing Incoming X.25 Circuits for Closed User Groups

Incoming Call Request Contains	Receiving DTE CUG Definition							
	Interface CUG Only	Protocol CUG Only	Address Specific CUG	Interface and Protocol CUG	Interface and Address CUG	Protocol and Address CUG	All CUGs	No CUGs
No CUG	Reject	Reject	Reject	Reject	Reject	Reject	Reject	Accept
Interface CUG	Accept	Reject	Reject	Reject	Reject	Reject	Reject	Reject

Table 56. Establishing Incoming X.25 Circuits for Closed User Groups (continued)

Protocol CUG	Reject	Accept	Reject	Accept	Reject	Reject	Reject	Reject
Address Specific CUG	Reject	Reject	Accept	Reject	Accept	Accept	Accept	Reject

For outgoing calls on an interface, if you have enabled either the CUG or the BCUG facility, each call request will contain the configured preferred CUG (if any) for the destination or, if no address-specific CUG is configured, the CUG used is the CUG defined for the protocol, or if no protocol-specific CUG is configured, the CUG used is the CUG defined for the interface. If no CUG number has been configured, the CUG facility is not included in any outgoing call request.

Overriding Closed User Group Processing for CUG 0

You can configure the DTE such that it does not validate incoming calls with a CUG of 0 in the call request. This ability allows you to permit specific calls to complete even when you have not enabled incoming access. Using the **national enable cug 0 override** command forces the device to ignore the CUG facility if the CUG number is 0. The call request will not be compared with any configured CUG number.

Configuring X.25 Closed User Groups

To use closed user groups on X.25 interfaces:

1. Request CUG numbers from your network provider. You will need these numbers when configuring X.25.
2. Enable the closed user group facility using the **national enable cug** command and related commands.
3. Enable the bilateral closed user group facility, if desired, using the **national enable bi-cug** command and related commands.
4. Configure the appropriate CUG numbers for the DTEs. Specify the preferred CUG, CUG, preferred bilateral CUG, and bilateral CUG, as needed. This is done through the **add address** command.
5. Configure the appropriate CUG and bilateral CUG for the protocol, if required. This is done through the **add protocol** command.

Note: You should only configure these CUGs if you are restricting all X.25 circuits established over the X.25 interface for this protocol to DTEs belonging to this set of unique CUGs or BCUGs unless you override it with an address-specific CUG.

6. Configure the appropriate CUG and bilateral CUG for the interface, if required. This is done through the **add cug** command.

Note: You should only configure these CUGs if you are restricting all X.25 circuits established over the X.25 interface to DTEs belonging to this set of unique CUGs or BCUGs unless you override it with an address or protocol-specific CUG.

Using the X.25 Network Interface

Chapter 34. Configuring and Monitoring the X.25 Network Interface

This chapter describes the X.25 configuration and operational commands and includes the following sections:

- “X.25 Configuration Commands”
- “Accessing the Interface Monitoring Process” on page 435
- “X.25 Monitoring Commands” on page 436
- “X.25 Network Interfaces and the GWCON Interface Command” on page 439

X.25 Configuration Commands

This section summarizes and explains all the X.25 configuration commands.

The X.25 configuration commands allow you to specify network parameters for router interfaces that transmit X.25 packets. The information you specify with the configuration commands activates when you restart the router.

Enter the X.25 configuration commands at the X.25 config> prompt. Table 57 shows the commands.

Table 57. X.25 Configuration Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Set	Sets the local and DDN X.25 node addresses, window size for packet levels, identifies the National personality, the MTU, and the maximum number of calls. Defines the PVC and SVC channel ranges, the number of seconds that a switched circuit can be idle before it is cleared, and specifies whether one router needs to act as a DCE (when two routers are directly connected without an intervening X.25 network) or the more normal method of acting at a DTE connected to an X.25 network. Sets speed, encoding, clocking, throughput class, and cable type.
Enable/Disable	Enables/Disables incoming-calls-barred feature, outgoing-calls-barred feature, dynamic DDN address translations, and lower-dtr feature.
National Enable or National Disable	Enables/Disables the parameters defined by the National Personality configuration.
National Set	Sets parameters defined by the National Personality configuration.
National Restore	Restores the National Personality configuration to its default values.
Add/Change/Delete	Adds/Changes/Deletes an address translation, a protocol encapsulation, or a PVC definition.
List	Lists the defined address translations, National Personality parameters, protocol encapsulation, or PVC definitions.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Configuring the X.25 Network Interface

Set

Use the **set** command to configure local X.25 node addresses, maximum number of calls, frame and packet level window size, lowest to highest PVC and SVC channels, and the idle time for a switched circuit.

Syntax:

```
set          address . . .
              cable
              calls-out . . .
              clocking . . .
              default-window-size . . .
              encoding
              equipment-type . . .
              htf addr . . .
              inter-frame-delay . . .
              mtu
              national-personality . . .
              pvc . . .
              speed . . .
              svc
              throughput-class . . .
              vc-idle . . .
```

address *x.25-node-addr*

Sets the local X.25 interface address (*x.25-node-addr*). Set the X.25 node address to 0, not to 00, to delete the local X.25 address.

Example: set address 8982800

cable *type*

Sets the cable type as follows:

- RS-232 DTE
- RS-232 DCE
- V35 DTE
- V35 DCE
- V36 DTE
- V36 DCE
- X21 DTE
- X21 DCE

A DTE cable is used when you are attaching the router to some type of DCE device (for example, a modem or a DSU/CSU).

A DCE cable is used when the router is acting as the DCE and providing the clocking for direct attachment.

Configuring the X.25 Network Interface

Notes:

1. If you are configuring an interface on the 8-port EIA 232 adapter then the only cable types you can configure are RS-232 DTE and RS-232 DCE.
2. If you are configuring an interface on the 6-port V.35/V.36 adapter then the only cables types you can configure are V.35 DTE, V.35 DCE, V.36 DTE, V.36 DCE.
3. If you are configuring an interface on the 8-port X.21 adapter then the only cable types you can configure are X.21 DTE and X.21 DCE.

calls-out *value*

Sets the maximum number of locally initiated, simultaneously active SVCs.

Valid Values: 1 to 239

Default Value: 4

clocking *external or internal*

To connect to a modem or DSU, configure clocking as external. To connect directly to another DTE device, use a DCE cable, set the clocking to internal, and configure the line speed. For internal clocking, the line speed depends on the interface, as shown in Table 58 on page 413.

Default: external

default-window-size *value*

Sets the window size for the packet level assigned by the router if there is no window-size facility in the Call-Request packet. The range is determined by the National Personality packet modulus (PACKET-EXT-SEQ-MODE).

Default: 2

Example: `set default-window-size 3`

encoding *NRZ or NRZI*

Sets the HDLC transmission encoding scheme for the interface. Encoding may be set for NRZ (non-return to zero) or NRZI (non-return to zero inverted). NRZ is the more widely used encoding scheme while NRZI is used in some IBM configurations.

Default: NRZ

equipment-type *DCE or DTE*

Specifies whether the frame and packet levels act as DCE or DTE. This command has no relation to the cable type in use.

Default: DTE (must be DTE for X.31)

htf addr *x.25-node-addr*

Sets the local DTE address when DDN is used. It converts the IP address to an X.121 address as opposed to the **set address** command, which is used to set the local DTE address when CCITT is used.

inter-frame-delay *value*

This parameter defines the minimum delay between transmitted frames. Setting this parameter is useful when interfacing directly to older equipment. This parameter is the amount of time between frames in seconds.

Note: If you configure a non-zero inter-frame delay for a X.25 interface on the 8-port EIA-232E adapter, 6-port V.35/V.36 adapter, or 8-port X.21 adapter, you configure the speed using the **set speed** command.

Configuring the X.25 Network Interface

Default: 0

mtu *value*

Sets the Maximum Transmit Unit (MTU) in bytes. This is the maximum message size that will be delivered to the X.25 interface to package and transmit over the serial line. The range is 576 to 16384.

Default: 1500

If you are encountering packet reassembly timeouts when transferring data over the X.25 interface, you should determine what the minimum packet size is for all LAN or serial interfaces that lead to the end-point, then calculate a more suitable X.25 MTU. You should not directly consider the actual X.25 packet size in this calculation because X.25 tends to use a smaller packet size. X.25 usually sends up to 7 packets at one time before waiting for an acknowledgment.

For example, consider a network topology that includes:

- A Token-Ring LAN having a packet size of 4000
- An X.25 serial line having a packet size of 128 with a window size of 7 and a bit rate of 9600 bps
- An Ethernet LAN with a packet size of 1500

In this case, you should probably set the X.25 MTU to 1500. That means that about 12 packets will be sent over the X.25 interface. (MTU / X.25 packet size = number of X.25 packets to be sent).

When using an MTU of 4096, 32 packets must be sent over the X.25 interface. (4000 / 128 = 31.25). In this case, packet reassembly timeouts will probably occur if the X.25 modem speed is 9600 bps. Using an X.25 modem speed of 56 Kbps would probably solve this problem.

Notes:

1. The MTU parameter has significant impact on the memory requirements and memory utilization of the device. Use an MTU value of 8192 or less for devices with less than 8M of memory.
2. The amount of memory available while the device is running limits the number of SVCs that can be established and still maintain optimal performance. For recommendations on the maximum number of SVCs see the product home page on the World Wide Web.

national-personality *GTE-Telenet or DDN*

Sets the 28 default parameters for either GTE-Telenet or DDN National Personality.

Default: GTE-Telenet

pvc low/high *value*

Defines the lowest to the highest Permanent Virtual Circuit channel number. Zero indicates no PVCs. By default there are no PVCs.

pvc low

0

pvc high

0

The range is 1 to 4095. These values are setting boundaries of a given VC range. There is a maximum of 2500 PVCs.

Example: `set pvc low 40`

Configuring the X.25 Network Interface

Note: Values must not overlap values set for SVCs.

speed *speed-setting*

For internal clocking, this command specifies the speed of the transmit and receive clock lines.

Valid values: Use Table 58 to determine the clock speeds you can set for the various adapters.

Table 58. Line Speeds When Internal Clocking is Used for 2216 Interfaces

Adapter Type	Speed Range
8-port EIA 232	9600 to 64 000 bps
6-port V.35/V.36	9600 to 460 800 bps, 1 544 000 bps, or 2 048 000 bps
8-port X.21	9600 to 460 800 bps, 1 544 000 bps, or 2 048 000 bps

For external clocking, this command does not affect the hardware but it sets the speed for some protocols, such as IPX, used to determine routing cost parameters. In these cases, set the speed to match the actual line speed. The maximum line speed that can be configured if using external clocking is shown in Table 59.

Table 59. Line Speeds When External Clocking is Used for 2216 Interfaces

Adapter Type	Speed Range
8-port EIA 232	2400 to 64 000 bps
6-port V.35/V.36	2400 to 2 048 000 bps
8-port X.21	2400 to 2 048 000 bps

Default: 9600

Note: The X.25 software is supported only at speeds up to 256 000 bps.

svc low/high *inbound or two-way or outbound value*

Defines the lowest to the highest switched virtual circuit channel number. When low=high=0, no VCs in this category are defined.

Example: set SVC low-two-way 1

Inbound

Specifies the range of logical channel numbers to be assigned to inbound SVCs. By default, there are no inbound-only SVCs.

Valid values: 0 to 4095

Default values: 0

Two-way

Specifies the range of logical channel numbers to be assigned to two-way SVCs. By default, there are sixty-four 2-way SVCs.

Valid values: 0 to 4095

Default values:

svc low

1

svc high

64

Outbound

Specifies the range of logical channel numbers to be assigned to outbound SVCs. By default, there are no outbound-only SVCs.

Configuring the X.25 Network Interface

Valid values: 0-4095

Default: 0

Note: Values in each range must not overlap other SVC ranges nor the PVC range. Table 60 shows a possible VC configuration.

Table 60. Example VC Definitions

	Low	High
PVC	1	40
inbound	0	0
two-way	41	59
outbound	60	500

throughput-class inbound or outbound *bit-rate*

Defines the throughput class requested when making a call request while throughput negotiation is enabled.

Default: 2400 bps

This setting is ignored when processing incoming call requests.

vc-idle *value*

Defines the number of seconds that a switched circuit can be idle before it is cleared by the router. Zero indicates that the router never clears an idle circuit.

Valid values: 1 to 255

Default: 30 seconds

Enable

Use the **enable** command to enable DDN address translations, interface resets, or the incoming-calls-barred, outgoing-calls-barred, and lower-dtr features.

Syntax:

enable

ddn—address-translations

Note: Enabling `ddn-address-translations` is no longer allowed. This feature defaults to enabled when the national personality selected is DDN, and defaults to disabled in all other cases.

incoming-calls-barred

lower-dtr

outgoing-calls-barred

incoming-calls-barred

Specifies that the router will not accept incoming calls. The default setting for this parameter is disabled or *off*, which allows incoming calls.

lower-dtr

This parameter determines the way the data terminal ready (DTR) signal is

Configuring the X.25 Network Interface

handled for leased serial-line interfaces that are disabled. If this parameter is set to "disabled" (the default), the DTR signal will be raised when the interface is disabled.

If *lower-dtr* is set to "enabled," the DTR will be lowered when the interface is disabled. This behavior may be desirable in situations where the interface has been configured as an alternate link for WAN Reroute and the interface is connected to a dial-out modem which maintains its dial connection based on the state of the DTR signal.

When *lower-dtr* is enabled and the interface is disabled, the DTR signal is low and the modem keeps the dial connection down. When the interface is enabled, due to a WAN Reroute backup scenario, DTR is raised and the modem dials a stored number to the backup site. When the primary interface is restored, the alternate interface is disabled, DTR is lowered, and the modem hangs up the dial connection.

The following cable types are supported:

RS-232

V.35

V.36

The default setting is disabled.

outgoing-calls-barred

Specifies that the router will not allow outgoing calls. The default setting for this parameter is disabled or *off*, which allows outgoing calls.

Disable

Use the **disable** command to disable DDN address translations, interface resets as part of network certification, or the incoming-calls-barred or outgoing-calls-barred features.

Note: If you set DDN as the national personality, DDN address translation is enabled automatically and this parameter has no effect.

Syntax:

disable ddn-address-translations

Note: Disabling *ddn-address-translations* is no longer allowed. This feature defaults to enabled when the national personality selected is DDN, and defaults to disabled in all other cases.

incoming-calls-barred

lower-dtr

outgoing-calls-barred

National Enable

Use the **national enable** command to enable a feature defined in the National Personality configuration.

Syntax:

Configuring the X.25 Network Interface

national enable

accept-reverse-charges

bi-cug

bi-cug-outgoing-access

cug

cug-deletion

cug-incoming-access

cug-insertion

cug-outgoing-access

cug-zero-override

flow-control-negotiation

frame-ext-seq-mode (required for X.31)

packet-ext-seq-mode

requst-reverse-charges

suppress-calling-addresses

throughput-class-negotiation

truncate-called-addresses

accept-reverse-charges

Accepts reverse charge calls during call establishment. This option is not available for DDN.

DDN Default

off

GTE Default

on

bi-cug Enables the bilateral closed user group facility on this device. By default, this facility is disabled.

Note: You cannot add any bilateral CUGs unless this parameter is enabled.

bi-cug-outgoing-access

Enables the bilateral CUG with outgoing access facility on this device. By default, this facility is disabled.

cug Enables the closed user group facility on this device. By default, this facility is disabled.

Note: You cannot add any CUGs unless this parameter is enabled.

cug-deletion

Deletes a CUG facility from a call packet received from XTP before transmitting it over X.25. By default, this function is disabled.

cug-incoming-access

Enables the CUG with incoming access facility on this device. By default, this facility is disabled.

cug-insertion

Inserts the appropriate (address-specific, protocol-specific, or interface-specific) preferred cug number into a call request received by XTP

Configuring the X.25 Network Interface

from the X.25 interface before transmitting the request over IP. If there is already a CUG facility in the call packet, it will not be replaced. By default, this function is disabled.

cug-outgoing-access

Enables the CUG with outgoing access facility on this device. By default, this facility is disabled.

cug-zero-override

Causes the closed user group facility to ignore any CUG facility in call request packets with a CUG number of 0. By default, this function is disabled.

flow-control-negotiation

Enables the negotiation of packet and window size during call setup of SVCs.

DDN Default

on

GTE Default

on

frame-ext-seq-mode

Sets the frame layer sequence numbering to modulo 128 (i.e., 0 through 127).

DDN Default

off (must be on for X.31)

GTE Default

off

packet-ext-seq-mode

Enables the packet layer to use extended sequence numbers (0 through 127).

DDN Default

off

GTE Default

off

request-reverse-charges

Requests reverse charges for all outgoing calls.

DDN Default

off

GTE Default

on

suppress-calling-address

Suppresses the source address in call packets.

DDN Default

off

GTE Default

off

throughput-class-negotiation

Enables the registration of throughput class.

Configuring the X.25 Network Interface

DDN Default
off

GTE Default
on

truncate-called-addresses

Enables truncation of the called DTE address when transmitting a call to a DTE. This option applies only to XTP circuits.

DDN Default
off

GTE Default
off

National Disable

Use the **national disable** command to disable a feature defined by the National Personality configuration.

Syntax:

national disable acept-reverse-charges
bi-cug
bi-cug-outgoing-access
cug
cug-deletion
cug-incoming-access
cug-insertion
cug-outgoing-access
cug-zero-override
flow-control-negotiation
frame-ext-seq-mode
packet-ext-seq-mode
requst-reverse-charges
suppress-calling-addresses
throughput-class-negotiation
tuncate-called-addresses

National Set

Use the **national set** command to set one or all of the default values made to the National Personality configuration.

Syntax:

national set call-req
clear-req . . .
disconnect-procedure . . .

Configuring the X.25 Network Interface

dp-timer
frame-window-size
n2-timeouts
packet-size . . .
reset . . .
restart . . .
min-recall
min-connect
collision-timer
standard-version
t1-timer
t2-timer
truncate-called-addr-size

call-req

Specifies the number of 10-second intervals permitted before giving up on a call request and clearing it. A zero indicates an infinite wait. In a list command output, this is displayed as the t21 timer.

DDN Default

20 decaseconds

GTE Default

20 decaseconds

clear-req *retries or timer*

Specifies the number of clear request retransmissions.

Retries

Number of clear request transmissions permitted before action is taken. In a list command output, this is displayed as the r23 retry count.

DDN Default

retries=1

GTE Default

retries=1

Timer Number of 10-second intervals to wait before retransmitting a clear request packet. A zero in the timer value indicates an indefinite wait. In a list command output, this is displayed as the t23 timer.

DDN Default

18 decaseconds

GTE Default

18 decaseconds

disconnect-procedure *passive or active*

Specifies the type of connect procedure to use when connecting.

DDN Default

passive

Configuring the X.25 Network Interface

GTE Default
passive

Passive
Specifies that SABM frames are not initiated by the router when connecting.

Active Specifies that SABM frames are initiated by the router when connecting.

dp-timer

Specifies the number of milliseconds that the frame level remains in a disconnected state. Zero indicates immediate transition from disconnected phase to link setup state.

DDN Default
500 milliseconds

GTE Default
500 milliseconds

frame-window-size

Specifies the number of frames that can be outstanding before acknowledgment.

DDN Default
7

GTE Default
7

n2-timeouts

Specifies the number of times the retransmit timer (T1) can expire before the interface is recycled.

DDN Default
20

GTE Default
20

packet-size *default or maximum or window*

Specifies the size of the packet.

default

Number of bytes in the data portion of the packet. Possible options include 128, 256, 512, 1024, 2048, and 4096. This value is used in the absence of packet size negotiation. *Default* cannot be greater than *maximum*.

DDN Default
128

GTE Default
128

maximum

Maximum number of bytes in the data portion of the packet. Possible options include 128, 256, 512, 1024, 2048, and 4096.

DDN Default
256

Configuring the X.25 Network Interface

GTE Default

256

window

Number of outstanding I-frames permitted before acknowledgment is required. The range is determined by the National Personality Packet Modulus.

Related configuration parameters are

- Protocol max default window
- Set default window size

reset *retries or timer*

Specifies the number of reset request retransmissions.

Example: `national set reset retries 2`

retries

Number of reset request transmissions permitted before the call is cleared. The range is 0 to 255. In a list command output, this is displayed as the r22 retry count.

DDN Default

1

GTE Default

1

timer Number of 10-second intervals to wait before retransmitting a reset request packet. The range is 0 to 255. A zero in the timer value indicates an indefinite wait. In a list command output, this is displayed as the t22 timer.

DDN Default

18 decaseconds

GTE Default

18 decaseconds

restart *retries or timer*

Specifies the number of restart request transmissions.

retries

Number of restart request transmissions permitted before the interface is recycled. The range is 0 to 255. In a list command output, this is displayed as the r20 retry count.

DDN Default

1

GTE Default

1

timer Number of 10-second intervals to wait before retransmitting a restart request packet. The range is 0 to 255. A zero in the timer value indicates an indefinite wait. In a list command output, this is displayed as the t20 timer.

DDN Default

18 decaseconds

GTE Default

18 decaseconds

Configuring the X.25 Network Interface

min-recall

Specifies the minimum number of seconds to wait prior to reinitiating a call to open an SVC. The range is 0 to 255 seconds.

DDN Default

10 seconds

GTE Default

10 seconds

min-connect

Specifies in seconds, the minimum amount a time an SVC will remain established once the connection is made barring any error conditions. The range is 0 to 255 seconds.

DDN Default

90 seconds

GTE Default

90 seconds

collision-timer

Specifies in seconds, the time delay used prior to reinitiating a call to open an SVC if the original attempt resulted in a call collision. The range is 0 to 255 seconds.

DDN Default

10 seconds

GTE Default

10 seconds

standard-version

Options are none, v1980, v1984, and v1988.

DDN Default

1984

GTE Default

1984

t1-timer

Specifies the frame retransmit time in seconds. The range is 1 to 255.

DDN Default

4 seconds

GTE Default

4 seconds

t2-timer

Specifies the amount of time in seconds to delay before acknowledging an I-frame. This is an optimization parameter. Setting the timer to 0 disables it. The range is 0 to 255.

DDN Default

0

GTE Default

0

truncate-called-addr-size

Specifies the number of characters truncated from the end of a called address. This parameter pertains only to XTP circuits. The range is 0 to 10.

DDN Default

2

GTE Default

2

National Restore

Use the **national restore** command to restore one or all of the default values made to the National Personality configuration via the **national set**, **national enable**, or **national disable** command.

Syntax:

```
national restore          all
                           accept-reverse-charges
                           bi-cug
                           bi-cug-outgoing-access
                           call-req
                           clear-req . . .
                           cug
                           cug-deletion
                           cug-incoming-access
                           cug-insertion
                           cug-outgoing-access
                           cug-zero-override
                           disconnect-procedure . . .
                           dp-timer
                           flow-control-negotiation
                           frame-ext-seq-mode
                           frame-window-size
                           min-collision-timer
                           min-connect-timer
                           min-recall-timer
                           network-type . . .
                           n2-timeouts
                           packet-size . . .
                           packet-ext-seq-mode
                           request-reverse-charges
                           reset . . .
                           restart . . .
                           standard-version
                           suppress-calling-addresses
```

Configuring the X.25 Network Interface

throughput-class-negotiation

t1-timer

t2-timer

truncate-called-addresses

truncate-called-addr-size

Add

Use the **add** command to add an X.121 address, a DDN X.25 Address, a protocol configuration, or a PVC definition.

Syntax:

```
add address  
bi-cugs  
cugs  
htf-address  
protocol  
pvc
```

address

Adds an X.121 address translation for a protocol supported in the configuration of the router. The prompts that appear depend on the protocol address that you are adding. (See the following examples.) The protocol address and X.121 address being entered represent the protocol and X.121 DTE address of the remote DTE connecting to the router X.25 interface. The mapping of a protocol address and the X.121 address must be unique unless the protocol is APPN or DLSw. A protocol address cannot map to more than one X.121 address. Also, a specific X.121 address cannot map to more than one protocol address. The **set address** command is used to set the local X.25 address. After setting the local X.25 address, you can use an X.25 remote address to dial out and an optional incoming remote address for call ID. If only remote called address is entered, then this address will be used for outgoing calls and incoming call verification.

Example: add address

IP example:

```
Protocol [IP]? IP  
IP Address [0.0.0.0]? 128.185.1.2  
Enc Priority 1 [ ]? CC  
Enc Priority 2 [ ]? SNAP  
Enc Priority 3 [ ]? Null  
X.25 Address [ ]? 1234590  
Remote address [ ]?  
Pref CUG [ ]? 11  
CUG (2) [ ]? 12  
CUG (3) [ ]? 13  
CUG (4) [ ]? 14  
CUG (5) [ ]? 15  
Pref BI-CUG [ ]? 21  
BI-CUG (2) [ ]? 22  
BI-CUG (3) [ ]?
```

IPX example:

Configuring the X.25 Network Interface

```
Protocol [IP]? IPX
CUD Field Usage (Standard or Proprietary)
IPX Host Number (in hex) []?
Enc Priority 1 []? SNAP
Enc Priority 2 []? Null
X.25 Address []?
Pref CUG [] ?
Pref Bi-CUG[]? 1
BI-CUG (2) []? 3
BI-CUG (3) []
```

Protocol

Specifies the protocol type of the address mapping you are adding. The valid values are APPN, DECnet, DLSw, IP, IPX and VINES. The default is IP.

Enc Priority

Determines the encapsulation type, as defined in RFC 1356, that will be put in the CUD. For IP, valid choices are CC, SNAP, or Null. For IPX, valid choice is SNAP or Null.

IP Address

Specifies the destination's IP address.

CUD Field Usage

This field is for IPX to X.25 address mapping only. It determines how the Call User Data (CUD) field is filled in when call request packets are received for IPX. The CUD field can be either Standard or Proprietary. Standard indicates that the usage is protocol multiplexing used in RFC 1356. Proprietary indicates a proprietary CUD field that can only be used with 2216 or compatible routers. The default is Standard.

IPX Host Number

Specifies the IPX host number of the destination.

X.25 Address

Specifies the X.121 DTE address of the remote DTE connecting to the router X.25 interface. The maximum address length is 15 digits.

pref cug

Specifies the preferred closed user group number for this DTE. The DTE uses this CUG when placing outgoing calls.

Valid values: 0 to 9999

Default value: None

Note: You will not be prompted for this value if you have not enabled the closed user group facility using the **national enable** command.

CUG Specifies the closed user group numbers for this DTE. Up to five CUGs may be defined, including the pref CUG.

Valid values: 0 to 9999

Default value: None

Note: You will not be prompted for this value if you have not enabled the closed user group facility using the **national enable** command.

Configuring the X.25 Network Interface

pref bi-cug

Specifies the bilateral closed user group number for this DTE. The DTE uses this CUG when placing outgoing calls.

Valid values: 0 to 9999

Default value: None

Note: You will not be prompted for this value if you have not enabled the bilateral closed user group facility using the **national enable** command.

bi-cug Specifies the bilateral closed user group numbers for this DTE. Up to five CUGs may be defined.

Valid values: 0 to 9999

Default value: None

Note: You will not be prompted for this value if you have not enabled the bilateral closed user group facility using the **national enable** command.

cugs Specifies the closed user group number for this X.25 interface.

Valid values: 0 to 9999

Default value: None

Note: You will not be prompted for this value if you have not enabled the closed user group facility using the **national enable** command.

Example:

```
add cugs
Pref CUG [ ]? 23
CUG (2) [ ]? 24
CUG (3) [ ]? 25
CUG (4) [ ]? 26
CUG (5) [ ]? 27
```

pref cug

Specifies the preferred closed user group number for this DTE. This DTE uses this CUG when placing outgoing calls.

Valid values: 0 to 9999

Default value: None

Note: You will not be prompted for this value if you have not enabled the closed user group facility using the **national enable** command.

cug Specifies the closed user group numbers for this DTE. Up to five CUGs may be defined.

Valid values: 0 to 9999

Default value: None

Note: You will not be prompted for this value if you have not enabled the closed user group facility using the **national enable** command.

Configuring the X.25 Network Interface

bi-cugs

Specifies the closed user group number for this DTE.

Valid values: 0 to 9999

Default value: None

Note: You will not be prompted for this value if you have not enabled the closed user group facility using the **national enable** command.

Example:

```
add bi-cugs
Pref BI-CUG []? 23
BI-CUG (2) []? 24
BI-CUG (3) []? 25
BI-CUG (4) []? 26
BI-CUG (5) []? 27
```

pref bi-cug

Specifies the preferred closed user group number for this DTE. This DTE uses this BI-CUG when placing outgoing calls.

Valid values: 0 to 9999

Default value: None

Note: You will not be prompted for this value if you have not enabled the bilateral closed user group facility using the **national enable** command.

bi-cug Specifies the closed user group numbers for this DTE. Up to five BI-CUGs may be defined.

Valid values: 0 to 9999

Default value: None

Note: You will not be prompted for this value if you have not enabled the bilateral closed user group facility using the **national enable** command.

htf-address

Adds a Defense Data Network (DDN) X.25 address translation.

Example:

```
add htf-address
Protocol [IP]
Convert HTF address
```

Protocol

Specifies the protocol that you are running over the X.25 interface. DDN supports IP only.

Convert HTF address

Converts the protocol address to a destination X.121 address in Host Table Format (HTF) format. Also see `ddn-address-translations` in the Enable/Disable commands section.

protocol

Enables a protocol encapsulation and defines the associated parameters.

Example:

Configuring the X.25 Network Interface

```
add protocol
Protocol [IP]?
Window Size [2]?
Default Packet Size [128]?
Maximum Packet Size [256]?
Circuit Idle Time [30]?
Max VCs [4]?
Pref CUG []? 1
CUG (2) []? 2
CUG (3) []? 3
CUG (4) []? 4
CUG (5) []? 5
Pref BI-CUG []? 11
BI-CUG (2) []? 12
BI-CUG (3) []? 13
BI-CUG (4) []? 14
BI-CUG (5) []? 15
```

QLLC example:

```
X.25 Config> add prot
Protocol [IP]? d1s
Idle timer [30]?
QLLC response timer (in decaseconds) [2]?
QLLC response count [3]?
Accept Reverse Charges [N]?
Request Reverse Charges [N]?
Station Type (1) PRI (2) SEC (3) (PEER) [3]?
Max Packet Size [128]?
Packet window size [7]?
Max Message Size [1500]?
Call User Data (in hex, 0 for null) []?
Pref CUG []? 20
CUG (2) []? 21
CUG (3) []?
Pref BI-CUG []?
```

Protocol

Specifies which protocol's encapsulation parameters you want to add: APPN, XTP, IP, DECnet, IPX, DLSw, or Banyan VINES. The default is IP.

Window Size

Specifies the maximum negotiable packet window size, the number of packets that can be outstanding before requiring packet confirmation. The default is 2. The window size can be negotiated down to 1 by the called DTE.

Related configuration parameters are:

- Set Default Window

Default Packet Size

Specifies the default requested packet size for SVCs. This value serves as the lowest negotiable packet size and must be equal to or less than the maximum packet size specified with the **national set packet-size** command. The maximum *default packet size* is 4096 bytes. The default value for this parameter is 128 bytes.

Related configuration parameters are:

- National Set Packet Size Default
- National Set Packet Size Maximum

Maximum Packet Size

Specifies the maximum negotiable packet size for SVCs. This value must be equal to or less than the maximum packet size specified with the **national set packet-size** command. The default value for this parameter is 256 bytes. The maximum value that can be

Configuring the X.25 Network Interface

configured for this parameter is 4096 bytes. This value is utilized in calculating the maximum frame size for this X.25 interface.

Related configuration parameters are:

- National Set Packet Size Default
- National Set Packet Size Maximum

Circuit Idle Time

Specifies the number of seconds that an SVC can be idle before it is cleared by the router. The range is 0 to 65365. The default is 30 seconds. A 0 (zero) specifies that the circuit is never cleared by the router.

Maximum VCs

Specifies the maximum number of circuits that are open to the same DTE address for a protocol. Refer to RFC 1356 for information on utilizing this parameter. The Valid range is 1 to 10. The default is 4.

pref CUG, CUG, pref bi-cug, bi-cug

See **add address** command.

The following are QLLC unique parameters:

QLLC response timer

The number of seconds to wait for a Q-response packet before retransmitting.

QLLC response count

The maximum number of times QLLC will retransmit. Upon exhausting this number of retries, the upper layer is notified which may result in the circuit being cleared or reset by the router.

Accept Reverse Charges

Allows this protocol to override the setting of this National Personality parameter. This does not affect the National Personality parameter.

Request Reverse Charges

Allows this protocol to override the setting of this National Personality parameter. This does not affect the National Personality parameter.

Station Type

Specifies the default station type for this protocol:

- Pri** Primary Station
- Sec** Secondary Station
- Peer** Peer Station

Max message size

The maximum message size for this protocol. Specify a value that is less than, or equal to, the Max MTU size of the interface.

Call User Data

Specifies the default CUD field used in call packets for this protocol. Specify from 1-to-16 characters. If you do not specify characters, the default 0xC3 is used.

pvc Adds PVC, window size, and packet size definitions.

Configuring the X.25 Network Interface

Example: add pvc

IP example:

```
Protocol [IP]? IP
Packet Channel Range Start [1]?
Destination X.25 Address[]?
Packet Channel Range End [1]?
Window Size [2]?
Packet Size [128]?
```

Protocol

Specifies which protocol's encapsulation you want to modify: APPN, XTP, DECnet, Banyan Vines, DLSw, IP or IPX. The default is IP.

Packet Channel Range Start

Specifies the starting circuit number of this range of PVCs.

Packet Channel Range End

Specifies the last circuit number of this range of PVCs. Defaults to the value of the Packet Channel Range Start.

Destination X.25 Address

Specifies the X.25 address of the PVC's destination.

Remote Address

Specifies the remote address for caller ID on received calls.

Window Size

Specifies the number of packets that can be outstanding before requiring packet confirmation. The default is 2.

Related configuration parameters are:

- Set Default Window

Packet Size

Specifies the maximum negotiable packet size for PVCs. This value must be equal to or less than the maximum packet size specified with the **national set packet-size** command. The default value for this parameter is 128 bytes. The maximum value that may be configured for this parameter is 4096 bytes. The maximum for X.31 is 256 bytes. This value is utilized in calculating the maximum frame size for this X.25 interface.

Related configuration parameters are:

- Nat Set Packet Size Default
- Nat Set Packet Size Maximum

Change

Use the **change** command to change an X.121 address, an DDN X.25 Address, a protocol configuration, or a PVC definition.

Note: To change an IP address that is associated with an X.121 address, you must delete the record that contains the address correlation, then redefine the address mapping.

Syntax:

```
change                address
                        htf-address
```

Configuring the X.25 Network Interface

protocol

pvc

address

Modifies a X.121 address translation. The prompts that appear depend on the protocol that is changing.

Example: change address

IP example:

```
Protocol [IP] IP
IP Address [0.0.0.0]?
Enc Priority []?
X.25 Address [00000124040000]?
```

IPX example:

```
Protocol [IP] IPX
CUD Field Usage (Standard or Proprietary) [Standard]?
IPX Host number (in hex) []?
Enc Priority []?
X.25 Address [00000124040000]?
```

htf address

Changes a Defense Data Network (DDN) X.25 address translation.

Example:

```
change htf-address
Protocol [IP]
Change HTF address [0.0.0.0]?
New HTF address [10.4.0.124]?
```

protocol

Changes a protocol configuration definition.

Example:

```
change protocol
Protocol [IP]
Window Size [2]
Default Packet Size [128]
Maximum Packet Size [256]
Circuit Idle Time [30]
Maximum VCs [6]
```

QLLC example:

```
X.25 Config> change prot
Protocol [IP]? d1s
Idle Timer [30]?
QLLC response timer (in decaseconds) [15]?
QLLC response count [255]?
Accept Reverse Charges [N]?
Request Reverse Charges [N]?
Station Type (1) PRI (2) SEC (3) PEER [3]?
Max Packet Size [256]?
Packet Window size [7]?
Max message size [2048]?
Call User Data (in HEX, 0 for Null) []? C3010000525450
```

pvc

Changes PVC, window size, and packet size definitions.

Note: To change the protocol, packet channel or destination X.25 address, you must delete the record which contains the definition, then add it back with the changed parameters. A change will apply to *all* PVCs in the range of circuits defined by the Packet Channel Range Start parameter.

Example:

Configuring the X.25 Network Interface

```
change pvc
Protocol [IP]? IP
Packet Channel Range Start [1]?
Destination X.25 Address [ ]?
Packet Channel Range End [1]
Window Size [2]?
Packet Size [128]?
```

Delete

Use the **delete** command to delete an X.121 address, a protocol configuration definition, or a PVC definition.

Syntax:

```
delete address
                                     bi-cugs
                                     cugs
                                     protol . . .
                                     pvc
```

address

Deletes an X.121 address translation.

Example: delete address

IP example:

```
Protocol [IP]?
IP Address [0.0.0.0]?
```

IPX example:

```
Protocol [IP]? IPX
IPX Host Number (in hex) [2]?
```

bi-cugs

Deletes a bilateral closed user group number used by this interface.

Valid values:

- Y** Deletes the current CUG.
- N** Does not delete the current CUG.
- ALL** Deletes all remaining CUGs.
- Q** Stops deleting any remaining CUGs.

Example:

```
delete bi-cugs
Delete Pref BI-CUG [Y]?
Delete BI-CUG (2) [Y]? N
Delete BI-CUG (3) [Y]? q
```

cugs Deletes the closed user group numbers used by this interface. This command works similar to the **delete bi-cug** command.

Example:

```
del cug
Delete Pref CUG [Y]?
Delete CUG (2) [Y]?
Delete CUG (3) [Y]? q
```

Configuring the X.25 Network Interface

protocol *prot-type*

Deletes a protocol encapsulation configuration definition. *Prot-type* is the name or number of the protocol encapsulation that is currently defined in the router's configuration.

pvc Deletes a PVC definition. *All PVCs* in the range of circuits defined by the Packet Channel Range Start parameter will be deleted.

Example:

```
delete pvc
Protocol [IP]?
Destination X.25 Address [ ]?
Packet Channel Range Start [ ]?
```

List

Use the **list** command to display the current configuration for the specified parameter.

Syntax:

```
list address
all
cugs
detailed
protocols
pvc
summary
```

address

Lists all the X.121 address translations.

Example:

```
list address
IF#      Prot #      Active Enc      Protocol ->      X.25 address
1        0(IP)         CC              10.1.2.3 ->      1238765742
1        7(IPX)         SNAP            10              ->      12389
                CUGS: 11 12 13 14 15          BI-CUGS: 21 22
```

all Lists all the X.25 addresses, National Personality parameters, all defined protocols and their values, and all defined PVCs.

Example:

```
list all
```

```
X.25 Configuration Summary
```

```
Node Address:      313131
Max Calls Out:     4
Inter-Frame Delay: 0      Encoding: NRZ
Speed:             64000   Clocking: Internal
MTU:               2048    Cable: V.35 DCE
Lower DTR:         Disabled
Default Window:   2      SVC idle: 30 seconds
National Personality: GTE Telenet (DTE)
PVC               low: 1   high: 1
Inbound           low: 0   high: 0
Two-Way           low: 2   high: 64
Outbound          low: 0   high: 0
Throughput Class in bps Inbound: 2400
Throughput Class in bps Outbound: 2400
```

Configuring the X.25 Network Interface

X.25 National Personality Configuration

```
Request Reverse Charges: on Accept Reverse Charges: on
Frame Extended seq mode: off Packet Extended seq mode: off
Incoming Calls Barred: off Outgoing Calls Barred: off
Throughput Negotiation: on Flow Control Negotiation: on
Suppress Calling Addresses: off DDN Address Translation: off
Truncate Called Addresses: off
Number of digits to truncate called addresses to: 2
CUG Support: off BI-CUG Support: off
CUG Outgoing Access: off CUG Incoming Access : off
BI-CUG Outgoing Access: off CUG 0 Override: off
CUG Isertion: off CUG deletion: off
Call Request Timer: 20 decaseconds
Clear Request Timer: 18 decaseconds (1 retries)
Reset Request Timer: 18 decaseconds (1 retries)
Restart Request Timer: 18 decaseconds (1 retries)
Min Recall Timer 10 seconds
Min Connect Timer 90 seconds
Collision Timer 5 seconds
T1 Timer: 4.00 seconds N2 timeouts: 20
T2 Timer: 2.00 seconds DP Timer: 500 milliseconds
Standard Version: 1984 Network Type: CCITT
Disconnect Procedure: passive
Window Size Frame: 7 Packet: 2
Packet Size Default: 128 Maximum: 256
```

X.25 protocol configuration

No protocols defined

X.25 PVC configuration

No PVCs defined

X.25 address translation configuration

No address translations defined

cugs Lists the CUG and BI-CUG numbers for each X.25 interface in this device.

Example:

```
1i cugs
CUGS: 23 24 25 26 27
```

detailed

Lists the value of all the default parameters that the **national set** command modifies. Descriptions of the screen display are listed in the **national set** command described later in this chapter.

Example:

```
list detail
```

X.25 National Personality Configuration

```
Follow CCITT: on OSI 1984: on OSI 1988: off
Request Reverse Charges: off Accept Reverse Charges: off
Frame Extended seq mode: off Packet Extended seq mode: off
Incoming Calls Barred: off Outgoing Calls Barred: off
Throughput Negotiation: on Flow Control Negotiation: off
Suppress Calling Addresses: off DDN Address Translation: off
Truncate Called Addresses: off
Number of digits to truncate called address to: 2
CUG Support: off BI-CUG Support: off
CUG Outgoing Access: off CUG Incoming Access : off
BI-CUG Outgoing Access: off CUG 0 Override: off
CUG Isertion: off CUG deletion: off
T21 (Call Request Timer): 20 decaseconds
T23 (Clear Request Timer): 18 decaseconds (1 retries)
T22 (Reset Request Timer): 18 decaseconds (1 retries)
T20 (Restart Request Timer): 18 decaseconds (1 retries)
Min Recall Timer: 10 seconds
Min Connect Timer: 90 seconds
Collision Timer: 8 seconds
T1 Timer: 4.00 seconds N2 timeouts: 20
T2 Timer: 0.00 seconds DP Timer: 500 milliseconds
Standard Version: 1984 Network Type: CCITT
```

Configuring the X.25 Network Interface

```
Disconnect Procedure: active
Window Size          Frame: 7          Packet: 2
Packet Size          Default: 256      Maximum: 256
```

protocols

Lists all the defined protocol configurations. See “Add” on page 424 for a description of the parameters.

Example:

```
list protocols
```

```
X.25 protocol configuration
```

Protocol Number	Window Size	Packet-Size Default	Packet-Size Maximum	Idle Time	Max VCs
0(IP)	2	128	256	30	4

CUGS: 11 12 13 14 15 BI-CUGS: 21 22

```
QLLC Protocols
```

Protocol Number	Packet Window	Packet MaxSize	Idle Time	Response Timer	Response Count	Reverse Charges Accept	Reverse Charges Request	Max Message	Station Type
26(DLSW)	7	256	30	15	255	N	N	2048	PEER

CUD : [C3 01 00 00 52 54 50]
CUGS: 11 12 13 14 15 BI-CUGS: 21 22

pvc Lists all the defined PVCs.

Example:

```
list pvc
```

```
X.25 PVC configuration
```

Prtcl	X.25 Address	Active Enc	Window	Pkt_len	Pkt_chan
0	8383838383	CC	4	1024	3 - 3

summary

Lists all the values established by the **set** and **enable** commands. These values modify the X.25 configuration.

Example:

```
list summary
```

```
X.25 Configuration Summary
```

```
Node Address:      313131
Max Calls Out:     4
Inter-Frame Delay: 0      Encoding: NRZ
Speed:             64000   Clocking: Internal
MTU:               2048    Cable: V.35 DCE
Lower DTR:         Disabled
Default Window:    2      SVC idle: 30 seconds
National Personality: GTE Telenet (DTE)
PVC                low: 1   high: 1
Inbound            low: 0   high: 0
Two-Way            low: 2   high: 64
Outbound           low: 0   high: 0
Throughput Class in bps Inbound: 2400
Throughput Class in bps Outbound: 2400
```

Accessing the Interface Monitoring Process

To monitor information related to the X.25 network interface, access the interface monitoring process as follows:

1. At the OPCON prompt, enter **talk 5**. For example:

```
* talk 5
+
```

Configuring the X.25 Network Interface

The GWCON prompt (+) is displayed on the console. If the prompt does not appear when you first enter GWCON, press **Return** again.

2. At the GWCON prompt, enter the **configuration** command to see the protocols and networks for which the router is configured. For example:

```
+ configuration
```

See page "Configuration" on page 108 for sample output of the **configuration** command.

3. Enter the **network** command and the number of the X.25 interface.

```
+ network 2  
X.25>
```

The X.25 monitoring prompt is displayed on the console. You can then view information about the X.25 interface by entering the X.25 monitoring commands.

X.25 Monitoring Commands

This section summarizes and explains all the X.25 monitoring commands. The X.25 monitoring commands allow you to view the parameters and statistics of the interfaces and networks that transmit X.25 packets. Monitoring commands display configuration values for the physical, frame, and packet levels. You also have the option of viewing the values for all three protocol levels at once.

Enter the X.25 monitoring commands at the X.25> prompt. Table 61 shows the commands.

Table 61. X.25 Monitoring Command Summary

Monitoring Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
List	Lists individual PVC or SVC statistics and general information.
Parameters	Displays the current parameters for any level of the X.25 configuration.
Statistics	Displays the current statistics for any level of the X.25 configuration.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

List

Use the **list** command to display the current active PVCs and SVCs.

Syntax:

```
list                pvc  
                    svc
```

pvc Displays the configured permanent virtual circuits.

svc Displays the active switched virtual circuits.

Example:

```
list svc
```

```
LCN/ Destination Originate Transmits Protocol Totals  
State Address Call Queued Encapsulated Xmts Rcvs Resets  
13 D 898280077113 YES 0 IP 8943 261 1
```


Configuring the X.25 Network Interface

```
20 D 898280077114 NO 0 IP 943 43 0
42 P 898280077116 YES 6 IP 0 0 0
23 C 898280077117 YES 0 IP 3054 110 0
```

D - Data Transfer P - Call Progressing
C - Call Clearing

Parameters

Use the **parameters** command to display the current parameters for any level of the X.25 configuration.

Syntax:

```
parameters                    all
                                 frame
                                 packet
                                 physical
```

all Displays the parameters for the packet, frame, and physical levels.

frame Displays the parameters for the frame level.

Example:

```
parameters frame
Frame Layer Parameters:
Maximum Frame Size = 262 Maximum Window Size = 7
Protocol Enabled = YES Equipment Type = DTE
T1 Retransmit Timer = 4 T2 Acknowledge Timer = 2
N2 Retry Counter = 20 Disconnect Procedure = PASSIVE
Disconnect Timer = 500 Network Type = GTE
Protocol Options: Inhibit Idle RRs No MOD 128 NO Enable SARM NO
```

packet

Displays the parameters for the packet level.

Example:

```
parameters packet
Packet Layer Parameters:
Default Packet Size = 128 Maximum Packet Size = 256
Log 2 Packet size = 2 Acknowledge Delay = 0
Layer Enabled = YES Default Window Size = 2
Lowest SVC = 1 Highest SVC = 64
Lowest PVC = 0 Highest PVC = 0
T20 (Restart) = 18 R20 (Retry) = 1
T21 (Call) = 20
T22 (Reset) = 18 R22 (Retry) = 1
T23 (Clear) = 18 R23 (Retry) = 1
Network Type = GTE Equipment Type = DTE
```

physical

Displays the parameters for the physical level.

Example:

```
parameters physical
Physical Layer Parameters:
Interface Type = V.35

Maximum Frame Size = 264 InterFrame Delay = 2
Configured Speed = 0 Clocking = External
Encoding = NRZ
Protocol Enabled = Yes
```

Statistics

Use the **statistics** command to display the current statistics of any level of the X.25 configuration.

Configuring the X.25 Network Interface

Syntax:

statistics

all

frame

packet

physical

all Displays the statistics for the packet, frame, and physical levels.

frame Displays the statistics for the frame level.

Example:

```
statistics frame
Frame Layer Counters:      Received      Transmitted
Information Frames         0              0
RR Command                 0              0
RR Response                0              0
RNR Command               0              0
RNR Response              0              0
REJ Command               0              0
REJ Response              0              0
SABM                      0              71
SABME                     0              0
UA                        0              0
DISC                      0              0
DM                        0              0
FRMR                      0              0
Total Bytes                0              0
Frame Layer Miscellaneous:
Queued Output Frames = 0 Protocol Layer State = Link Setup
Send Sequence N(S) = 0 Receive Sequence N(R) = 0
```

packet

Displays the statistics for the packet level.

Example:

```
statistics packet
Packet Counters:          Received      Transmitted
Call Request              0              0
Call Accepted             0              0
Clear Request             0              0
Clear Confirm             0              0
Interrupt Request         0              0
Interrupt Confirm         0              0
RR Packet                 0              0
RNR Packet                0              0

Reset Request             0              0
Reset Confirm             0              0
Restart Request           0              0
Restart Confirm           0              0
Diagnostic                0              0
Data Packet               0              0
Data Bytes                0              0
Buffers Queued            0              0
Invalid Packets Received = 0
Switched Circuits Opened = 0
```

physical

Displays the statistics for the physical level.

Example:

```
statistics physical
X.25 Physical Layer Counters:
Rx Bytes                  0 Tx Bytes          0

Adapter cable:           V.35 DTE

Nicknames:   RTS CTS DSR DTR DCD
PUB 41450:   CA CB  CC  CD  CF
State:       ON  ON  ON  ON  ON

Line speed:           unknown
Last port reset:     12 minutes, 21 seconds ago

Input frame errors:
```

Configuring the X.25 Network Interface

```
CRC error          0 alignment (byte length)    0
missed frame      0 too long (> 0 bytes)      0
aborted frame     0 DMA/FIFO overrun         0
Output frame counters:
DMA/FIFO underrun errors  0 Output aborts sent      0
```

X.25 Network Interfaces and the GWCON Interface Command

While X.25 interfaces have their own monitoring processes for monitoring purposes, the router also displays complete statistics for installed network interfaces when you use the **interface** command from the GWCON environment. (For more information on the **interface** command, refer to Chapter 10. The Operating/Monitoring Process (GWCON - Talk 5) and Commands).

Statistics Displayed for X.25 Interfaces

The following statistics display when you run the **interface** command from the GWCON environment for X.25 interfaces:

```
+interface 11
Nt Nt' Interface Slot-Port Self-Test Self-Test Maintenance
11 11 X25/0 Slot: 8 Port: 1 Passed Failed Failed
                                1 0 0
X.25 MAC/data-link on V.35/V.36 interface
Interface State: DCD CTS Packet Layer Frame Layer
                  ON ON UP UP
Packet Counters: Received Transmitted
Data Packet 0 353
Data Bytes 0 18888
Buffers Queued 0 0
Invalid Packets Received = 0
Switched Circuits Opened = 0
Frame Layer Counters: Received Transmitted
Information Frames 354 354
X.25 Physical Layer Counters:
Rx Bytes 3316 Tx Bytes 22204
Adapter cable: V.35 DTE
V.24 circuit: 105 106 107 108 109
Nicknames: RTS CTS DSR DTR DCD
PUB 41450: CA CB CC CD CF
State: ON ON ON ON ON
Line speed: 64.000 Kbps
Last port reset: 1 hour, 20 minutes, 25 seconds ago
Input frame errors:
CRC error 0 alignment (byte length) 0
missed frame 0 too long (> 2057 bytes) 0
aborted frame 0 DMA/FIFO overrun 0
Output frame counters:
DMA/FIFO underrun errors 0 Output aborts sent 0
Interface buffer pool: Total = 57, Free = 56
```

The following list describes the interface statistics:

- Nt** Global interface number
- Nt '** Reserved for future dial circuit use
- Interface** Interface name and number (within interfaces of the same type)
- Slot** Slot number of interface
- Port** Port number of interface

Configuring the X.25 Network Interface

Self-Test Passed

Number of times self-test succeeded

Self-Test Failed

Number of times self-test failed

Maintenance Failed

Number of maintenance failures

Interface state

Display the current state of the input modem control signals, the packet layer (X.25 layer 3), and the frame layer (X.25 layer 2).

Packet Counters

Provides statistics on packets received and transmitted.

Data Packets

Displays the number of data packets the interface transmits receives on the network

Data Bytes

Displays the number of data bytes the interface transmits receives on the network.

Buffers Queued

Displays the number of buffers currently queued for transmission over the network. These may be frame or packet layer supervisory messages as well as forwarder packets.

Invalid Packets Received

Displays the number of invalid X.25 packets received from the network.

Switched Circuits Open

Displays the number of switched circuits currently open.

Frame Layer Counters

Provides statistics generated from Frame Layer counters.

Information Frames

Displays the number of X.25 Information frames the interface has transmitted and received.

X.25 Physical Layer Counters

Provides statistics generated from Physical Layer counters.

RX Bytes

Display the number of bytes received by the Physical layer.

TX Bytes

Displays the number of bytes transmitted by the Physical layer.

Line speed

The transmit clock rate.

Last port reset

The length of time since the last port reset.

Input frame errors:

CRC error

The number of packets received that contained checksum errors and as a result were discarded.

Configuring the X.25 Network Interface

Alignment

The number of packets received that were not an even multiple of 8 bits in length and as a result were discarded.

Too short

The number of packets that were less than 2 bytes in length and as a result were discarded.

Too long

The number of packets that were greater than the configured size, and as a result were discarded.

Aborted frame

The number of packets received that were aborted by the sender or a line error.

DMA/FIFO overrun

The number of times the serial interface card could not send data fast enough to the system packet buffer memory to receive them from the network.

Missed frame

When a frame arrives at the device and there is no buffer available, the hardware drops the frame and increments the missed frame counter.

L & F bits not set

On serial interfaces, the hardware sets input-descriptor information for arriving frames. If the buffer can accept the complete frame upon arrival, the hardware sets both the last and first bits of the frame, indicating that the buffer accepted the complete frame. If either of the bits is not set, the packet is dropped, the L & F bits not set counter is incremented, and the buffer is cleared for reuse.

Note: It is unlikely that the L & F bits not set counter will be affected by traffic.

Output frame counters:

DMA/FIFO underrun errors

The number of times the serial interface card could not retrieve data fast enough from the system packet buffer memory to transmit them onto the network.

Output aborts sent

The number of transmissions that were aborted as requested by upper-level software.

Configuring the X.25 Network Interface

Chapter 35. Using XTP

This chapter describes the X.25 Transport Protocol (XTP) for transporting X.25 traffic over TCP/IP. Included are the following sections:

- “The X.25 Transport Protocol”
- “DTE Address Wildcards” on page 445
- “XTP Backup Peer Function” on page 446
- “Local XTP” on page 447
- “XTP and Closed User Groups” on page 447
- “Configuring XTP” on page 448
- “Configuration Procedures” on page 448

The X.25 Transport Protocol

X.25 Transport Protocol (XTP) provides you with the services of a “protocol forwarder.” A protocol forwarder is the focal point for inbound and outbound protocol packet processing. Forwarders receive packets on one network interface and send them to another interface.

XTP is designed to work with X.25 devices that are situated at multiple remote sites. In such environments, XTP can eliminate the use of X.25 packet-switched networks for communicating with servers at one or more centralized locations.

To enable this, you use routers at the server and remote locations to encapsulate the data and deliver the X.25 packets between the clients and server via TCP/IP.

Figure 37 on page 444 illustrates a network configuration before and after using XTP.

Using XTP

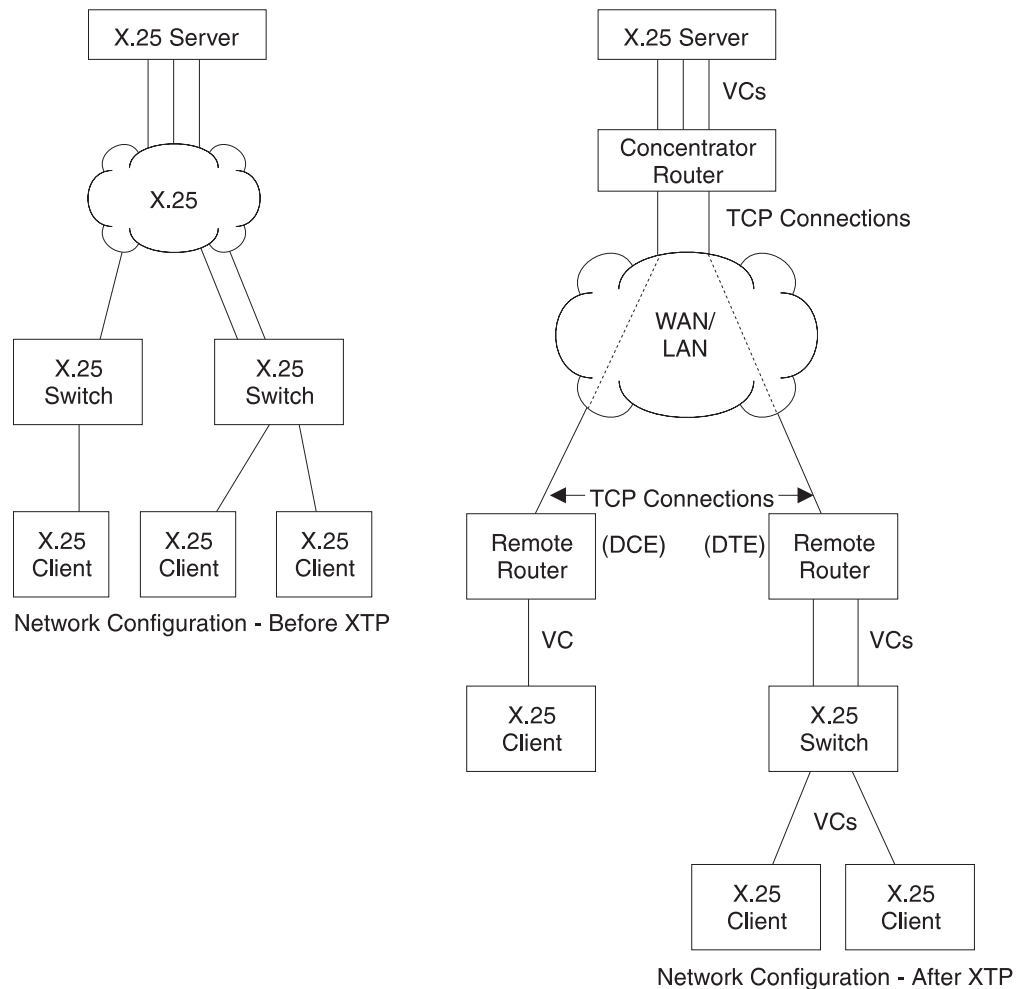


Figure 37. Configuration Before and After XTP

Configuration Information

X.25 recognizes an incoming call for XTP based on the node addresses configured for XTP. Therefore, in order to transport X.25 traffic between the X.25 nodes, you must configure X.25 to map to the data terminal equipment (DTE) address and IP addresses of the routers to which the nodes are connected.

For example, in Figure 37, you configure X.25 clients on remote routers and on the concentrator router. *Remote routers* in this example are the routers that connect the X.25 clients to the TCP/IP network that is used to access the X.25 server; the *concentrator router* connects the X.25 server to the TCP/IP network that is used to access the remote routers.

Note: When you configure XTP, if a router is connected to an X.25 switch, it is considered to be DTE. If it is not connected to a switch, it is considered to be DCE (Data Circuit-Terminating Equipment).

To configure a router for XTP, define the following information from the XTP config> prompt and then restart the router:

- Local DTEs
- Peer routers

- Remote DTEs
- PVCs
- CUGs

Local DTEs

X.25 nodes connected to the X.25 interfaces on the router

To configure local DTEs, use the X.121 address that is assigned to the local DTE. Multiple local DTEs can be configured on an interface.

Peer Routers

Routers with which you communicate over TCP/IP

Peer routers can differ depending on “point of view”. For example, in Figure 37 on page 444, the *two remote routers* are the peer routers from the perspective of the concentrator router. However, the *concentrator router* is the peer router from the perspective of the two remote routers.

You designate the peer router by its internal IP address.

Remote DTEs

Remote X.25 nodes to which the local X.25 nodes open connections and exchange data. Use the X.121 address that is assigned to the remote DTE.

Configure a *unique* IP address for each peer router. For example, in Figure 37 on page 444, the concentrator router must know the unique IP address of each remote router, and each remote router must know the IP address of the concentrator router.

PVC A permanent channel that remains connected after X.25 restarts.

PVCs, because they are constant channels, are similar to leased telephone lines. A PVC, in the XTP context, is a PVC from a local X.25 DTE node to a remote X.25 DTE.

When you configure a router for PVCs, map the IP address of the peer router and the PVC number of the remote and local DTE. A PVC is identified by four pieces of information which are the:

- Logical channel numbers of the local PVCs
- X.121 address of the local DTE
- Logical channel numbers of the PVCs on the remote (peer) router
- X.121 address of the remote DTE

CUGS The closed user groups for the XTP protocol. See “Understanding Closed User Groups” on page 405.

Additional configuration information can be found at “Configuring XTP” on page 448 and at “XTP Configuring Commands” on page 457.

DTE Address Wildcards

The “*” wildcard is available for DTE address configuration. This is in addition to the “?” character that can be specified in a DTE address to represent any one digit in that position in the address. For example, a specification of “1?2?3” can match address 18243 where the first, third, and fifth digits are 1, 2, and 3, respectively.

The “*” wildcard character can represent any string of zero or more digits. Its use is limited to the end of a DTE address specification. For example: “123*”, “5555*”, “9*”

Using XTP

or “*”. The special case of a DTE address of “*” represents any DTE address, even a null address. The null address is useful for handling incoming calls with no calling address in the X.25 Call Request packet.

Use of the “*” wildcard increases the chances for adding a local or a remote DTE address that conflicts with an existing address. The **add local-dte** and **add remote-dte** commands are enhanced to provide the conflicting address when the user attempts to add a DTE address that conflicts with an existing address.

Example: xtp config> add local-dte

```
Interface number [0]? 1
DTE address [ ] 123456
DTE address [ ]?
```

```
XTP config>add local-dte
Interface number [0]?1
DTE address [ ]?1*
DTE address conflicts with existing DTE address 123456
```

XTP Backup Peer Function

The Backup Peer Function allows the association of multiple peer routers with a remote DTE. The user specifies a list of peer routers associated with a remote DTE.

Example:

```
XTP config>add rem
DTE address [ ]?123456
Peer router's internal IP Address [0.0.0.0]?10.0.0.2
Peer router's internal IP Address [0.0.0.0]?10.0.0.4
Peer router's internal IP Address [0.0.0.0]?11.0.0.1
Peer router's internal IP Address [0.0.0.0]?
```

When an incoming call for the remote DTE is received, a connection is attempted through each router in the list in the same order that they appear for the remote DTE.

Searching for a Remote DTE

When a DTE initiates a call for a remote DTE, both DTE addresses are inspected to determine if they are acceptable for X.25 transport. If they are acceptable, the X.25 Transport protocol forwarder determines through which peer router to attempt to complete the call. It starts with the first router in the remote DTE's list of peer routers in its search. The first condition that must be met is an active TCP connection to the peer router. If there is not an active TCP connection to the peer, the next router in the list is checked. When an active TCP connection is found, an attempt is made to complete the call. The Connection Request Timer is started to time the call connection process.

The remote DTE search is terminated by one of the following events:

- Successful completion of the call through the peer router
This completes call setup processing and ends the search for the remote DTE.
- Rejection of the call by the peer router
This causes the search for the remote DTE to proceed to the next router in the peer router list.
- Expiration of the Connection Request Timer

This causes the search for the remote DTE to proceed to the next router in the peer router list.

If a pass through the list of peer routers is completed without a successful connection through any of the peer routers, the call to the local DTE is cleared.

Connection Request Timer

The Connection Request Timer is used to ensure that no call setup procedure hangs for an indeterminable time. There is a timer configured for each peer router.

Example:

```
XTP config>add peer-router
Router's internal IP Address [0.0.0.0]?10.0.0.2
Connection setup timeout [230]?60
```

The Connection Request Timer can be configured from 10 to 480 seconds. The default is 230 seconds. This default was determined based on the fact that the default setting for the X.25 Call Request Timer is 200 seconds.

The timer is started when an attempt is made to complete a call through a peer router. It is stopped when the call attempt is either accepted or rejected by the peer router.

Local XTP

Local XTP allows you to route incoming X.25 traffic to the same or different interfaces on the current router. To configure local XTP, specify the router's internal IP address as a peer address on the **add peer** command.

XTP and Closed User Groups

XTP supports closed user groups through the local DTE address defined by the **add local** or the **add cug** command. To enable XTP to use closed user groups, you must:

- Enable CUG or BI-CUG on the appropriate X.25 interfaces.
- Supply the XTP protocol-specific CUGs using the **add cug** and **add bi-cug** commands, if desired.
- Supply the appropriate closed user group numbers in the **add local** command. These include:
 - Closed user group number
 - Preferred closed user group number
 - Bilateral closed user group number
 - Preferred bilateral closed user group number
- Enable CUG insertion or deletion for the interface in the **national enable cug_insertion** or **national enable cug_deletion** commands, if desired.
- Enable the CUG 0 override option on the **national enable cug 0 override** command, if desired.

Configuring XTP

XTP is a protocol forwarder used to transport X.25 traffic over TCP/IP. XTP allows existing X.25 devices to communicate over a TCP/IP backbone and migrate from an X.25 network to a network of your choice.

Configuration Procedures

This section defines the detail for configuring the network displayed in Figure 38.

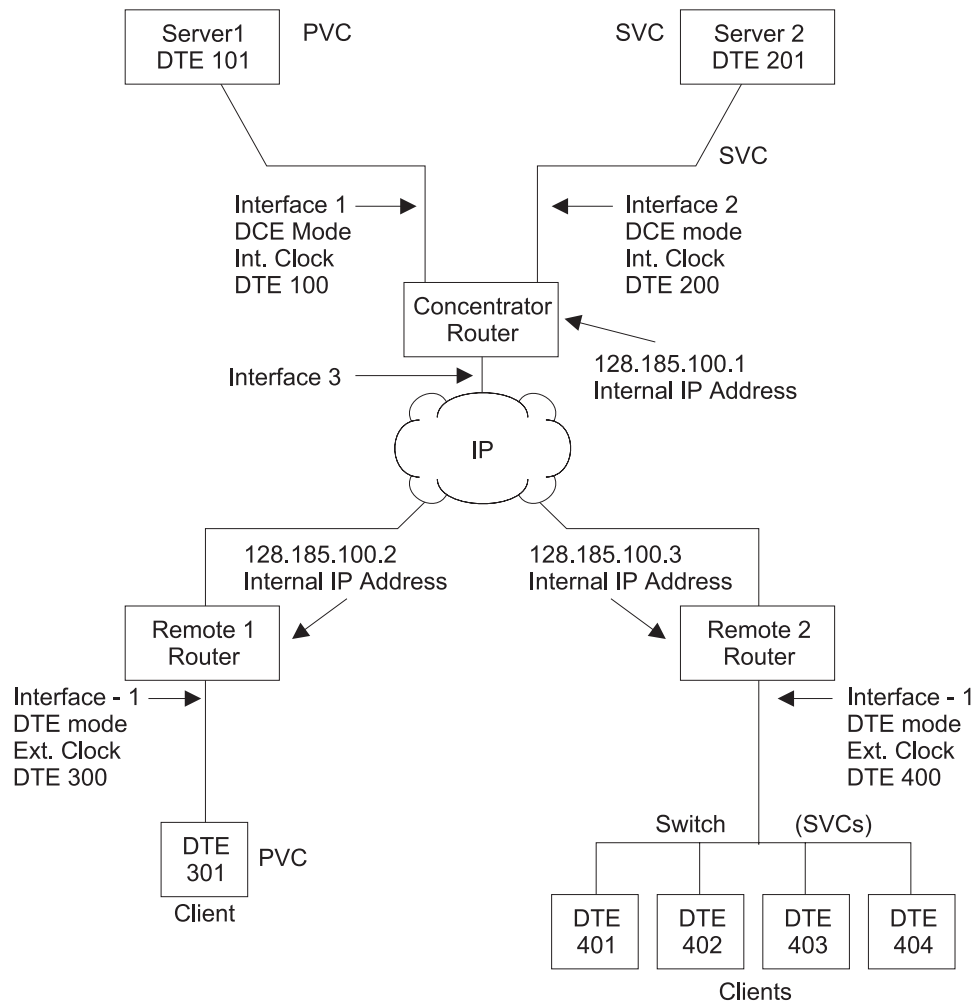


Figure 38. Sample XTP Configuration

This configuration shows three routers, the Concentrator router, Remote 1 router, and Remote 2 router. To make XTP operational on this network, perform the following steps for each of these routers:

- Set the data link
- Configure the IP interface
- Configure X.25
- Set the National Personality values
- Define the IP address

- Set the Internal IP address
- Configure XTP

Note: New configurations do not take effect until you restart the router.

Setting the Data Link

The data link defines the protocol you are using to send data packets over the network. Define the data link between the router you are configuring and each serial interface. The example in Figure 38 on page 448 configures a concentrator router with three serial interfaces, two for X.25 and one for PPP.

Set the data-link protocol for the serial interfaces:

```
Config>set data-link X25 1
Config>set data-link x25 2
Config>set data-link ppp 3
```

Configuring the IP Interface

In Figure 38 on page 448, the IP interface is PPP; enter **network 3** at the Config> prompt to configure this PPP interface:

```
Config>network 3
PPP interface configuration
```

Note: This procedure does not include details about the configuration of PPP. For details, refer to *Software User's Guide*

Configuring X.25

Before configuring XTP, configure the X.25 parameters for each interface. The following example configures the basic parameters for X.25 and is based on the topology in Figure 38 on page 448.

The parameters you need to configure depend on your network topology. For details about all the X.25 parameters, refer to *Software User's Guide*

Interface 1

Use the following instructions to configure *Interface 1* on the concentrator router as defined in Figure 38 on page 448.

1. At the Config> prompt, enter **network** followed by the number of the X.25 interface. In this example, it is interface 1.

```
Config>network 1
X.25 User Configuration
X.25 Config>
```

2. Add the XTP protocol to the X.25 interface and define general interface values. Enter **add protocol xtp** at the X.25 Config> prompt. This command needs to be entered *one time only*.

```
X.25 Config>add protocol xtp
Window Size [2]?
Default Packet Size [128]?
Maximum Packet Size [256]?
```

3. Specify the network address by entering **set address** X.25 node address. In Figure 38 on page 448, the node address (DTE address) is 100.

```
X.25 Config>set address 100
```

Using XTP

4. Enter **set clocking** followed by **internal** or **external** based on your router type.

```
X.25 Config>set clocking internal
```
5. Enter **set speed** followed by the access rate (line speed).

```
X.25 Config>set speed
Access rate in bps [9600]?19200
```
6. Enter **set equipment-type** and specify whether the frame and packet levels act as DCE or DTE.

```
X.25 Config>set equipment-type dce
```
7. Enter **set pvc** and define the lowest and the highest PVC you are using.

```
X.25 Config>set pvc low 1
X.25 Config>set pvc high 1
```
8. Enter **add pvc** to define individual PVCs.

```
X.25 Config>add pvc
Protocol [IP]?xtp
Packet Channel [1]?
Destination X.25 Address [ ]?101
Window Size [2]?
Packet Size [128]
```
9. (Optional) Enter **national enable truncate-called-addresses**. If you want to truncate the called address size, enter **national set truncate-called-address-size** followed by the number of digits to truncate the called DTE address to.
10. (Optional) Enable CUG support, CUG insertion, and CUG deletion as required.

Interface 2

Use the following instructions to configure interface 2.

1. At the Config> prompt, enter **network** followed by the number of the X.25 interface. In Figure 38 on page 448, it is 2.

```
Config>network 2
X.25 User Configuration
X.25 Config>
```
2. Use the same procedures as defined in “Interface 1” on page 449 to set the following parameters for interface 2:
 - address = 200
 - clocking = internal
 - speed = 19200
 - equipment = dce
3. Enter **set svc** and define the lowest and highest SVC you are using.

There are three types of SVCs: two-way, inbound and outbound. The defaults are “svc low-two-way = 1” and “svc high-two-way = 64.” All other SVC types default to 0. For additional information on SVCs and PVCs, refer to *Software User’s Guide*

```
X.25 Config>set svc ?
X.25 Config>set svc low-inbound 0
X.25 Config>set svc high-inbound 0
X.25 Config>set svc low-outbound 0
X.25 Config>set svc high-outbound 0
X.25 Config>set svc low-two-way 2
X.25 Config>set svc high-two-way 2
```
4. Exit the X.25 Config> prompt.

```
X.25 Config>exit
Config>
```

Setting the National Personality

Each X.25 public network has its own standard configuration. The National Personality refers to a group of 28 variables that define the characteristics of the public data network. These variables provide the router with control information for packets transferred over the link and influence the X.25 facilities used between and XTP router and its local DTE.

All facilities contained in incoming call requests are passed on to the peer router, regardless of whether the local router was configured to support that facility. For example, when packet size negotiation is requested in the incoming call and flow control negotiation is not configured in the router.

The router will insure any packet size and window size being negotiated is within the range specified when defining the X.25 interface. For example, a packet window greater than 7 is negotiated down to 7 if packet-ext-seq-mode has not been defined for the X.25 interface.

To view the configuration values, enter **list detailed** at the X.25 Config> prompt. To set the default values for the national personality, enter **set national-personality** at the X.25 Config> prompt. For further information, refer to *Software User's Guide*

Defining the IP Address

Before you configure the Concentrator router (as displayed in Figure 38 on page 448) for XTP, define the IP address for this router. Enter **protocol ip** at the Config> prompt and enter **add address** at the IP config> prompt.

```
Config>protocol ip
IP config>add address
Which net is this address for [0]?3
New address [0.0.0.0]?128.185.100.7
Address mask [255.255.0.0]?255.255.255.0
```

Setting the Internal IP Address

Each router identifies its peer routers by the internal IP address of the peer routers.

To set the internal IP address of the peer router, enter **set internal IP address** at the IP Config> prompt.

```
IP config>set internal-ip-address
Internal IP address [0.0.0.0]?128.185.100.1
```

Configuring XTP

After you have configured X.25 and defined the IP address, you are ready to configure XTP for the router.

If you need further configuration information when configuring XTP, see “XTP Configuring Commands” on page 457.

Note: When configuring your network for XTP, remember that the peer routers are always the routers you are communicating with over TCP/IP. Therefore, the peer router can differ depending on the point of view. When configuring the routers defined as Remote 1 router and Remote 2 router in Figure 38 on page 448 , to them the peer router is the Concentrator router.

Using XTP

Implement the following steps to configure XTP for the router:

1. To access the XTP config> prompt, enter **protocol xtp** at the Config> prompt.
2. Add interface 1 to the XTP configuration. Enter **add local-dte** at the XTP Config> prompt.

```
XTP config>add local-dte
Interface number [0]?1
Allow inbound calls without calling DTE address? (Y or N) [N]? n
DTE address [ ]?101
Pref CUG [ ]? 18
CUG (2) [ ]? 2
CUG (3) [ ]?
Pref BI-CUG [0]?
DTE address [ ]?
```

Entering a null DTE address ends the command input.

3. Add interface 2 to the XTP configuration. Enter **add local-dte** at the XTP Config> prompt.

```
XTP config>add local-dte
Interface number [0]?2
Allow inbound calls without calling DTE address? (Y or N) [N]? n
DTE address [ ]?201
DTE address [ ]?
```

Entering a null DTE address ends the command input.

4. (Optional) Add XTP protocol-specific CUGs.

```
add cug
Pref CUG [ ]? 11
CUG (2) [ ]? 12
CUG (3) [ ]? 13
CUG (4) [ ]? 14
CUG (5) [ ]? 15

add bi-cug
Pref BI-CUG [ ]? 21
BI-CUG (2) [ ]? 22
BI-CUG (3) [ ]?
```

5. Add Remote 1 router as the peer router. Enter **add peer-router** and enter the IP address of this router.

```
XTP config>add peer-router
Router's internal IP Address [0.0.0.0]?128.185.100.2
Connection setup timeout [230]?
```

6. Add the remote DTE for Remote 1 router. Enter **add remote-dte** and enter the IP and DTE address of this DTE.

```
XTP config>add remote-dte
DTE address [ ]?301
Peer router's internal IP Address [0.0.0.0]?128.185.100.2
Peer router's internal IP Address [0.0.0.0]?
```

Note: A remote DTE is *required* only if one of the following applies:

- The Concentrator Router will be initiating XTP connections to the remote DTE due to incoming calls from its local DTEs.
- The DTE is part of an XTP PVC definition.

7. Add Remote 2 router (as the peer router). Enter **add peer-router** and enter the IP address of this router.

```
XTP config>add peer-router
Router's internal IP Address [0.0.0.0]?128.185.100.3
Connection setup timeout [230]?
```

8. Add the remote DTEs for Remote 2 router. Enter **add remote-dte** and enter the IP and DTE addresses of this DTE.

```
XTP config>add remote-dte
DTE address [ ]?401
Peer router's internal IP Address [0.0.0.0]?128.185.100.3
Peer router's internal IP Address [0.0.0.0]?
```



```

XTP config>add remote-dte
DTE address [ ]?402
Peer router's internal IP Address [0.0.0.0]?128.185.100.3
Peer router's internal IP Address [0.0.0.0]?

XTP config>add remote-dte
DTE address [ ]?403
Peer router's internal IP Address [0.0.0.0]?128.185.100.3
Peer router's internal IP Address [0.0.0.0]?

XTP config>add remote-dte
DTE address [ ]?404
Peer router's internal IP Address [0.0.0.0]?128.185.100.3
Peer router's internal IP Address [0.0.0.0]?

```

9. Add an XTP PVC to logically associate the local PVC to Server 1 with the remote DTE 301.

```

XTP config>add pvc
Local PVC Range Start [1]?
Local PVC Range End [1]?
Local X.25 DTE address [ ]? 101
Remote PVC Range Start [1]?
Remote PVC Range End [1]?
Remote X.25 DTE address [ ]?301

```

When entering DTE addresses, you can specify either of the following:

A '?' in place of any digit. The '?' means any single digit in this digit position.

An '*' as the last digit of an address to represent any combination of zero or more digits.

Sample Configuration of Remote Routers

The following is a sample configuration of Remote 1 router and Remote 2 router (see Figure 38 on page 448). The process is the same as that defined in the section at "Configuration Procedures" on page 448.

Remote 1 router

```

*talk 6

Config>set data-link x25 1
Config>set data-link ppp 2
Config>network 1

X.25 Config>set address 300
X.25 Config>set clocking internal
X.25 Config>set speed 19200
X.25 Config>set equipment-type dce
X.25 Config>set pvc low 1
X.25 Config>set pvc high 1
X.25 Config>add pvc
Protocol [IP]?xtp
Packet Channel [1]?1
Destination X.25 Address [ ]?301

Window Size [2]?
Packet Size [128]?
X.25 Config>exit
Config>

Config>protocol ip
IP config>add address
Which net is this address for [0]?2
New address [0.0.0.0]?128.185.100.8
Address mask [255.255.0.0]?255.255.255.0

IP config>set internal-ip-address
Internal IP address [0.0.0.0]?128.185.100.2
IP Config>exit
Config>

```

Using XTP

```
Config>protocol xtp
XTP config>add local-dte
Interface number [0]?1
Allow inbound calls without calling DTE address? (Y or N) [N]? n
DTE address [ ]?301
DTE address [ ]?

XTP config>add peer-router
Router's IP address?128.185.100.1

XTP config>add remote-dte
DTE address [ ]?101
Peer router's internal IP Address ]0.0.0.0]?128.185.100.1
Peer router's internal IP Address [0.0.0.0]?

XTP config>add pvc
Local PVC Range Start [1]?
Local PVC Range End [1]?
Local X.25 DTE address [ ]? 101
Remote PVC Range Start [1]?
Remote PVC Range End [1]?
Remote X.25 DTE address [ ]? 301
```

Remote 2 router

*talk 6

```
Config>set data-link x25 1
Config>set data-link ppp 2
Config>network 1

X.25 Config>set address 400
X.25 Config>set clocking external
X.25 Config>set speed 19200
X.25 Config>set equipment-type dte
X.25 Config>set svc low-inbound 0
X.25 Config>set svc high-inbound 0
X.25 Config>set svc low-outbound 0
X.25 Config>set svc high-outbound 0
X.25 Config>set svc low-two-way 1
X.25 Config>set svc high-two-way 64
X.25 Config>add protocol
Protocol [IP]?xtp
Window Size [2]?
Default Packet Size [128]?
Maximum Packet Size [256]?
X.25 Config>exit

Config>protocol ip
IP config>add address
Which net is this address for [0]?2
New address [0.0.0.0]?128.185.100.9
Address mask [255.255.0.0]?255.255.255.0

IP config>set internal-ip-address
Internal IP address [0.0.0.0]?128.185.100.3
IP Config>exit
Config>

Config>protocol xtp
XTP config>add local-dte
Interface number [0]?1
Allow inbound calls without calling DTE address? (Y or N) [N]? n
DTE address [ ]?401
Pref CUG [ ]? 23
CUG (2) [ ]? 24
CUG (3) [ ]? 25
CUG (4) [ ]? 26
CUG (5) [ ]? 27

DTE address [ ]?402
Pref CUG [ ]?
DTE address [ ]?403
Pref CUG [ ]?
DTE address [ ]?404
Pref CUG [ ]?
DTE address [ ]?
```

```
XTP Config>add peer-router  
Router's IP address?128.185.100.1  
  
XTP config>add remote-dte  
DTE address [ ]?201  
Peer router's internal IP Address [0.0.0.0]?128.185.100.1  
Peer router's internal IP Address [0.0.0.0]?  
XTP config>exit  
  
Config>
```

Using XTP

Chapter 36. Configuring and Monitoring XTP

This chapter describe the XTP configuring and monitoring commands. It includes the following sections:

- “XTP Configuring Commands”
- “XTP Monitoring Commands” on page 464

XTP Configuring Commands

This section describes the XTP configuring commands.

To access the XTP configuring environment, enter the **protocol xtp** command at the Config> prompt.

```
Config> p xtp
XTP config>
```

Enter the XTP configuring commands at the XTP config> prompt.

Table 62. XTP Configuration Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Add	Adds an interface, peer router, closed user groups, remote DTE or PVC definitions.
Change	Changes a peer router, remote DTE or PVC definition.
Delete	Deletes a local DTE, peer router, closed user groups, remote DTE or PVC definition.
Enable-XTP	Activates the XTP forwarder.
Disable-XTP	Deactivates the XTP forwarder.
Set	Sets the value of the XTP Keepalive Timer.
List	Lists interfaces, peer routers, remote DTEs and PVC definitions.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Add

Adds a local X.25 node, a peer router, a remote X.25 node with corresponding routers, or a PVC from a local X.25 node to a remote X.25 node.

Wild card addressing is included in the XTP forwarder. When the local or remote DTE addresses are entered, they can contain a wild card character (? or *). For additional information on the use of wildcards, see “DTE Address Wildcards” on page 445 .

Syntax:

```
add                bi-cug
                   cug
                   local-dte
                   peer-router
```

XTP Configuring Commands (Talk 6)

remote-dte

pvc

cug Specifies the closed user group numbers for the XTP protocol. The first CUG you are prompted for is the preferred cug.

Valid values: 0 to 9999

Default value: None

Example:

```
add cug
Pref CUG [ ]? 114
CUG (2) [ ]? 314
CUG (3) [ ]? 478
CUG (4) [ ]?
```

bi-cug Specifies the bilateral closed user group numbers for the XTP protocol. The first bi-cug you are prompted for is the preferred bi-cug.

Valid values: 0 to 9999

Default value: None

Example:

```
add bi-cug
Pref BI-CUG [ ]? 50
BI-CUG (2) [ ]? 51
BI-CUG (3) [ ]? 52
BI-CUG (4) [ ]? 53
BI-CUG (5) [ ]? 54
```

local-dte

Adds the X.25 DTE addresses, or the X.25 nodes, that communicate with the router on the specified interface. The valid interface numbers for use with XTP are 0 to 255.

You can configure multiple local nodes. However, if the option to allow incoming calls without a calling DTE address has been selected and such a call is received, the *last* local DTE address added becomes the calling DTE address for that call.

Example:

```
add local-dte

Interface number [0]?4
Allow inbound calls without calling DTE address? (Y or N) [N]? y
DTE address [ ]?101
Pref CUG [ ]? 23
CUG (2) [ ]? 24
CUG (3) [ ]? 25
CUG (4) [ ]? 26
CUG (5) [ ]? 27
Pref BI-CUG [ ]? 6
BI-CUG (2) [ ]? 7
BI-CUG (3) [ ]? 8
BI-CUG (4) [ ]? 9
BI-CUG (5) [ ]? 10
DTE address [ ]?
```

peer-router

Adds peer routers. Enter the internal IP addresses of the routers to which the remote X.25 nodes are connected. You can use these IP addresses to open TCP connections and transport X.25 packets that contain connection requests and X.25 data.

If the internal IP address you configure for the peer-router is this router's internal IP address, the software establishes a local XTP connection.

Example:

```
add peer-router
```

```
Router's internal IP Address [0.0.0.0]?128.185.100.2
Connection setup timeout [230]?
```

remote-dte

Adds remote X.25 nodes and corresponding routers. You can connect remote nodes with local X.25 nodes so they can exchange data. You must configure an IP address for each remote X.25 node you configure. Any request or data sent to this remote node goes to the router. The router then uses one of its local X.25 interfaces to forward the data to the X.25 node.

Define a remote DTE if this router is to initiate XTP connections to the remote DTE due to incoming calls from its local DTEs, or if the remote DTE is part of an XTP PVC definition.

To use Local XTP, the peer router address must be the internal address of the local router and that DTE address must be previously defined using the **add local** command.

Example:

```
add remote-dte
```

```
DTE address [ ]?301
Peer router's internal IP Address [0.0.0.0]?128.185.100.2
Peer router's internal IP Address [0.0.0.0]?
```

pvc

Adds a PVC from a local X.25 node to a remote X.25 node.

Three things need to exist in order to activate a PVC configuration:

- An X.25 PVC from the router to the local X.25 node
- An X.25 PVC from the peer router to the remote X.25 node
- A TCP connection to the peer router where the remote node is resident

Example:

```
XTP config>add pvc
Local PVC Range Start [1]?
Local PVC Range End [1]?
Local X.25 DTE address [ ]? 101
Remote PVC Range Start [1]?
Remote PVC Range End [1]?
Remote X.25 DTE address [ ]? 301
```

Notes:

1. When you add PVCs to the router configuration, you also must configure the PVC in X.25. For details on configuring X.25 interfaces, refer to *Software User's Guide*
2. For Local XTP, you must define the PVC in both directions. You need this definition because the router is performing both local and remote functions. For example, to define Local PVC 8 and Remote PVC 10 when you are using Local XTP, you would do the following:

```
XTP config>add pvc
Local PVC Range Start [1]? 8
Local PVC Range End [1]? 8
Local X.25 DTE address [ ]? 108
Remote PVC Range Start [1]? 10
Remote PVC Range End [1]? 10
Remote X.25 DTE address [ ]? 301
```

```
XTP config>add pvc
Local PVC Range Start [1]? 10
Local PVC Range End [1]? 10
Local X.25 DTE address [ ]? 310
Remote PVC Range Start [1]? 8
Remote PVC Range End [1]? 8
```

XTP Configuring Commands (Talk 6)

Remote X.25 DTE address []? 108

3. A PVC range can be defined through the PVC range start and PVC range end parameters. The same number of circuits must be defined in the local PVC range as in the remote PVC range. For example, if one circuit is defined in the local PVC range, one circuit must be defined in the remote PVC range.
4. The PVCs defined must fall within the range of 1 to 255.

Note: When you add PVCs to the router configuration, you also must configure the PVC in X.25. For details on configuring X.25 interfaces, refer to the *Software User's Guide*

Change

Changes a peer router, remote DTE, or PVC from the XTP configuration.

Syntax:

```
change                peer-router
                        remote-dte
                        pvc
```

peer-router

Changes specific peer routers from the XTP configuration.

Example:

```
change peer-router
Router IP Address [0.0.0.0]?128.185.100.2
```

remote-dte

Changes specific remote DTEs in the XTP configuration.

Example:

```
change remote-dte
DTE address [ ]?401
Peer router's internal IP Address [0.0.0.0]?128.185.100.2
Peer router's internal IP Address [0.0.0.0]?
```

pvc

Changes PVC definitions for all PVCs in the range defined by the Local PVC Range Start parameter.

Example:

```
change pvc
Local PVC Range Start [1]?1
Local DTE address [ ]?301
```

Delete

Deletes a local DTE, peer router, remote DTE, or PVC from the XTP configuration.

Syntax:

```
delete                bi-cug
                        cug
                        local-dte
                        peer-router
```


XTP Configuring Commands (Talk 6)

remote-dte

pvc

bi-cug Deletes a bilateral closed user group number used by this interface.

Valid values:

- Y** Deletes the current CUG.
- N** Does not delete the current CUG.
- ALL** Deletes all remaining CUGs.
- Q** Stops deleting any remaining CUGs.

Example:

```
delete bi-cug
Delete Pref BI-CUG [Y]?
Delete BI-CUG (2) [Y]? N
Delete BI-CUG (3) [Y]? q
```

cug Deletes the closed user group numbers used by this interface. This command works similar to the **delete bi-cug** command.

Example:

```
del cug

Delete Pref CUG [Y]?
Delete CUG (2) [Y]?
Delete CUG (3) [Y]? q
```

local-dte

Deletes specific local interfaces from the XTP configuration.

Example:

```
delete local-dte

Interface number [0]?1
DTE address [ ]?101
Record deleted
```

peer-router

Deletes specific peer routers from the XTP configuration.

Example:

```
delete peer-router

Router IP Address [0.0.0.0]?128.185.100.2
Record deleted
```

remote-dte

Deletes specific remote DTEs from the XTP configuration.

Example: delete remote-dte

```
DTE address [ ]?401
```

pvc Deletes PVC definitions for all PVCs in the range defined by the Local PVC Range Start parameter.

Example:

```
delete pvc

Local PVC Range Start [1]?1
Local DTE address [ ]?301
Record deleted
```

XTP Configuring Commands (Talk 6)

Enable

Activates the XTP forwarder.

Syntax: `enable-ntp`

Example: `enable-ntp`

Disable

Deactivates the XTP forwarder.

Syntax: `disable-ntp`

Example: `disable-ntp`

Set

Sets the XTP Keepalive Timer.

Syntax: `keep-alive-timer`

Example:

```
set keep-alive-timer
```

Keepalive timer in seconds [10]?60

List

Lists the interfaces, peer routers, remote DTEs, or PVCs.

Syntax:

```
list          _all
              _cugs
              _keep-alive-timer
              _local-dtes
              _peer-routers
              _remote-dtes
              _pvcs
              _ntp-status
```

all Displays all the interfaces, peer routers, remote DTEs, and PVCs configured for XTP.

Example:

```
list all
```

```
STATUS: XTP-DISABLED
```

```
Local DTEs:
```

```
Interface      DTE Address
1              44444          Calling DTE address is optional
Pref CUG       : 7777 Others : 9999 0
Pref BI-CUG    : 0   Others :
```

XTP Configuring Commands (Talk 6)

```
4          33333          Calling DTE address is optional
          Pref CUG      : 1      Others : 2 3 4 5
          Pref BI-CUG   : 6      Others : 7 8 9 10

Peer Routers      Connection Timeout

Remote DTEs:
  DTE Address      Peer Router(s)

PVCs:
Local PVC          Local DTE      Remote PVC      Remote DTE
LCN Range          Address         LCN Range       Address

Pref CUG          : 114      Others : 314 478
Pref BI-CUG       : 1        Others : 1 1 1 1111

KEEP-ALIVE-TIMER: 10 seconds
```

cugs Lists the CUG and BI-CUG numbers defined for the XTP protocol.

keep-alive-timer

Displays all the Keepalive time configured for XTP.

local-dtes

Displays all the local DTEs configured for XTP.

Example:

```
list local-dtes
```

```
Local DTEs:
Interface      DTE Addr
1              101 Calling DTE address is required
2              201 Calling DTE address is required
```

peer-routers

Displays all the peer routers configured for XTP.

Example:

```
list peer-routers
```

```
Peer Routers:
128.185.100.2
128.185.100.3
```

pvcs Displays all the PVCs configured for XTP.

Example-

```
list pvcs
```

```
PVCs:

Local PVC      Local DTE      Remote PVC      Remote DTE
LCN Range      Address         LCN Range       Address
1 - 1          100            1 - 1           301
```

remote-dtes

Displays all the remote DTEs configured for XTP.

Example:

```
list remote-dtes
```

```
Remote DTEs:
DTE Address      Peer Router
301              128.185.100.2
401              128.185.100.3
402              128.185.100.3
403              128.185.100.3
404              128.185.100.3
```

xtp-status

Displays the status of XTP indicating whether it is enabled or disabled.

Example:

```
list xtp-status
```

```
STATUS: XTP-ENABLED
```


Delete

Deletes a local DTE, peer router, or remote DTE from the router configuration.

Syntax:

```
delete                local-dtes
                        peer-router
                        remote-dtes
```

local-dtes

Deletes a local interface from the XTP configuration.

Example:

```
delete local-dtes
Interface Number [0]?1
DTE address [ ]?101
DTE address [ ]?
```

peer-router

Deletes a peer router from the XTP configuration.

Example: delete peer-router

```
Router's IP Address [0.0.0.0]?123.185.100.2
```

remote-dtes

Deletes a remote DTE from the XTP configuration.

Example:

```
delete remote-dtes
DTE address [ ]?401
DTE address [ ]?
```

List

Displays the current active interfaces, peer routers, remote DTEs, PVCs, and SVCs.

Syntax:

```
list                  all
                        xtp-status
                        local-dtes
                        peer-routers
                        remote-dtes
                        pvcs
                        pvc-detailed
                        pvcs-all-detailed
                        svcs
                        svc-detailed
                        svc-all-detailed
```

all Displays output of all list command options.

Example:

XTP Monitoring Commands (Talk 5)

list all

STATUS: XTP-ENABLED
KEEP-ALIVE TIMER = 20 seconds

LIST OF LOCAL DTES

Interface No	Local DTE	
1	101	Calling DTE address is required
2	201	Calling DTE address is required

LIST OF PEER ROUTERS

Router	CNN State	Number of Ckts	Received Pkts	Received Bytes	Sent Pkts	Sent Bytes
128.185.100.3	Active	15	60	1533	12	142
128.185.100.2	Active	12	63	1620	10	130

LIST OF REMOTE DTES

Remote DTE	Router IP
404	128.185.100.3
403	128.185.100.3
402	128.185.100.3
401	128.185.100.3
301	128.185.100.2

LIST OF PVCS

Index No	Int No	PVC State	Local LCN	Local DTE	Remote LCN	Remote DTE
1	1	Active		100		301

LIST OF SVCS (list svcs)

Index No	Int No	Logical Channel	SVC State	Local DTE	Remote DTE	Peer Router
1	2	5	ACT	33333333333333	44444444444444	3.3.3.3

SVC 1 IN DETAIL (list svc-detailed)

Int No	Log Chn	SVC State	Received Pkts	Received Bytes	Sent Pkts	Sent Bytes	Dropped Pkts	Dropped Bytes
2	5	ACT	2	116	2	106	0	0

LIST OF SVCS (svcs-all-detailed)

Int No	Log Chn	SVC State	Received Pkts	Received Bytes	Sent Pkts	Sent Bytes	Dropped Pkts	Dropped Bytes
2	5	ACT	1	7	1	2	0	0

xtp-status

Displays whether XTP is enabled/disabled, and the time specified for the Keepalive Timer.

Example:

list xtp-status

STATUS: XTP-ENABLED
KEEP-ALIVE-TIMER = 20 seconds

local-dtes

Displays all the interfaces configured for XTP.

Example:

list local-dtes

LIST OF LOCAL DTES

Interface	Local
-----------	-------

XTP Monitoring Commands (Talk 5)

```
No          DTE
1           101    Calling DTE address is required
2           201    Calling DTE address is required
```

peer-routers

Displays all the peer routers configured for XTP.

Example:

```
list peer-routers
```

```
LIST OF PEER ROUTERS
```

Router	CNN State	Number of Ckts	Received		Sent	
			Pkts	Bytes	Pkts	Bytes
128.185.100.3	Active	15	60	1533	12	142
128.185.100.2	Active	12	63	1620	10	130

remote-dtes

Displays all the remote interfaces configured for XTP.

Example:

```
list remote-dtes
```

```
LIST OF REMOTE DTES
```

Remote DTE No	Router IP
404	128.185.100.3
403	128.185.100.3
402	128.185.100.3
401	128.185.100.3
301	128.185.100.2

pvcs Displays all the PVCs configured for XTP.

Example:

```
list pvcs
```

```
LIST OF PVCS
```

Index No	Int No	PVC State	Local LCN	Local DET	Remote LCN	Remote DTE
1	1	Active		100		301

pvc-detailed

Displays detailed information for a specific PVC definition. For a listing of Index numbers, enter **list all** at the xtp> prompt.

Example:

```
list pvc-detailed
```

```
PVC Index Number [1]?1
```

```
PVC 1 IN DETAIL
```

Int No	PVC State	Received		Sent		Dropped	
		Pkts	Bytes	Pkts	Bytes	Pkts	Bytes
1	ACTIVE	55	3220	35	2350	15	1870

pvcs-all-detailed

Displays detailed information for all PVC definitions.

Example:

```
list pvcs-all-detailed
```

```
LIST OF PVCS
```

INT No	Local LCN	PVC State	Received		Sent		Dropped	
			Pkts	Bytes	Pkts	Bytes	Pkts	Bytes
1		ACTIVE	55	3220	35	2350	15	1870

svcs Displays all the SVCs definitions.

Example:

XTP Monitoring Commands (Talk 5)

list svcs

LIST OF SVCS

Index	Int	LOG	SVC	Local	Remote	Peer
No	No	Chan	State	DTE	DTE	Router
1	1	1	Active	200	401	3.3.3.3
2	1	1	Active	200	402	3.3.3.3
3	2	2	Active	200	403	3.3.3.3
4	2	2	Active	200	404	3.3.3.3

svc-detailed

Displays information for specific SVC definitions.

Example:

list svc-detailed

SVC Index Number [1]?1

SVC 1 IN DETAIL

Int	LOG	SVC	Received		Sent		Dropped	
No	Chan	State	Pkts	Bytes	Pkts	Bytes	Pkts	Bytes
1		ACTIVE	75	4220	55	3350	20	870

svcs-all-detailed

Displays information for all the SVC definitions.

Example:

list svcs-all-detailed

LIST OF SVCS

Index	Int	Log	SVC	Received		Sent		Dropped	
No	No	Chn	State	Pkts	Bytes	Pkts	Bytes	Pkts	Bytes
1	1	1	ACTIVE	4220	55	550	20	870	
2	1	1	ACTIVE	3220	40	2350	15	970	
3	2	2	ACTIVE	4003	50	3892	20	870	
4	2	2	ACTIVE	3967	58	4167	12	800	

Chapter 37. Using Frame Relay Interfaces

This chapter describes how to use the Frame Relay interface and includes the following sections:

- “Frame Relay Overview”
- “Frame Relay Network Management” on page 477
- “Frame Relay Data Rates” on page 478
- “Circuit Congestion” on page 481
- “Bandwidth Reservation over Frame Relay” on page 484
- “Displaying the Frame Relay Configuration Prompt” on page 484
- “Frame Relay Basic Configuration Procedure” on page 484
- “Enabling Frame Relay PVC Management” on page 485
- “Enabling Frame Relay SVC Management” on page 486

Frame Relay Overview

The Frame Relay (FR) protocol is a method of transmitting internetworking packets by combining the packet switching and port sharing of X.25 with the high speed and low delay of time division multiplexing (TDM) circuit switching. FR allows you to connect multiple LANs to a single high-speed (1.54 Mbps) WAN link with multiple point-to-point virtualcircuits (VCs). FR offers the following features:

- *High throughput and low delay.* Utilizing the *core aspects* (error detection, addressing, and synchronization) of the Link Access Protocol, D-Channel (LAPD) datalink protocol, FR eliminates all network layer (Layer 3) processing. By using only the core aspects, FR reduces the delay of processing each frame.
- *Congestion detection.* Upon receiving Backward Explicit Congestion Notification (BECN) or a Forward Explicit Congestion Notification (FECN), the router initiates a controlled slowdown of traffic, thereby avoiding a complete FR network shutdown.

The router can also initiate a slowdown of traffic when it receives a Consolidated Link Layer Management (CLLM) congestion message. CLLM is an optional part of the Frame Relay standards that provides additional management information about the operation of the frame relay network to attaching DTEs.

- *Circuit access and control.* As the router dynamically learns about the availability of non-configured circuits (orphan circuits), you can control access to those new circuits.
- *Network management option.* As your network requires, the FR protocol can operate with or without a local network management interface.
- *Multiplexing protocols.* Using one VC to pass multiple protocols.
- *Data compression* that supports the FRF.9 standard. See Using the Data Compression Subsystem in *Using and Configuring Features* for details.
- *Data encryption* using a proprietary encryption scheme. See Overview of Encryption in *Using and Configuring Features* for details.

FR provides no error correction or retransmission function. To provide error-free end-to-end transmission of data, FR relies on the intelligence of the host devices.

Using Frame Relay

Frame Relay Network

The FR network consists of the FR backbone (consisting of FR switches provided by the FR carrier) providing the FR service. The router functions as the FR connection device. The router encapsulates FR frames and routes them through the network based on a Data Link Connection Identifier (DLCI). The DLCI is the medium access control (MAC) address that identifies the PVC or SVC between the router and the FR destination device. For example, in Figure 39, a packet destined to go from router B to router D would have a DLCI of 19 to reach router D; however, a packet destined to go from router D to router B would have a DLCI of 16.

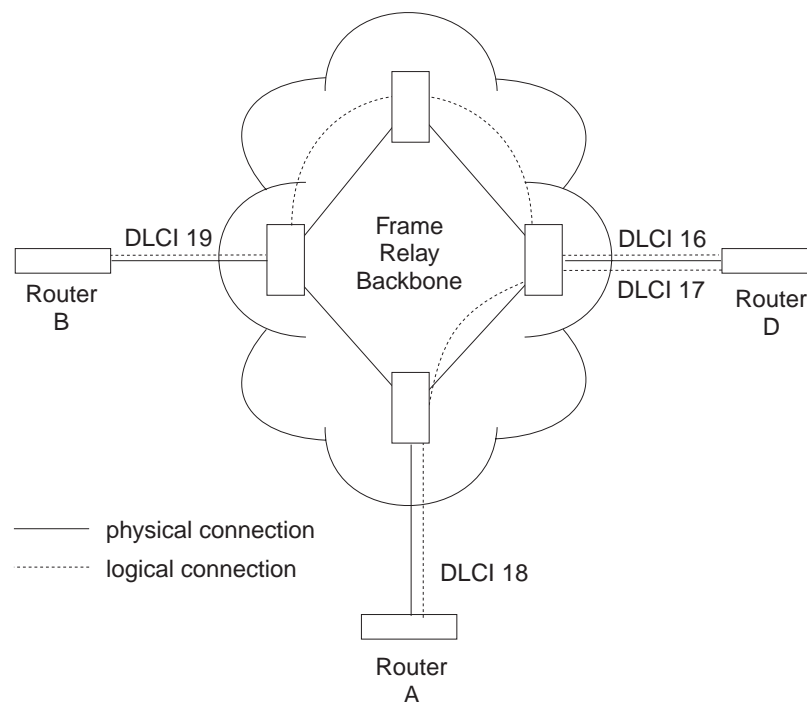


Figure 39. DLCIs in Frame Relay Network

A DLCI can have either local or global significance. Local DLCIs are significant at the point of entry to the network, but global DLCIs are significant throughout the network. To the user, however, the DLCI that the router uses to route a packet is the DLCI that the user associates with the frame's global or local destination. DLCIs are configured through the FR configuration process or learned through FR management.

FR PVCs are predefined connections used to route data through a FR network. The bandwidth allocated for a PVC within the network is a subscription option and must be allotted to the PVC whether or not the PVC uses it.

A Frame Relay network has the following characteristics:

- Transports frames transparently. The network can modify only the DLCI, congestion bits, and frame check sequence. High-Level Data Link Control (HDLC) flags and zero bit insertion provide frame delimiting, alignment, and transparency.
- Detects transmission, format, and operational errors (frames with an unknown DLCI)

- Preserves the ordering of frame transfer on individual VCs
- Does not acknowledge or retransmit frames

Frame Relay Switched Virtual Circuits

Frame Relay Switched Virtual Circuits (SVCs) provide the ability to implement "cut-through" routing in a Frame Relay network, minimizing or eliminating intermediate router hops between DTEs. Network complexity can be simplified and the DTE may experience improved performance.

SVCs may replace PVCs to conserve network bandwidth, reducing bandwidth cost.

FR SVC standards are a subset of ISDN standards and provide many of the same advantages as ISDN with less complexity.

The following protocols are supported over FR SVCs:

- AppleTalk 2
- ARP
- Bridging
- DECnet IV
- DLSw
- IP/OSPF/RIP/BGP4
- IPX

SVCs cannot be required and cannot belong to a required group.

Frame Relay Interface Initialization

Local Management Interface (LMI) is used to determine the status of PVCs on a Frame Relay interface. If an LMI is enabled, the FR interface is active when a successful exchange of LMI frames occurs between the router and the FR switch; however, no data can be received from or transmitted to another router until an LMI status message indicates that the PVC status for the DLCI to the other router is active. Also, there are instances where the FR interface state is tied to PVC states and the interface does not come up even if LMI or Q.922 exchanges are successfully occurring (for additional information, see "Configuring PVC States to Affect the Frame Relay Interface State" on page 473).

If LMI is not enabled and SVCs are enabled, the Frame Relay interface is active when a successful exchange of Q.922 frames occurs between the router and the adjacent device. All PVCs are considered active at this point. However, SVCs are active only after a successful Q.933 activation exchange.

PVC status appears for all PVCs as either active or inactive. An active PVC has a completed connection to an end system. An inactive PVC does not have a completed connection to an end system because either an end system or an FR switch is off-line.

For example, in Figure 40 on page 472 router B has a configured PVC to router D. Router B is successfully interacting with FR management through FR switch B. Because either another FR switch is down or the end system is down, the

Using Frame Relay

end-to-end PVC connection is not established. Router B receives an inactive status for that PVC.

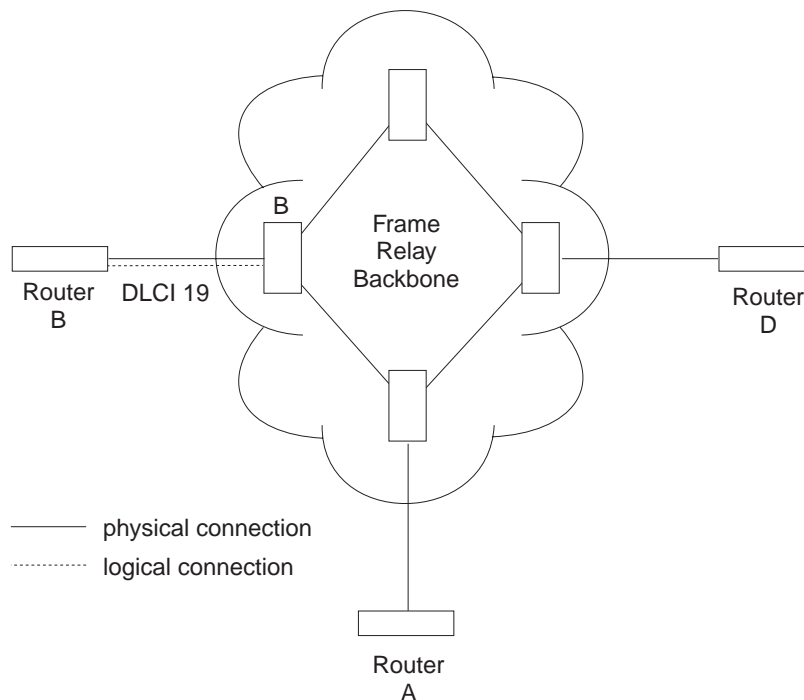


Figure 40. DLCIs in Frame Relay Network

When the LMI and SVCs are disabled, the FR interface is running on a serial line and a DTE cable is being used, the FR protocol asserts the DTR and RTS modem control signals. (The Control signal is asserted for X.21). The FR interface goes up once the DSR, CTS, and DCD modem control signals are on. (When X.21 is used, the FR interface goes up once the Indication modem control signal is on.) The FR interface is down or in the testing state if either DSR, CTS, or DCD are off or, when X.21 is used, the Indication signal is off. Therefore, you need to ensure that the modem, modem eliminator, or DSU that is used drops one or more of these signals when the physical connection to the FR switch or the other FR DTE (if configured for FR DTE to DTE connectivity) is lost.

Orphan Circuits

An orphan permanent virtual circuit is any PVC that is not configured for your router but is learned indirectly through the actions of the network management entity. For example, Figure 41 on page 473 assumes that router B has a configured PVC to router D, but none to router A. Router A configures a PVC to router B. Router B would then learn about the PVC to router A from LMI messages and classify it as an orphan.

Orphan PVCs are treated the same as configured circuits except that you may enable or disable their use with the **enable orphan-circuit** and **disable orphan-circuit** commands.

By disabling orphan circuits, you add a measure of security to your network by preventing any unauthorized entry into your network from a non-configured circuit.

Using Frame Relay

By enabling orphan circuits, you allow the router to forward packets over circuits you did not configure. Packets that would normally be dropped are now forwarded.

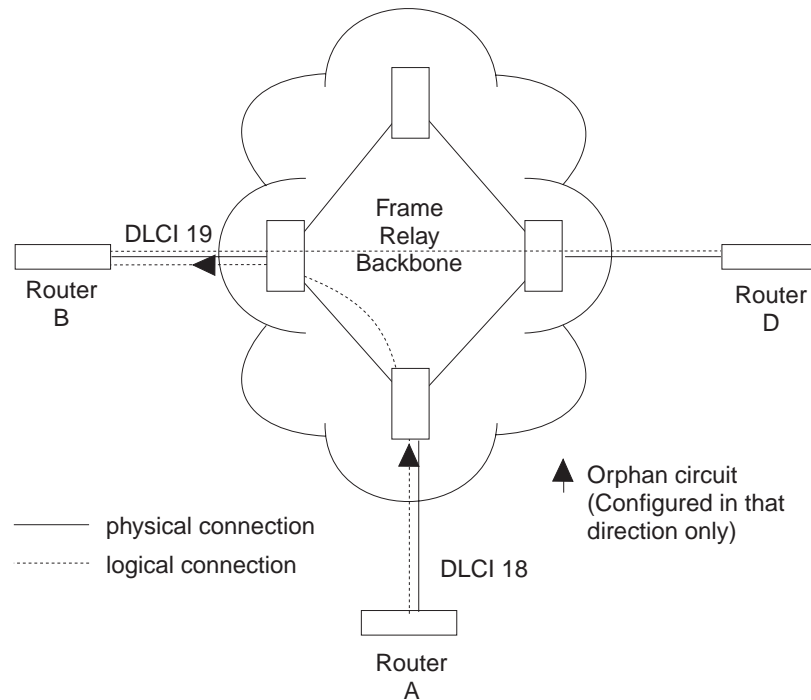


Figure 41. Orphan Circuit

An orphan switched virtual circuit is an SVC that is not configured for your router but is created when a call-in is received for it. This is similar to Figure 41. However, Q.933 messages are used instead of LMI to generate the circuit and associate the appropriate parameters with it. Orphan SVCs are treated the same as configured SVCs except that you may enable or disable their use with the call-in option of the **enable switched-virtual-circuit** command.

Configuring PVC States to Affect the Frame Relay Interface State

You can control the operation of your Frame Relay interface by

1. Enabling the “No-PVC” feature or
2. Configuring “required PVCs” or
3. Configuring “required PVC groups”.

By enabling the Frame Relay “No-PVC” feature, the Frame Relay interface becomes inactive when there are no active PVCs on the interface. If at least one PVC is active, the Frame Relay interface becomes active when a successful LMI exchange occurs between the router and the FR switch.

You can configure a PVC as a “required PVC”. If a PVC is required but not in a group, the Frame Relay interface becomes inactive when the PVC becomes inactive. When the PVC becomes active, the interface is activated following a successful exchange of LMI frames between the router and the Frame Relay switch.

Command/Response (C/R)

This field's use is not defined within the Frame-Relay standards and the field is passed transparently across the network.

Extended Address

This version of FR does not support extended addressing.

Forward Explicit Congestion Notification (FECN)

The FR backbone network sets this bit to 1 to notify the user receiving the frame that congestion is occurring for the PVC in the direction the frame is being sent. You can configure the device to slow down data transmission in the direction from which it receives a FECN using the **enable throttle-transmit-on-fecn** command. You can also set the BECN bit in data frames sent to the originator of the FECN using the **enable notify-fecn-source** command.

APPN High Performance Routing (HPR) uses detection of this bit set to allow Rapid Transport Protocol's adaptive rate-based flow and congestion control algorithm to adjust the data send rate. This algorithm prevents traffic bursts and congestion, maintaining a high level of throughput.

Backward Explicit Congestion Notification (BECN)

The FR backbone network sets this bit to 1 to notify the user that the frames sent by this router for this PVC have encountered congestion. The router then initiates a *throttle down* to a rate equal to or less than the user-defined CIR when CIR or congestion monitoring are enabled. The CIR for a PVC is supplied by the FR service provider and is configured using the **add permanent-virtual-circuit** command.

Discard Eligibility (DE)

The Frame Relay network may discard transmitted data exceeding CIR on a PVC. The DE bit can be set by the router to indicate that some traffic should be considered discard eligible. If appropriate, the Frame Relay network will discard frames marked as discard eligible which may allow frames that are not marked discard eligible to make it through the network. To identify traffic that is discard eligible:

1. Configure BRS on the Frame Relay interface and any FR circuits that has traffic that you are making discard eligible.
2. Assign a protocol or filter to a BRS traffic class using the **assign** command. You specify whether the DE bit should be set on for this protocol or filter traffic.

User Data

This field contains the protocol packet being transmitted. This field can contain a maximum of 8188 octets; however, the frame check sequence (FCS) can effectively detect errors only on a maximum of 4096 octets of data. The protocol data is preceded by a Frame Relay encapsulation header as defined in RFC 1490.

Frame Check Sequence

This field is the standard 16-bit cyclic redundancy check (CRC) that HDLC and LAPD frames use. This field detects bit errors occurring in the bits of the frame between the opening flag and FCS.

Using Frame Relay

Note: You can configure the use of a 32-bit CRC for a Frame Relay interface on a HSSI adapter.

Frame Forwarding over the Frame Relay Network

When the FR protocol receives a packet for encapsulation, it compares the packet's network address to the entries in the Address resolution Protocol (ARP) cache. If the ARP cache contains the DLCI number that matches the network address, the FR protocol encapsulates that packet into a frame and transmits the frame over its specified local DLCI. If the ARP cache does not contain a match, the FR protocol sends out an ARP request over all configured PVCs on the interface. When the appropriate end-point responds with an ARP response, the FR protocol adds its local DLCI that received the ARP response to the ARP cache. Subsequent data packets directed to the same network address are then encapsulated into a frame and sent out over its local DLCI.

Protocol Addresses

Protocol addresses can be either mapped statically to FR network PVC addresses or SVCs using locally configured names or discovered dynamically through Inverse ARP or ARP. (For more information on ARP and Inverse ARP, see the *Protocol Configuration and Monitoring Reference*.) Either method is protocol-dependent as illustrated in Table 64.

Note: Static protocol addresses are also referred to as static ARP entries. A static ARP entry is added to the configuration with the **add protocol-address** command.

Table 64. Protocol Address Mapping

Protocol Type	ARP and Inverse ARP Usage	Static Mapping	VC Configured at Protocol Configuration
AP2	Yes	Yes	No
IP	Yes	Yes	No
IPX	Yes	Yes	No
Banyan VINES**	No	No	No
DNA IV	Yes	Yes	No
OSI*, **	No	No	Yes

* You must configure OSI at the protocol level to map the protocol address to the FR PVC.

** Not supported using SVCs.

Multicast Emulation and Protocol Broadcast

Multicast emulation is an optional feature that allows protocols requiring multicast such as ARP to function properly over the FR interface. With multicast emulation, a multicast frame is transmitted on each active PVC. By using the **enable** and **disable multicast** commands, you can turn this feature on or off. Protocols that utilize multicast are AP2, ARP, Banyan VINES, DNA4, IP, and IPX.

Protocol broadcast is another optional feature that allows the IP RIP protocol to function properly over the FR interface. By using the **enable protocol-broadcast** and **disable protocol-broadcast** commands, you can turn this feature on or off.

For protocols that support ARP/InARP over Frame Relay, Frame Relay will only multicast a protocols packets over a circuit if a protocol address was either learned or configured for that circuit.

Multicast can also be enabled or disabled for an individual SVC. Use the multicast option on **add switched-virtual-circuit**.

Frame Relay Network Management

The supplier of the FR network backbone provides FR network management. It is management's responsibility to provide FR end-stations (routers) with status and configuration information concerning PVCs available at the interface.

For PVCs, the FR protocol supports the ANSI T1.617 Annex D, ITU-T Q.933 Annex A (also referred to as CCITT Q.933 Annex A), and the Interim Local Management Interface (LMI) management entities. You can turn these entities on or off using the **enable** and **disable** LMI configuration commands. Specifically, FR LMI provides the following information:

- Notification of additional PVCs (orphans) and whether they are active or inactive, or notification of any PVC deletions.
- Notification of the availability of a configured PVC. The availability of a PVC is indirectly related to the successful participation of the PVC end-point in the *heartbeat polling* process, which is detailed in "Link Integrity Verification Report" on page 478.
- Verification of the integrity of the physical link between the end-station and network by using a *keep alive* sequence number interchange.

Although the FR interface supports PVC network management, it is not necessary for management to run on the FR backbone for the interface to operate over the FR backbone. For example, you may want to disable management for back-to-back configurations.

For SVCs, the FR protocol supports FRF 4 (Frame Relay Forum Implementation Agreement 4). This includes an implementation of ANSI Q.922 and a subset of ANSI Q.933. Q.922 provides verification of the integrity of the physical link between the router and the network. Q.933 provides the means for establishing and disconnecting SVCs across the network. Q.922 and Q.933 are always enabled when SVCs are used.

Management Status Reporting

Upon request, FR LMI provides two types of status reports, a full status report and a link integrity verification report. A full status report provides information about all PVCs the interface knows about. A link integrity verification report verifies the connection between a specific end station and a network switch. All status inquiries and responses are sent over DLCI 0 for ANSI T1.617 Annex D and ITU-T Q.933 Annex A, or DLCI 1023 for interim LMI management.

Full Status Report

When the FR interface requires a full status report, the router's FR protocol sends a status enquiry message to the FR network backbone requesting a full status report. A status enquiry message is a request for the status of all PVCs on the interface.

Using Frame Relay

Upon receiving this request, FR management must respond with a full status report consisting of the link integrity verification element and a PVC status information element for each PVC. (See “Link Integrity Verification Report”.)

The PVC status information element contains the following information: the local DLCI number for the particular PVC; the state of the PVC (active or inactive); and whether the PVC is new or an existing PVC that management already knows about.

Note: The number of PVCs supplied at the FR interface is restricted by the network frame size and the amount of individual PVC information elements that can fit into a full status report. For example, 202 is the maximum number of PVCs for a network with a 1K frame size.

Link Integrity Verification Report

The link integrity verification report, sometimes referred to as *heartbeat polling*, contains the link integrity verification element. This element is where the exchange of the send and receive sequence numbers takes place. By exchanging sequence numbers, management and the end station can evaluate the integrity of the synchronous link. The send sequence number is the current send sequence number of the message originator. The receiver looks at this number and compares it to the last send sequence number to verify that this number is incrementally correct. The receive sequence number is the last send sequence number that the originator sent out over the interface. It is the receiver's responsibility to place a copy of the send sequence number into the receive sequence number field. This way the originator can ensure that the receiver receives and interprets the frames correctly.

When an end-station fails to participate in this polling process, all remote end-stations with logically attached PVCs are notified through management's full status report mechanism that the PVC is inactive.

Consolidated Link Layer Management (CLLM)

CLLM is an optional FR management function that is not widely supported by the industry but it has been adopted by some Frame Relay switch manufacturers. CLLM provides some of the same management information provided by LMI, in particular, outage notification. CLLM's main use is to provide asynchronous congestion notification of PVCs to attaching devices. A single CLLM message may indicate outage or congestion for multiple PVCs. The Frame Relay protocol supports the following standards for CLLM: ANSI T1.618, ITU-T (CCITT) Q.922 Annex A, and ITU-T (CCITT) X.36 Annex C.

Frame Relay Data Rates

This section introduces data rates for Frame Relay permanent virtual circuits (PVCs).

Committed Information Rate (CIR)

The CIR is the data rate that the network commits to support for the VC under normal, uncongested conditions. Any VC that is configured or is learned is provided a CIR (by the FR service provider). The CIR is a portion of the total bandwidth of

the physical link of either 0 or between 300 bps and 2 Mbps * reserved for the VC. 64 Kbps or a single DS0 channel is most common.

***Note:** The maximum CIR value for a FR interface on a HSSI adapter is 52 Mbps.

You define the CIR with the **add permanent-virtual-circuit**, **change permanent-virtual-circuit**, **add switched-virtual-circuit**, or **change switched-virtual-circuit** configuration command. You can also dynamically change the CIR with the **set circuit** console command. You can also set the default CIR for all Frame Relay circuits on this interface using the **set CIR-defaults** command.

Some Frame Relay switches allow a value of 0 to be configured for CIR. When CIR is equal to 0, little or no bandwidth is reserved in the Frame Relay network backbone for the VC, and the VC's traffic uses non-reserved bandwidth.

Orphan Permanent Virtual Circuit CIR

The router assigns a CIR to orphan circuits based on the CIR defaults configured at the interface level. If you are relying on the orphan circuit to route important data and the CIR, Bc, and Be values from the network provider are different from the values configured at the interface level, it is recommended that you define a PVC instead of an orphan circuit. Doing this, you can assign a CIR that the network commits to support.

Committed Burst (Bc) Size

The *committed burst (Bc) size* is the maximum amount of data (in bits) that the network commits to deliver during a *calculated time (Tc) interval*. The Tc is equal to the Bc divided by the CIR ($Tc = Bc / CIR$). If you configure 0 for CIR, Frame Relay uses a value of 1 second for Tc..

For example, if you set a VC's CIR to 9600 bps and the committed burst size to 14 400 bits, the time period is 1.5 sec. ($14\ 400\ \text{bits} / 9600\ \text{bps} = 1.5\ \text{sec}$). This means that the VC is allowed to transmit a maximum of 14 400 bits in 1.5 seconds.

Note: The minimum Tc supported by FR is .1 second.

This parameter is important because of the relationship between the committed burst size and the maximum frame size. If the maximum frame size in bits is greater than the committed burst size, the network may discard frames whose size exceeds the committed burst size. Therefore, the committed burst size should be greater than or equal to the maximum frame size. It should also equal the burst size set up with the network provider.

Use the **add permanent-virtual-circuit**, **change permanent-virtual-circuit**, **add switched-virtual-circuit** or **change switched-virtual-circuit** configuration commands to set the committed burst size. The **set circuit** console command can be used to dynamically change the committed burst size. You can also set the default committed burst size for all Frame Relay circuits on this interface using the **set CIR-defaults** command.

The device assigns orphan circuits a committed burst size based on the default you set with the **set CIR-defaults** command. If you configure 0 for CIR, then the committed burst (Bc) size also equals 0.

Using Frame Relay

Excess Burst (Be) Size

The *excess burst (Be) size* is the maximum amount of uncommitted data the router can transmit on a PVC in excess of the Bc during the Tc ($Tc = Bc / CIR$) when CIR and Bc are nonzero. When CIR = 0, Frame Relay used a value of 1 second for Tc.

The network delivers this excess data with a lower probability of success than committed burst size data. Set the Be to a value greater than zero only if you are willing to accept the risk of discarded data and its effect on higher-layer protocol performance. The Be should equal the value set up with the network provider.

Use the **add permanent-virtual-circuit**, **change permanent-virtual-circuit**, **add switched-virtual-circuit** or **change switched-virtual-circuit** commands during frame-relay configuration to set the excess burst size. You can also use the **set circuit** console command to dynamically change the excess burst size. Orphan circuits will receive a default excess burst size equal to the value set in the **set CIR-defaults** command. If you configure 0 for CIR, then you must configure a nonzero value for the excess burst (Be) size. You can also set the default excess burst size for all Frame Relay circuits on this interface using the **set CIR-defaults** command.

Line Speed

The *line speed* is the interface's line speed.

The FR interface's line speed is configured using the **set line-speed** configuration command. The line speed must be configured when internal clocking is used. However, it is recommended that you configure a line speed for external clocking since the router uses the line speed as the maximum information rate when congestion monitoring is enabled. Also some of the protocols use an interface's configured line speed when calculating a route's cost.

The line speed is not configurable on a Frame Relay dial circuit interface. If the dial circuit is mapped to an ISDN base interface, 64 Kbps is used as the line speed.

For dial circuits using Channelized T1/E1 as the base net, the line speed is 64 Kbps times the number of timeslots assigned or 56 Kbps if you set the bandwidth of the Channelized circuit to 56 Kbps. For example, if you set the number of timeslots for a Channelized circuit to 3, the line speed is 192 Kbps ($3 * 64$ Kbps).

If the dial circuit is mapped to a V.25bis base interface, the line speed of the V.25bis interface is used for the FR dial circuit.

Minimum Information Rate

The *minimum information rate (IR)* is the minimum data rate for a VC that the router throttles down to when it is notified of congestion. You set the minimum IR as a percentage of CIR using the **set ir-adjustment** configuration command. It can be dynamically changed using the **set ir-adjustment** console command. If you configure CIR equal to 0, the minimum IR is 1500 bps.

Maximum Information Rate

The *maximum information rate* is the maximum data rate at which the router transmits for a VC. If the CIR monitoring feature is enabled and CIR and Bc are nonzero, the maximum information rate is calculated using CIR, Bc, and Be as follows:

$$(Bc + Be) \text{ per } Tc \text{ interval}$$

If the CIR monitoring feature is enabled and CIR and Bc are configured equal to 0, the maximum information rate is equal to the excess burst size (Be) per second.

If the CIR monitoring feature is not enabled the maximum information rate is equal to the line speed.

Variable Information Rate

The *variable information rate* (VIR) ranges from the configured minimum IR to the calculated maximum IR when the CIR monitoring or congestion monitoring features are enabled. The VIR is gradually decreased down to the minimum information rate when the router is notified of congestion on a circuit and is gradually increased to the maximum information rate when the router stops receiving congestion notifications. Using the **set ir-adjustment** configuration command, you configure the percentage of the information rate by which the VIR should decrease when the router is notified of congestion. You also use this command to configure the percentage of the information rate by which the VIR should be gradually increased when the congestion ends.

To avoid impulse loading of the network, the router initially sets the VIR to CIR when the VC becomes active. If you configure 0 for CIR, VIR is initially set to excess burst (Be) times the MIR adjustment percentage. For example, if Be is set to 64 000 and the MIR adjustment percentage is set to 25%, then the initial VIR would be equal to 16 000 bps.

The VIR can actually exceed the maximum value in one case. If the length of a frame in bits is greater than the maximum IR, Frame Relay transmits the frame anyway.

Circuit Congestion

Circuit congestion occurs for one of the following reasons:

- The sender is transmitting faster than the allowable throughput
- The receiver is too slow when processing the frames
- An intermediate backbone link is congested, resulting in the sender transmitting faster than the available throughput allows.

When circuit congestion happens, the network must drop packets and/or shut down.

In response to circuit congestion, the router implements a *throttle down*, which is a step-wise slowing of packet transmission to the configured minimum IR. Throttle down occurs during the following conditions:

- Circuit congestion is occurring.
- The router is the sender of frames.
- CIR monitoring or congestion monitoring is enabled.

Using Frame Relay

This section discusses monitoring of Frame Relay data rates and circuit congestion.

CIR Monitoring

CIR monitoring is an optional Frame Relay feature that you can set for each interface to prevent the router from creating congestion conditions in the FR network. CIR monitoring allows the VIR for a VC to range between the configured minimum and maximum IR.

CIR monitoring is configured with the **enable cir-monitor** configuration command and is disabled by default. CIR monitoring, when enabled, overrides congestion monitoring. You can also dynamically enable and disable CIR monitoring using the **enable cir-monitor** and **disable cir-monitor** console commands.

Congestion Monitoring

Congestion monitoring is an optional feature, set per interface, that allows the VIR of VCs to vary in response to network congestion. The VIR assumes values between the minimum IR and a maximum IR of the line speed. Congestion monitoring is enabled by default. It can be disabled with the **disable congestion-monitor** configuration command and re-enabled with the **enable congestion-monitor** command. You can also dynamically enable and disable congestion monitoring using the **enable congestion-monitor** and **disable congestion-monitor** console commands.

CIR monitoring, if enabled, overrides congestion monitoring. If both CIR monitoring and congestion monitoring are disabled, the VIR for each VC on the interface is set to the line speed and does not decrease in response to network congestion.

Note: Even with compression enabled, the device uses the uncompressed size of frames to determine if the VIR is being exceeded.

Congestion Notification and Avoidance

When congestion occurs, the FR backbone network is responsible for notifying the sender and receiver by sending out a FECN or a BECN signal. FECN and BECN are bits that are set in a frame to notify the DTEs at each end of a VC that congestion is occurring. FECN indicates that congestion is occurring in the same direction from which the frame was received; the sender is causing the congestion. BECN indicates that the frames sent by this DTE are causing network congestion.

Optionally, the network can use CLLM messages to convey congestion information for PVCs. CLLM messages are sent only to the congestion source and should be treated similarly to BECN messages by the DTE.

The example in Figure 43 on page 483 shows a congestion condition at switch B when frames are sent from router X to router Y. The FR backbone network notifies router X that frames it sends are encountering congestion by setting the BECN bit in frames sent to router X. The FR backbone network also notifies router Y that frames it receives encountered congestion by setting the FECN bit.

When the router receives a frame containing BECN, it is the router's responsibility to throttle down the VC's VIR (variable information rate) if either CIR monitoring or congestion monitoring is enabled. The router does this gradually as it receives consecutive frames with BECN until either the minimum IR is reached or a frame

Using Frame Relay

without BECN arrives. FR switches often set BECN in multiple frames after reaching a congestion threshold. In order for FR to avoid overreacting to network congestion when the network is setting multiple frames with BECN, FR will decrease a VC's VIR at most once every second. This allows the VIR to decrease gradually. As the router receives consecutive frames without BECN, the VIR gradually rises to the maximum IR.

Depending on the operation of the FR network, it may be necessary for the device to throttle down the VC's VIR when the device receives a FECN to minimize the overall amount of traffic being offered to the network as quickly as possible. Reducing the overall load on the network reduces the number of packets discarded for all VCs to relieve congestion. Enabling the **throttle-transmit-on-fecn** parameter, along with either the CIR or congestion monitoring options, causes the device to treat a FECN like a BECN thus reducing overall FR network congestion when any congestion notification is received. Use the **throttle-transmit-on-fecn** parameter only in FR networks whose queuing methods do not provide dedicated buffers for both input and output. If the **throttle-transmit-on-fecn** is enabled, FR will decrease a VC's VIR at most once every second for each BECN or FECN received.

Some FR network switches set FECN to indicate congestion but do not set BECN. To provide congestion notification to the source of the congestion, enable the **notify-fecn-source** parameter allowing the device to set BECN in frames that it transmits over a VC on which it has received a FECN. This action provides a signal to the device that is causing the network congestion to throttle down its VC's VIR.

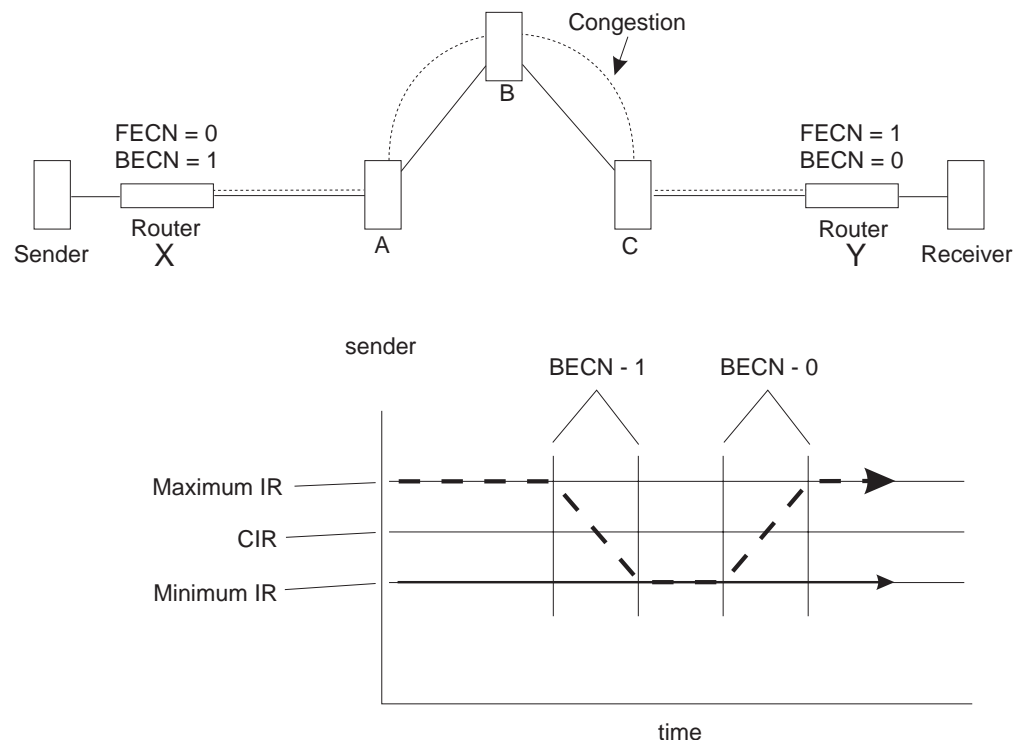


Figure 43. Congestion Notification and Throttle Down

Note: If multiple DLCIs are configured between two end-stations when congestion occurs, it is possible that a second DLCI may be used to transmit data at a higher throughput until the congestion condition on the first DLCI is corrected.

Using Frame Relay

Similarly, if the network provider supports CLLM, you can configure Frame Relay to *throttle down* its transmit rate for PVCs contained in a CLLM message. CLLM messages contain a cause code that indicates the type and severity of the problem being reported. The device reacts differently depending on the cause code and the CIR configured for each PVC contained in the CLLM message. When the device receives a CLLM message that indicates:

- A short-term condition, and the configured CIR for the PVC is nonzero, the Frame Relay protocol will throttle the transmit rate for the affected PVCs by the configured IR decrement percentage.
- A long-term condition, the Frame Relay protocol will set the transmit rate for the affected PVCs to the calculated minimum information rate.
- Facility or equipment failure or maintenance action, or if the CIR was configured as zero, the FR protocol will continue to transmit any queued data for the affected PVCs but will not accept any more outgoing packets from the upper layer protocols until the congestion condition is cleared.

Once a CLLM message for a PVC has been received, if the device does not receive any CLLM messages or BECNs within the *Ty* timer period or if a frame without a BECN is received, the device will consider the congestion condition cleared and gradually return the PVC to its configured transmission rates. If you are using CLLM to control congestion, you must not configure DLCI 1007 for any other use.

Bandwidth Reservation over Frame Relay

For information on bandwidth reservation over Frame Relay, refer to Using Bandwidth Reservation and Priority Queuing and Configuring and Monitoring Bandwidth Reservation in *Using and Configuring Features*.

Displaying the Frame Relay Configuration Prompt

To access the Frame Relay configuration environment:

1. At the OPCON prompt (*), type **talk 6**.
2. At the configuration prompt (Config>), enter the **list devices** command to see a list of interfaces configured on the router.
3. Enter the **network** command to display the Frame Relay configuration prompt. The network number is the number of the Frame Relay interface.

```
Config>network
What is the network number [0] 2
Frame Relay user configuration
FR 2 Config>
```

4. At the Frame Relay interface configuration prompt (FR Config>), use the commands discussed in this chapter to configure Frame Relay parameters.

Frame Relay Basic Configuration Procedure

This section outlines the minimum configuration steps that you are required to perform to get the Frame Relay protocol up and running. If you desire any further configuration information and explanation, refer to the configuration commands described in this chapter.

Note: You must restart the router for new configuration changes to take effect.

- **Select FR management.** The FR Local Management Interface (LMI) protocol defaults to ANSI. You have the option of connecting to a network using the Interim LMI (REV1), ANSI T1.617 Annex D management, or ITU-T/CCITT Q.933 Annex A management. Use the **enable** and **set** commands to enable and set the required management.
- **Add a PVC.** Add any required PVCs that are needed if FR management is disabled or orphan circuits are disabled. If you want to bridge over a FR PVC, or if you want to run APPN over a FR PVC, you also must configure that PVC. Use the **add permanent-virtual-circuit** command.
- **Configure FR destination addresses.** If you are running a protocol such as IP or IPX over the FR interface, and are interconnecting with devices not supporting the Address Resolution Protocol (ARP) or Inverse ARP on FR, use the **add protocol-address** command to add the static protocol and address mapping.
- **Configure Bandwidth Reservation over Frame Relay.** In addition to the basic Frame Relay configuration, which must be done, you can also configure Bandwidth Reservation (an optional feature) over Frame Relay. For information on configuring Bandwidth Reservation, refer to Using Bandwidth Reservation and Priority Queuing in *Using and Configuring Features*.
- **Configure Discard Eligibility.** You can configure Discard Eligibility (DE) congestion control using Bandwidth Reservation. For information on configuring Discard Eligibility, refer to Using Bandwidth Reservation and Priority Queuing in *Using and Configuring Features*.
- **Configure Data Compression.** You can configure data compression for Frame Relay. For information on configuring data compression, refer to Using Data Compression in *Using and Configuring Features*.

Enabling Frame Relay PVC Management

There are three management options under Frame Relay:

- Interim Local Management Interface Revision 1
- ANSI T1.617 Annex D management
- ITU-T/CCITT Q.933 Annex A management.

Frame Relay defaults to ANSI enabled. If you want to change management types, or if you want to re-enable ANSI management, use the following procedure.

Enabling management over Frame Relay is a two-step process:

1. Enter the **enable lmi** command at the FR Config> prompt to enable management activity.
2. Enter the **set lmi-type** command to select the type of management for the interface.

See Table 65 for details of the management types available using the **set** command.

An example of how to set these management types is shown after the table. Also, refer to the **enable** and **set** command sections in this chapter for more information.

Table 65. Frame Relay Management Options

Command	Options	Description
set	lmi-type rev1	Conforms to LMI Revision 1 (Stratacom's Frame Relay Interface Specification)
set	lmi-type ansi	Conforms to ANSI T1.617 ISDN-DSS1-Signalling Specification for Frame Relay Bearer Service (known as Annex D)

Using Frame Relay

Table 65. Frame Relay Management Options (continued)

Command	Options	Description
set	lmi-type ccitt	Conforms to Annex A of ITU-T/CCITT Recommendation Q.933 - DSS1 Signalling Specification for Frame Mode Basic Call Control.

Example:

```
enable lmi
set lmi-type ansi
```

Enabling Frame Relay SVC Management

Frame Relay SVC management is automatically enabled when SVCs are enabled.

Chapter 38. Configuring and Monitoring Frame Relay Interfaces

This chapter describes the Frame Relay configuration and operational commands and includes the following sections:

- “Frame Relay Configuration Commands”
- “Accessing the Frame Relay Monitoring Prompt” on page 515
- “Frame Relay Monitoring Commands” on page 516
- “Frame Relay Interfaces and the GWCON Interface Command” on page 528

Note: For information on monitoring bandwidth reservation over Frame Relay, refer to Configuring and Monitoring Bandwidth Reservation in *Using and Configuring Features*.

Frame Relay Configuration Commands

This section describes the Frame Relay configuration commands. Enter all commands at the Frame Relay> prompt.

You must save the router for new configuration changes to take effect. Table 66

Table 66. Frame Relay Configuration Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Add	Adds PVCs, Required PVC groups, SVCs, and destination protocol addresses to the Frame Relay interface.
Change	Modifies a PVC, SVC or Required PVC group previously defined by the add command.
Disable	Disables any enabled Frame Relay features.
Enable	Enables Frame Relay features such as circuit monitoring, management options, multicast, protocol-broadcast, and orphans.
List	Displays the current configuration of the LMI, PVCs, Required PVC groups, SVCs, HDLC information, and protocol addresses.
LLC	Configures LLC parameters on the Frame Relay interface. These LLC parameters are required when running APPN over the Frame Relay interface.
Remove	Deletes any previously added PVCs, SVCs, or required PVC groups (if empty), or protocol addresses.
Set	Configures the Frame Relay management options and parameters (N1-parameter, N2-parameter, N3-parameter, P1 parameter, and T1-parameter). Configures the physical-layer parameters for FR serial interfaces. Sets the maximum frame size.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Note: In this section, the terms *circuit number* and *PVC* are synonymous with the term DLCI (Data Link Circuit Identifier).

Configuring Frame Relay Interfaces

Add

Use the **add** command to add a PVC, Required PVC group, or destination protocol address supported by the Frame Relay interface.

Syntax:

```
add                permanent-virtual-circuit . . .  
                   protocol-address . . .  
                   pvc-group . . .  
                   switched-virtual-circuit . . .
```

permanent-virtual-circuit

Adds a PVC to the Frame Relay interface beyond the reserved range 0 through 15. The maximum number of PVCs that can be added is approximately 992, but the actual number of PVCs that the interface can support depends on the throughput required for each PVC, the line speed, the type of protocols running on the interface, and the number of local management interface PVC information elements that can fit in the maximum frame size.

Example:

```
add permanent-virtual-circuit  
Circuit Number [16]?  
Committed Information Rate (CIR) in bps [64000]?  
Committed Burst Size (Bc) in bits [64000]?  
Excess Burst Size (Be) in bits [0]?  
Assign Circuit name []?  
Is circuit required for interface operation [N]?  
Does the circuit belong to a required PVC group [N]?  
What is the group name []?  
Do you want to have data compression performed [Y]?  
Do you want to have data encryption performed [N]? y  
  
Data encryption requires a key that is 16 hexadecimal characters long  
You will be asked to enter the key twice for security reasons  
  
Please enter the key for the first time now  
  
A valid encryption key has been entered  
  
Please confirm the key by entering it again  
  
The encryption keys match - the key has been accepted
```

Circuit Number

Indicates the circuit number for this PVC.

Valid Values: 16 to 1007.

Committed Information Rate

Indicates the committed information rate (CIR). The CIR can be either 0 or a value in the range 300 bps to 2 048 000 bps. For more information, see “Committed Information Rate (CIR)” on page 478. The maximum is the value of the default CIR configured for the interface.

Note: The default value is determined according the CIR-defaults set at the interface level.

Committed Burst Size

The maximum amount of data in bits that the network agrees to deliver during a measurement interval equal to committed burst (Bc)

Configuring Frame Relay Interfaces

size / CIR seconds. The range is 300 to 2048000 bits. The maximum value is value of the default committed burst configured for the interface.

Notes:

1. The default value is determined according the Bc defaults set at the interface level.
2. If CIR is configured as 0 then the committed burst size is set to 0 and you are not prompted for a value. For additional information, see “Committed Burst (Bc) Size” on page 479.

Excess Burst Size

The maximum amount of uncommitted data in bits in excess of committed burst size that the network attempts to deliver during a measurement interval equal to (Committed Burst Size/CIR) seconds. Range is 0 to 2 048 000 bits. The maximum value is the value configured for excess burst size for the interface. For additional information, see “Excess Burst (Be) Size” on page 480.

Note: The default value is determined according the Be defaults set at the interface level.

Assign Circuit Name

Indicates the ASCII string that is assigned to describe the circuit. The default is unassigned.

Is the circuit required for operation

Specify Y or N to indicate whether the circuit is required for interface operation.

Does the circuit belong to a required PVC group

This prompt is displayed only for circuits that are required. Specify Y or N to indicate whether the circuit should belong to a required PVC group.

What is the group name

Enables you to specify the name of the required PVC group when the PVC is defined as belonging to a required group. Enter a question mark (?) for a list of currently defined groups.

Do you want to have compression performed

Enables you to specify whether or not the circuit will compress data packets. This question appears only if compression is enabled on the interface.

Note: If you enable compression on a PVC and exceed the interface’s compression circuit limit, you will get a message. Compression will be performed on the circuit, if possible – that is, the active compression limit has not been exceeded when the circuit becomes active. Compression limit includes the number of compression contexts allocated to SVCs as well as PVCs.

Do you want to have data encryption performed

Enables you to specify whether or not the circuit will encrypt data packets. This question appears only if encryption is enabled on the interface. The prompts for the encryption key will only appear if you respond “yes” (or “y”) to this question.

Configuring Frame Relay Interfaces

Specifying the Encryption Key: The encryption key is 16 hexadecimal characters long. You must specify the encryption key as a value between X'0000000000000000' and X'FFFFFFFFFFFFFFFF'.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See “Load” on page 90 .

protocol-address

This command adds statically configured destination protocol (protocol-name) addresses to the Frame Relay interface. Statically configured destination protocol addresses are useful if neither Inverse ARP nor ARP is an option, or for other reasons such as security. Adding protocol name and address mappings (static ARP) is less efficient than Inverse ARP or ARP.

- Inverse ARP is the preferred, efficient method because of dynamic address mapping with no broadcasts.
- ARP is recommended if Inverse ARP is not an option. It is less efficient than Inverse ARP because it uses address broadcast and mappings are relearned at regular intervals.

This parameter prompts you for different information depending on the type of protocol that you are adding.

Example:

```
add protocol-address  
Protocol name or number [0]?
```

IP protocol:

```
IP Address [0.0.0.0]?  
Circuit Number or name [16]?
```

IPX protocol:

```
Host Number (in hex) []?  
Circuit Number or name [16]?
```

AppleTalk Phase 2 protocol:

```
Network Number (1-65279) []?  
Node Number (1-253) []?  
Circuit Number or name[16]?
```

DN protocol:

```
Node address [0.0]?  
Circuit Number or name[16]?
```

Protocol name or number

Defines the name or number of the protocol that you are adding. If you should specify an unsupported protocol, the system will prompt you with the error message:

```
Unknown protocol name, try again
```

For example, you may have erroneously specified one of the following:

```
Prot#  Name  
0      IP  
4      DN  
7      IPX  
22     AP2
```

Configuring Frame Relay Interfaces

To see a list of supported protocol types, type ? at the Protocol name or number [IP]? prompt.

IP Address

Defines the 32-bit Internet address in dotted-decimal notation of the remote IP host.

Host Number

Defines the 48-bit IPX node address of the remote IPX host.

Network Number

Defines the AppleTalk Phase 2 network number of the remote AppleTalk host.

Node Number

Defines the node number of the interface attached to the remote AppleTalk host.

Node address

Defines the DECnet node address of the remote DECnet host. Configure the node address in the format x.y, where x is a 6-bit area address and y is a 10-bit node number.

Circuit Number or name

Defines the PVC by DLCI or name or SVC by name that this remote protocol address is associated with.

pvc-group *groupname*

Adds a required PVC group name.

Note: SVCs may not belong to a required PVC group.

switched-virtual-circuit

Adds a switched virtual circuit (SVC). The SVC will act similar to a PVC except that the SVC's bandwidth will be allocated for it dynamically by the FR network only when the SVC is active. The number of SVCs that can be added is similar to the number of PVCs that can be added in that the number depends on the throughput required for each circuit, the line speed, etc. However, since the bandwidth for an SVC is only reserved when the SVC is active, it may be possible to support more SVCs over an interface than PVCs.

```
FR 4 Config>add switched-virtual-circuit
Circuit name []? svc01
Remote party number []? 12345
Remote party number numbering plan (E.164 or X.121) [E.164]?
Remote party number type (Unknown or International) [International]?
Remote party subaddress in hexadecimal []? 01
Remote party subaddress format (private or NSAP) [private]1?
Requested outgoing Committed Information Rate (CIR) in bps [64000]?
Minimum acceptable outgoing Committed Information Rate (CIR) in bps [64000]?
Requested incoming Committed Information Rate (CIR) in bps [64000]?
Minimum acceptable incoming Committed Information Rate (CIR) in bps [64000]?
Requested outgoing Committed Burst size (Bc) in bits [64000]?
Requested incoming Committed Burst size (Bc) in bits [64000]?
Requested outgoing Excess Burst size (Be) in bits [0]?
Requested incoming Excess Burst size (Be) in bits [0]?
Idle timer in seconds [60]?
Establish circuit to learn remote protocol addresses [Y]?
Is multicast required for this circuit [Y]?
Are call-ins allowed for this circuit [Y]?
```

Circuit name

Specifies the circuit name for the SVC. This name will be used to associate the call with both a protocol and a BRS definition and will be used to identify a connection instead of a circuit number.

Configuring Frame Relay Interfaces

Valid Values: A 1 - 32 character ASCII string

Default Value: The name is required and must be unique for this interface

Remote party number

Specifies the remote destination's Frame Relay address.

Valid Values: A 1 - 20 character string of decimal digits

Default Value: None

Remote party numbering plan

Specifies the format of the remote party number. The numbering plan must match that used by the FR network.

Valid Values: E.164 (ISDN) or X.121 (Data)

Default Value: E.164

Remote party number type

Specifies the destination Frame Relay party number type. The number type must match that used by the FR network.

Valid Values: International or Unknown

Default Value: International

Remote party subaddress

Specifies the party entity (for example, protocol) within the destination node. If the subaddress is used, it will be matched to the remote device's subaddress. The subaddress at both ends of the connection must be the same.

The format of the **remote party subaddress** can be:

- NSAP

The number of digits entered must be even and in the range of X'0' - X'F'.

- Private

If the encoding is BCD, then an odd number of digits in the range of 0 - 9 can be entered.

If the encoding is not BCD, then an even number of digits in the range of X'0' - X'F' can be entered.

The combination of **remote party number** and **remote party subaddress** must be unique on this interface. If parallel connections between two router interfaces is required, the subaddress must be used to uniquely identify each switched virtual connection definition.

Valid Values: 1 - 40 character hexadecimal string

Default Value: None

Requested outgoing throughput (CIR)

Specifies the requested outgoing CIR. The network will provide this bandwidth, if available.

Valid Values: The CIR can be either 0 or a value in the range 300 bps to 2 048 000 bps.

Configuring Frame Relay Interfaces

Note: The valid values for a FR interface on a HSSI adapter are: 0 or 300 - 52 000 000

Default Value: Default value is determined according to CIR-defaults at the interface level

Minimum acceptable outgoing Committed Information Rate (CIR)

Specifies the minimum CIR that will be accepted if the network cannot provide the requested CIR.

Valid Values: The CIR can be either 0 or a value in the range 300 bps to 2 048 000 bps with a maximum of the **requested outgoing throughput (CIR)**.

Note: The valid values for a FR interface on a HSSI adapter are: 0 or 300 - 52 000 000

Default Value: Default value is determined according to CIR-defaults at the interface level

Requested incoming CIR

Specifies the requested incoming CIR.

Valid Values: The CIR can be either 0 or a value in the range 300 bps to 2 048 000 bps.

Note: The valid values for a FR interface on a HSSI adapter are: 0 or 300 - 52 000 000

Default Value: Value of the **requested outgoing CIR**

Minimum acceptable incoming Committed Information Rate (CIR)

Specifies the minimum CIR that will be accepted if the network cannot provide the requested CIR.

Valid Values: The CIR can be either 0 or a value in the range 300 bps to 2 048 000 bps with a maximum of the **requested incoming CIR**.

Note: The valid values for a FR interface on a HSSI adapter are: 0 or 300 - 52 000 000

Default Value: Same as **minimum acceptable outgoing CIR**

Requested outgoing committed burst size (Bc)

Specifies the requested outgoing committed burst size.

Valid Values: The CIR can be either 0 or a value in the range 300 bps to 2 048 000 bps.

Note: The valid values for a FR interface on a HSSI adapter are: 0 or 300 - 52 000 000

Default Value: Value determined according to CIR-defaults at the interface level

Requested incoming committed burst size (Bc)

Specifies the requested incoming committed burst size.

Valid Values: The CIR can be either 0 or a value in the range 300 bps to 2 048 000 bps.

Configuring Frame Relay Interfaces

Note: The valid values for a FR interface on a HSSI adapter are: 0 or 300 - 52 000 000

Default Value: Value equal to **requested outgoing Bc**

Outgoing excess burst size (Be)

Specifies the requested outgoing burst size.

Valid Values: The CIR can be either 0 or a value in the range 300 bps to 2 048 000 bps.

Note: The valid values for a FR interface on a HSSI adapter are: 0 or 300 - 52 000 000

Default Value: Value determined according to CIR-defaults at the interface level

Requested incoming excess burst size (Be)

Specifies the requested incoming excess burst size.

Valid Values: The CIR can be either 0 or a value in the range 300 bps to 2 048 000 bps.

Note: The valid values for a FR interface on a HSSI adapter are: 0 or 300 - 52 000 000

Default Value: Same as **requested outgoing excess burst size (Be)**

Idle timer

Specifies the time period that a SVC will remain active in the absence of traffic. Specifying 0 designates this SVC as a fixed circuit that will be established the first time data arrives for it and will not be disconnected even if no traffic flows over it.

Valid Values: 0 - 65535 seconds

Default Value: 60

Establish circuit to learn remote protocol addresses

Specifies whether this SVC should be established when the interface comes up to learn the protocol addresses of the adjacent node. This option can be used in place of statically configured destination protocol names and addresses for protocols that support dynamic address discovery, such as IP, IPX, Appletalk2, and DECnet IV to force the router to learn the protocol addresses associated with the remote device via directed InARP. Using this option may help reduce ARP broadcasts. The idle timer will be used to disconnect the SVC once the protocol addresses are learned.

Valid Values: yes or no

Default Value: yes

Is multicast required for this circuit

Specifies whether or not this SVC should be used to transmit multicast packets on this interface even if it means setting the SVC up just to do so. You may use static routes to keep from requiring multicast over SVCs so that the SVCs will not be established just to exchange routing information.

Valid Values: yes or no

Configuring Frame Relay Interfaces

Default Value: Defaults according to the multicast emulation setting at the interface level

Are call-ins allowed

Specifies whether or not a call-in from this remote DTE should be accepted. Specifying no can be used to block call-ins from specific users and help eliminate call-in/call-out race conditions.

Valid Values: yes or no

Default Value: yes

Compression capable

Specifies whether Frame Relay compression is supported

Valid Values: yes or no

Default Value: yes, if compression is enabled for the interface. Otherwise, no.

Encryption capable

Specifies whether encryption is supported for this SVC.

Valid Values: yes or no

Default Value: yes, if encryption is enabled for the interface. Otherwise, no.

Change

Use the **change permanent-virtual-circuit** command to change any previous PVCs that were added with the **add permanent-virtual-circuit** command.

Syntax:

```
change permanent-virtual-circuit . . .  
switched-virtual-circuit . . .
```

Example:

```
change permanent-virtual-circuit  
Circuit Number [16]?  
Committed Information Rate in bps [64000]?  
Committed Burst Size (Bc) in bits [64000]?  
Excess Burst Size (Be) in bits [0]?  
Assign Circuit Name: []?  
Is the circuit required for interface operation [N]?  
Does the circuit belong to a required group [N]?  
What is the group name []?  
Do you want to have data compression performed []?  
Do you want to have data encryption performed []?
```

permanent virtual circuit

See page 488 for a description of the parameters.

switched-virtual-circuit

```
FR 4 Config>change switched-virtual-circuit  
Circuit name []? svc01  
Remote party number []? 12345  
Remote party number numbering plan (E.164 or X.121) [E.164]?  
Remote party number type (Unknown or International) [International]?  
Remote party subaddress in hexadecimal []? 01  
Remote party subaddress format (private or NSAP) [private]1?  
Requested outgoing Committed Information Rate (CIR) in bps [64000]?  
Minimum acceptable outgoing Committed Information Rate (CIR) in bps [64000]?  
Requested incoming Committed Information Rate (CIR) in bps [64000]?  
Minimum acceptable incoming Committed Information Rate (CIR) in bps [64000]?
```

Configuring Frame Relay Interfaces

```
Requested outgoing Committed Burst size (Bc) in bits [64000]?
Requested incoming Committed Burst size (Bc) in bits [64000]?
Requested outgoing Excess Burst size (Be) in bits [0]?
Requested incoming Excess Burst size (Be) in bits [0]?
Idle timer in seconds [60]?
Establish circuit to learn remote protocol addresses [Y]?
Is multicast required for this circuit [Y]?
Are call-ins allowed for this circuit [Y]?
```

See page 491 for a description of the parameters.

Disable

Use the **disable** command to disable those features previously enabled using the **enable** command.

Syntax:

```
disable                cir-monitor
                        cllm
                        compression
                        congestion-monitor
                        dn-length-field
                        encryption
                        lmi
                        lower-dtr
                        multicast-emulation
                        no-pvc
                        notify-fecn-source
                        orphan-circuits
                        protocol-broadcast
                        switched-virtual-circuits
                        throttle-transmit-on-fecn
```

cir-monitor

Disabling this feature allows the circuit's information rate to exceed the maximum information rate that is calculated using the parameters configured with the **add permanent-virtual-circuit** or **add switched-virtual-circuit** command. The default setting for this feature is disabled. See "Circuit Congestion" on page 481 for more information.

cllm Disables the device from *throttling down* in response to a CLLM message. The default is disabled. See "Circuit Congestion" on page 481 for details.

compression

Disables compression on the interface. Compression will not be performed for any VC.

congestion-monitor

Disables the congestion monitoring feature. Disabling this feature prevents a circuit's information rate from varying in response to congestion between

Configuring Frame Relay Interfaces

the minimum information rate and the line speed. See “Circuit Congestion” on page 481 for more information. The default setting for this feature is enabled.

dn-length-field

Prevents inter-operation with implementations of DECnet Phase IV over Frame Relay that require a length field to precede DECnet packets in Frame Relay frames, but allows inter-operation with DECnet Phase IV Frame Relay software that does not use a length field before the DECnet packet. Disabling dn-length-field causes Frame Relay not to insert a length field into transmitted frames containing DECnet packets and not to attempt to remove the length field from received frames containing DECnet packets.

Note: This option is presented as a configuration option only

encryption

Disables encryption on the interface. Even though the PVCs on this interface may be encryption capable, encryption will not take place.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See “Load” on page 90.

Imi

Disabling this parameter allows for normal operation or end-to-end Frame Relay testing in the absence of a real network or management interface. With end-to-end Frame Relay testing, it is necessary to add like PVCs (the same PVC number, such as 16 and 16) on both ends of the link.

lower-dtr

This parameter determines how the data terminal ready (DTR) signal is handled for leased serial-line interfaces on the router. It is not supported on Frame Relay dial circuit interfaces. See the **enable lower-dtr** command for a more complete description of the lower-dtr parameter.

The following cable types are supported:

- EIA 232 (RS-232)
- V.35
- V.36

The default setting is **disable lower-dtr**.

multicast-emulation

Disables multicast emulation on each active VC. The default setting for this feature is enabled. If you disable this feature, you are required to add protocol static address maps.

Some protocols, such as IPX RIP, will not function on the Frame Relay interface if multicast-emulation is disabled. The protocol-broadcast feature also requires multicast-emulation in order to function properly. For more information, see “Multicast Emulation and Protocol Broadcast” on page 476.

no-pvc

Controls whether the interface is considered active or inactive. If no-pvc is disabled, the presence of active PVCs on the interface does not affect whether the Frame Relay interface is considered active or inactive.

notify-fecn-source

Disables setting a BECN bit on the first packet destined to a device from which the router received a packet with the FECN bit set. See “Circuit Congestion” on page 481 for more information.

Configuring Frame Relay Interfaces

orphan-circuits

Prohibits the use of all non-configured PVC orphan circuits at the interface. The default setting for orphan circuits is enabled. Disabling orphan circuits adds a measure of security to your network by preventing unauthorized entry from a non-configured circuit. However, if you disable orphan circuits, you are required to add PVCs that will be used on the interface.

protocol-broadcast

Prohibits protocols such as IP RIP from functioning over the Frame Relay interface. For more information, see “Multicast Emulation and Protocol Broadcast” on page 476. The default setting for this feature is enabled.

switched-virtual-circuits

Prohibits the use of SVCs.

throttle-transmit-on-fecn

Prohibits the device from *throttling down* the transmission of packets in response to a packet with a FECN bit set on. The default is disabled. See “Circuit Congestion” on page 481 for more information.

Enable

Use the **enable** command to enable Frame Relay features.

Syntax:

enable cir-monitor
cllm
compression
congestion-monitor
dn-length-field
encryption
lmi
lower-dtr
multicast-emulation
notify-fecn-source
no-pvc
orphan-circuits
protocol-broadcast
switched-virtual-circuits
throttle-transmit-on-fecn

cir-monitor

Enables the circuit monitoring feature. The circuit monitoring feature ensures that the circuit's information rate varies between the minimum information rate and the maximum information rate, calculated using the parameters configured with the **add permanent-virtual-circuit** command or the **change permanent-virtual-circuit** command

Configuring Frame Relay Interfaces

Note: The circuit monitoring feature overrides the congestion monitoring feature if there is a conflict when both are enabled. The default setting for this feature is disabled.

For additional information on CIR monitoring, see “CIR Monitoring” on page 482 .

Note: To maximize throughput for circuits running data compression, you should not enable CIR monitoring on the same interface on which you have enabled compression. Because the device uses the uncompressed size of frames to determine if the VIR of a PVC is being exceeded and compressed frames will require less bandwidth, the CIR of a PVC will be under-utilized if the device strictly monitors and does not exceed the configured CIR. Instead, congestion monitoring can be used to allow the device to react to congestion indications sent by the FR network to avoid frame loss.

cllm Enables the device to *throttle down* in response to a CLLM message. Contact your FR network provider to see whether this support is available. See “Circuit Congestion” on page 481 for more information.

compression

Enables compression on the interface. All compression-capable VCs on the interface can compress data packets, provided that contexts are available and the active compression circuit limit has not been exceeded. (See Using the Data Compression Subsystem in *Using and Configuring Features* for details.)

Note: To maximize throughput for circuits running data compression, you should not enable CIR monitoring on the same interface on which you have enabled compression. Because the device uses the uncompressed size of frames to determine if the VIR of a VC is being exceeded and compressed frames will require less bandwidth, the CIR of a VC will be under-utilized if the device strictly monitors and does not exceed the configured CIR. Instead, congestion monitoring can be used to allow the device to react to congestion indications sent by the FR network to avoid frame loss.

congestion-monitor

Enables the congestion monitoring feature. This feature allows a circuit's information rate to vary in response to congestion between the minimum information rate and the line speed.

Note: The circuit monitoring feature overrides the congestion monitoring feature if there is a conflict when both are enabled. The default setting for this feature is enabled.

For additional information on congestion monitoring, see “Congestion Monitoring” on page 482.

dn-length-field

Supports inter-operation with implementations of DECnet Phase IV over Frame Relay that require a length field to precede DECnet packets in Frame Relay frames. Enabling dn-length-field causes Frame Relay to insert a length field into transmitted frames containing DECnet packets and to remove the length field from received frames containing DECnet packets. This option is disabled by default. By default, Frame Relay will neither insert nor attempt to remove the length field.

Configuring Frame Relay Interfaces

Note: This option is presented as a configuration option only when the router software contains the DECnet Phase IV protocol.

encryption

Enables encryption on the interface. All VCs that are configured as encryption enabled, will encrypt all transmitted data.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See “Load” on page 90.

lmi Enables management activity.

After issuing the **enable lmi** command, use the **set lmi-type** command to select the management mode for your Frame Relay interface. See “Enabling Frame Relay PVC Management” on page 485. The system defaults to ANSI T1.617 Annex D management.

Use the **enable lmi** command to resume LMI management if you have previously disabled Frame Relay management.

LMI only provides information about PVCs on an interface, so it does not need to be enabled if only SVCs are used unless it is required by the network. Q.922 determines the usability of all SVCs on an interface and is an indicator of the state of the interface itself. When both PVCs and SVCs are on an interface, LMI and Q.922 may be active at the same time.

lower-dtr

This parameter determines how the data terminal ready (DTR) signal is handled for leased serial-line interfaces that are disabled. It is not supported on Frame Relay dial circuit interfaces. If this parameter is set to “disabled” (the default), the DTR signal will remain raised when the interface is disabled.

When lower-dtr is enabled, DTR will be lowered when the interface is disabled. This behavior may be desirable in situations where the interface has been configured as an alternate link for WAN Reroute and the interface is connected to a dial-out modem which maintains its dial connection based on the state of the DTR signal.

If this feature is enabled and the interface is disabled, the DTR signal is low and the modem keeps the dial connection down. When the interface is enabled, due to a WAN Reroute backup scenario, DTR is raised and the modem dials a stored number to the backup site. When the primary interface is restored, the alternate interface is disabled, DTR is lowered, and the modem hangs up the dial connection.

The following cable types are supported:

- EIA 232 (RS-232)
- V.35
- V.36

The default setting is **disable lower-dtr**.

multicast-emulation

Enables multicast emulation. This allows a multicast/broadcast frame to be transmitted on each active VC. Protocols such as ARP, IPX RIP, and IP RIP require multicast emulation to be enabled to function correctly over a Frame Relay interface. For more information, see “Multicast Emulation and Protocol Broadcast” on page 476. The default for this parameter is enabled.

Configuring Frame Relay Interfaces

no-pvc

Controls whether the interface is considered active or inactive. When this feature is enabled, the Frame Relay interface becomes inactive when there are no active PVCs on the interface. If at least one PVC is active, the Frame Relay interface becomes active when a successful LMI exchange occurs between the router and the FR switch.

notify-fecn-source

Enables setting a BECN bit on the first packet destined to a device from which the router received a packet with the FECN bit set. Use this parameter to enhance the congestion control mechanisms of the device in a network whether the FR switches do not themselves set BECN but set FECN. See "Circuit Congestion" on page 481 for more information.

orphan-circuits

Enables the use of all non-configured orphan circuits. The default for this feature is enabled. See "Orphan Permanent Virtual Circuit CIR" on page 479 for information about the default CIR values.

protocol-broadcast

Allows protocols such as IP RIP to function correctly over the Frame Relay interface. The multicast emulation feature must be enabled for the protocol-broadcast feature to function correctly. The default setting for this feature is enabled.

switched-virtual-circuits

Allows the use of SVCs and prompts you for the local SVC network number, the numbering plan, whether call-ins from orphan SVCs are allowed, the number of dial-out retries performed for all SVCs on the interface, and whether network emulation mode, which is used in back-to-back (for example, dial circuit) router configurations, is required.

You can also use the **enable switched-virtual-circuits** command to change configured SVC interface parameters if SVCs have already been enabled.

Example:

```
FR 1 Config> enable switched
Local party number []? 4141990
Local party number numbering plan (E.164 or X.121) [E.164]?
Local party number type (Unknown or International) [International]?
Are call-ins allowed on this interface [Y]?
Call-out redial attempts [2]?
Network emulation mode [N]?
```

Local party number

Specifies the destination's Frame Relay address.

Valid Values: A 1 - 20 character string of decimal digits

Default Value: None

Local party numbering plan

Specifies the format of the party number. The numbering plan must match that used by the FR network.

Valid Values: E.164 (ISDN) or X.121 (Data)

Default Value: E.164

Local party number type

Specifies the destination Frame Relay party number type. The number type must match that used by the FR network.

Valid Values: International or Unknown

Configuring Frame Relay Interfaces

Default Value: International

Call-ins allowed

Specifies whether calls from unconfigured (orphan) SVCs are allowed on this interface.

Call-out redial attempts

Specifies the number of call-out redial attempts that will be performed for each SVC in case of a call-out timeout on this interface.

Default Value: 2

Network emulation mode

Specifies whether this SVC is in network emulation mode. It is used for a back-to-back router configuration.

throttle-transmit-on-fecn

Enables the device to *throttle down* the transmission of packets in response to a packet with a FECN bit set on. Use this parameter to minimize overall FR network congestion whenever a congestion indication is received. It causes the device to react to a FECN in the same way that it reacts to a BECN.

List

Use the **list** command to display currently configured management and PVC information.

Syntax:

```
list                all
                    hdlc
                    lmi
                    permanent-virtual-circuits
                    protocol-address
                    pvc-groups
                    switched-virtual-circuits
```

all Displays the Frame Relay configuration. The display is a combination of the **list hdlc**, the **list lmi**, and the **list permanent virtual circuits** commands.

See **list hdlc** and **list lmi** for descriptions of the parameters.

hdlc Displays the Frame Relay High-Level Data Link Control (HDLC) configuration.

Example:

```
list hdlc
                                Frame Relay HDLC Configuration

Maximum frame size             = 2048
Encoding                       = NRZ
Idle state                     = Flag
Clocking                       = External
Cable type                     = V.35 DTE
Line speed (bps)              = 64000
Transmit delay                 = 0
Lower DTR                      = Enabled
```

Configuring Frame Relay Interfaces

Encoding

The transmission encoding scheme for the serial interface. Encoding is NRZ (non-return to zero) or NRZI (non-return to zero inverted).

Idle The data link idle state: flag or mark.

Clocking

The type of clocking: internal or external.

Cable type

The serial adapter cable type: RS-232, V.35, V.36, or X.21.

Line Speed (bps)

Indicates the physical data rate for the Frame Relay interface.

Maximum frame size

Indicates the maximum frame size that can be transmitted or received over the network at any given time.

Transmit delay

Indicates the number of additional flag bytes sent between frames.

Lower DTR

Indicates whether the router will drop the DTR signal when a WAN Reroute alternate link is no longer needed. Dropping the DTR signal causes the modem to terminate the leased-line connection for the alternate link. Lower DTR does not appear when the cable type is X.21.

Notes:

1. For a FR dial circuit interface, only the maximum frame size is displayed.
2. For FR interfaces on the HSSI adapter, the **list hdlc** command only displays a subset of the HDLC parameters shown above.

Imi Displays logical management and related configuration information about the Frame Relay interface.

Example:

```
list imi
Frame Relay Configuration

LMI enabled          = Yes  LMI DLCI          = 0
LMI type             = ANSI  LMI Orphans OK    = Yes
CLLM enabled        = Yes  Timer Ty seconds  = 10

SVC network number  = 4141990
SVC Number type     = International
SVC Numbering plan = E.164  SVC Call-out redial attempts = 2
SVC Call-ins allowed = Yes  SVC Network emulation mode = No

Protocol broadcast  = Yes  Congestion monitoring = Yes
Emulate multicast  = Yes  CIR monitoring        = No
Notify FECN Source = Yes  Throttle Transmit on FECN = Yes

Data compression   = Yes  Orphan compression   = No
Compression circuit limit = 10  Number of compression circuits = 5 1
Data encryption    = Yes  Number of encryption circuits = 1 2

PVCs P1 allowed   = 64  Interface down in no PVCs = No
Timer T1 seconds  = 10  Counter N1 increments   = 6
LMI N2 error threshold = 3  LMI N3 error threshold window = 4
MIR % of CIR      = 25  IR % Increment          = 25
IR % Decrement    = 25  DECnet length field     = No
Default CIR       = 64000  Default Burst Size      = 64000
Default Excess Burst = 0
```

¹ This line appears only when data compression is on (yes).

² This line appears only when data encryption is on (yes).

Configuring Frame Relay Interfaces

LMI enabled

Indicates whether the management features are enabled on the Frame Relay interface, yes or no.

LMI DLCI

Indicates the management circuit number. This number reflects the LMI type: 0 for ANSI and ITU-T/CCITT and 1023 for REV1.

LMI Type

Indicates the LMI type: REV1, ANSI, or CCITT.

LMI Orphans OK

Indicates if non-configured circuits are available for use, yes or no.

CLLM Enabled

Indicates whether CLLM is enabled on the Frame Relay interface.

Timer Ty seconds

Indicates the amount of time that must elapse without the device receiving any CLLM messages or BECNs before the device considers a congestion condition cleared and gradually return the PVC to its configured transmission rate.

SVC network number

Specifies the network number for the SVCs on this interface.

SVC number type

Specifies the SVC number type, unknown or international.

SVC numbering plan

Specifies whether the numbering plan is E.164 or X.121.

SVC call-out redial attempts

Specifies the number of call-out redial attempts on this interface.

SVC network emulation mode

Specifies whether this interface operates in network emulation mode for SVCs.

SVC call-ins allowed

Specifies whether call-ins are allowed on this interface.

Protocol Broadcast

Indicates whether protocols such as IP RIP can function over the Frame Relay interface, yes or no.

Emulate multicast

Indicates whether the multicast emulation feature is enabled on each active PVC, yes or no.

Congestion Monitoring

Indicates whether the congestion monitoring feature that responds to network congestion is enabled, yes or no.

CIR monitoring

Indicates whether the circuit monitoring feature that enforces the transmission rate is enabled, yes or no.

Notify FECN Source

Indicates whether this device sets a BECN bit on the first packet destined to a device from which the router received a packet with the FECN bit set.

Configuring Frame Relay Interfaces

Throttle Transmit on FECN

Indicates whether the device will *throttle down* the transmission of packets in response to a packet with a FECN bit set on.

Data compression

Indicates whether this interface has data compression enabled.

Data encryption

Indicates whether this interface has data encryption enabled and the number of circuits that are encryption capable.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See “Load” on page 90 .

Orphan compression

Indicates whether orphan circuits on this interface will have data compression enabled.

Note: Enabling compression on orphan circuits will decrease the number of available compression contexts available for the native PVCs on the device.

Orphan compression applies to both PVCs and SVCs.

Compression circuit limit

Indicates the maximum number of circuits that can participate in data compression.

Number of compression VCs

Indicates the current number of VCs supporting data compression.

P1 allowed

Indicates the number of allowable PVCs and SVCs for use with this interface.

Timer T1 seconds

Indicates the frequency with which the Frame Relay interface performs a sequence number exchange with the Frame Relay switch LMI entity.

Counter N1 increments

Indicates the number of T1 timer intervals which must expire before a complete PVC LMI status enquiry is made.

LMI N2 error threshold

Indicates the number of management event errors occurring within the N3 window that will cause a reset of the Frame Relay interface.

LMI N3 error threshold window

Indicates the number of monitored management events used to measure the N2 error threshold.

MIR % of CIR

Minimum IR, expressed as a percentage of CIR.

IR % Increment

Percentage by which the router increments the IR each time it receives a frame without BECN until it reaches the maximum IR.

Configuring Frame Relay Interfaces

IR % Decrement

Percentage by which the router decrements the IR each time it receives a frame that contains BECN until it reaches the minimum IR.

Default CIR

The committed information rate, in bits per second, used as the default for VCs on this interface.

Default Burst Size

The committed burst size, in bits, used as the default for VCs on this interface.

Default Excess Burst Size

The excess burst size, in bits, used as the default for VCs on this interface.

permanent-virtual-circuits

Displays all the configured PVCs on the Frame Relay interface.

Example:

```
FR Config>11 perm
```

```
Maximum circuits allowable = 64
Total circuits configured = 9
Total PVCs configured = 7
```

Circuit Name	Circuit Number	Circuit Type	CIR in bps	Burst Size	Excess Burst
cir16	16	\$@#Permanent	64000	64000	0
cir244	244	#Permanent	64000	64000	0
cir33	33	#Permanent	64000	64000	0
cir1005	1005	#Permanent	64000	64000	0
cir55	55	#Permanent	64000	64000	0
cir22	22	@Permanent	64000	64000	0
cir66	66	@*Permanent	64000	64000	0

* = circuit is required

= circuit is required and belongs to a Required PVC group

@ = circuit is data compression capable

\$ = circuit is data encryption capable

Maximum circuits allowable

Indicates the number of PVCs and SVCs that can exist for this interface. This number includes any PVCs that you added with the **add permanent-virtual-circuit** command and any SVCs that you added with the **add switched-virtual-circuit** command and dynamically learned through the management interface.

Total circuits configured

Indicates the total number of currently configured PVCs and SVCs that can exist for this interface.

Circuit Name

Indicates the ASCII designation of the configured PVC.

Circuit Number

Indicates the DLCI of a currently configured PVC.

Circuit Type

Indicates the type of virtual circuit currently configured. This release of Frame Relay only supports permanent virtual circuits.

Committed Information Rate

Indicates the information rate at which the network agrees to transfer data under normal conditions.

Configuring Frame Relay Interfaces

Committed Burst Size

The maximum amount of data in bits that the network agrees to deliver during a measurement interval equal to (Committed Burst Size/CIR) seconds.

Excess Burst Size

The maximum amount of uncommitted data in bits in excess of Committed Burst Size that the network attempts to deliver during a measurement interval equal to (Committed Burst Size/CIR) seconds.

pvc-groups

Displays all the Required PVC groups on the Frame Relay interface.

Example:

```
list pvc-groups
  Required PVC group = group1

  Circuit # 16
```

protocol-addresses

Displays all the statically configured protocol addresses of circuit mappings at the Frame Relay interface.

Example:

```
list protocol-addresses
  Frame Relay Protocol Address Translations
```

Protocol Type	Protocol Address	Circuit Number or Name
IP	125.2.29.4	21
IPX	000000004503	16

Protocol Type

Displays the name of the protocol running over the interface.

Protocol Address

Displays the protocol address of the device at the other end of the circuit.

Circuit Number or Name

Displays the DLCI of the PVC or the name of the SVC that is handling the protocol.

switched-virtual-circuits

```
FR 4 Config>list s
```

```
Maximum circuits allowable = 64
Total circuits configured = 9
Total SVCs configured = 2
```

Circuit Name	Options	Idle Timer		Outgoing Value	Incoming Value
circ01	ILM	60	CIR:	64000	64000
Remote party number:	IE12345		Min CIR:	64000	64000
Remote subaddress:	None		Burst:	64000	64000
			Excess:	0	0
svc01	ILM	60	CIR:	64000	64000
Remote party number:	IE12345		Min CIR:	64000	64000
Remote subaddress:			Burst:	64000	64000
P01			Excess:	0	0

Options: I - call-ins allowed, L - learn protocols, M - Multicast required
c - compression capable, e - Encryption capable

Address type: I - International, U - Unknown

Numbering plan: E - E.164, X - X.121

Subaddress format: N - NSAP, P - private

```
FR 4 Config>
```

Configuring Frame Relay Interfaces

Maximum circuits allowable

Indicates the number of circuits that can exist for this interface.

Total circuits configured

Indicates the total number of currently configured circuits for this interface.

Circuit Name

Indicates the ASCII designation of the configured circuit.

Committed Information Rate

Indicates the information rate at which the network agrees to transfer data under normal conditions.

Committed Burst Size

The maximum amount of data in bits that the network agrees to deliver during a measurement interval equal to (Committed Burst Size/CIR) seconds.

Excess Burst Size

The maximum amount of uncommitted data in bits in excess of Committed Burst Size that the network attempts to deliver during a measurement interval equal to (Committed Burst Size/CIR) seconds.

Idle Timer

Time period that the SVC will remain active in the absence of traffic.

Options

Indicates the options configured for the circuit.

Remote party number

Remote destination FR address. This address is prefixed by the address type and numbering plan used.

Remote subaddress

Remote party subaddress assigned to this connection. The subaddress is prefixed by the subaddress format.

LLC

Use the **LLC** command to access the LLC configuration environment. See "LLC Configuration Commands" on page 235 for an explanation of each of these commands.

Note: The **LLC** command is supported only if APPN is in the software load.

Syntax:

llc

Remove

Use the **remove** command to delete any PVC, Required PVC group, or protocol-address previously added using the **add** command.

Syntax:

remove permanent-virtual-circuit . . .

Configuring Frame Relay Interfaces

protocol-address

pvc-group

switched-virtual-circuit *circuit-name*

permanent-virtual-circuit *pvc#*

Deletes any configured PVC in the range 16 to 1007.

Notes:

1. When you delete a PVC that is running compression, the interface decreases the count of active compression PVCs. If this action brings the count of compression PVCs below the limit, you will receive a message to that effect.
2. When you delete a PVC that is running encryption, the interface decreases the count of active encryption PVCs.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See the CONFIG process **load** command in *Nways Multiprotocol Access Services Software User's Guide*.

protocol-address

Deletes any configured protocol addresses (static ARP entries). This parameter prompts you for different information depending on the type of protocol that you are adding.

Example:

```
remove protocol-address  
Protocol name or number [IP]?
```

IP protocol:

```
IP Address [0.0.0.0]?  
Circuit Name or Number [16]?
```

IPX protocol:

```
Host Number (in hex)[]?  
Circuit Name or Number [16]?
```

AppleTalk Phase 2 protocol:

```
Network Number (1-65279) []?  
Node Number (1-253) []?  
Circuit Name or Number [16]?
```

DN protocol:

```
Node address [0.0]?  
Circuit Name or Number [16]?
```

Protocol name or number

Defines the name or number of the protocol that you are deleting. If you try to delete an unsupported protocol the system will display the error message:

```
Unknown protocol name, try again
```

To see a list of supported protocols, type ? at the Protocol name or number [IP]? prompt.

IP Address

Defines the 32-bit internet address of the remote IP host in dotted-decimal notation.

Configuring Frame Relay Interfaces

Host Number

Defines the 48-bit node address of the remote IPX host.

Network Number

Defines the AppleTalk Phase 2 network number.

Node Number

Defines the node number of the interface attached to the remote AppleTalk host.

Node address

Defines the DECnet node address of the remote DECnet host. Configure the node address in the format *x,y*, where *x* is a 6-bit area address and *y* is a 10-bit node number.

Circuit Number

Defines the name of a PVC or SVC that the protocol runs over.

pvc-group *groupname*

Deletes any configured PVC group by name. The group is removed only if it has no member circuits.

Example: remove pvc-group PVC group name [IP]?

switched-virtual-circuit

Deletes any configured SVC by circuit name.

Set

Use the **set** command to configure the interface to run the Frame Relay protocol.

Set Command Considerations

Two parameters, the n2-parameter and the n3-parameter, require further explanation before you configure them. The n2-parameter sets the error threshold for management events, and the n3-parameter sets the number of events that are monitored in the event window. If the number of management errors in the event window equals n2, the Frame Relay interface resets. For example:

```
set n3-parameter 4
```

```
set n2-parameter 3
```

You now have a window size of 4 ($n3 = 4$) and an error threshold of 3 ($n2 = 3$). That means the system is monitoring 4 management events and checking to determine if any of those are in error. If the number of events in error equals 3 (the n2 parameter), the Frame Relay interface is reset and the status of the network is considered *network down*.

For the status of the network to be considered *network up*, the number of events in error within the window must be less than n2 prior to any change in status.

Syntax:

```
set                cable*  
                   cir-defaults  
                   clocking*  
                   crc-type*  
                   encoding*
```

Configuring Frame Relay Interfaces

frame-size
idle . . . *
ir-adjustment . . .
line-speed*
lmi-type n1-parameter
n2-parameter
n3-parameter
p1-parameter
t1-parameter
transmit-delay . . . *
ty-parameter

* **Note:** The commands with an * following them are not available for FR dial circuit interfaces.

cable *physical-interface-link-type data-connection-type*
Sets the cable type for the network physical link.

A DTE cable is used when you are attaching the router to some type of DCE device (for example, a modem or a DSU/CSU). A DCE cable is used when the router is acting as the DCE and providing the clocking for direct attachment.

The available options are:

Physical Interface Link Type	Data Connection Type
EIA 232 (RS-232)	DTE, DCE
V35	DTE, DCE
V36	DTE, DCE
X21	DTE, DCE
HSSI	DTE, DCE (see note)

Note: When a HSSI DCE cable is used, the other device must also be configured to use a HSSI DCE cable.

cir-defaults

Sets the default values for the circuit congestion parameters. The parameters are:

cir Sets the default value of *cir* to the value provided by a Frame Relay network provider.

Valid Values: 0 or 300 to 204 800 bps

Default Value: 64 000

For HSSI, the maximum value that can be configured is 52 000 000 bps.

bc Sets the default value of *bc* to the value provided by a Frame Relay network provider.

Valid Values: See “Committed Burst (Bc) Size” on page 479

Configuring Frame Relay Interfaces

Default Value: 64 000

For HSSI, the maximum value that can be configured is 52 000 000 bps.

be Sets the default value of *be* to the value provided by a Frame Relay network provider.

Valid Values: See “Excess Burst (Be) Size” on page 480

Default Value: 0

For HSSI, the maximum value that can be configured is 52 000 000 bps.

Example:

```
FR 6 config> set cir-default
Default Committed Information Rate (CIR) in bps [64000]? 48000
Default Committed Burst Size (Bc) in bits [64000]? 40000
Default Excess Burst Size (Be) in bits [0]? 52000
```

clocking [external or internal]

To connect to a modem or DSU, configure clocking as external. To connect directly to another DTE device, use a DCE cable and set the clocking to internal. For internal clocking, you must enter the

- interface 1.
- port 1 of a 4-port WAN concentration adapter.
- ports 1 and 5 of an 8-port WAN concentration adapter.

set line-speed command to configure a clock speed using the ranges shown in Table 67 on page 514.

Note: **Clocking** is set to *external* if the cable type is *HSSI DTE* and is set to *internal* if the cable type is *HSSI DTE* and is not configurable.

crc-type [crc-ccitt-16 or crc-ccitt-32]

CRC type can be configured as either 16-bit CRC or 32-bit CRC. The default is **crc-ccitt-16**.

Note: CRC type can only be configured for a FR interface on a HSSI adapter.

encoding [NRZ or NRZI]

Sets the HDLC transmission encoding scheme as NRZ (non-return to zero) or NRZI (non-return to zero inverted). Most configurations use NRZ, which is the default.

Note: Encoding is set to NRZ for a FR interface on a HSSI adapter and is not configurable.

frame-size

Sets the maximum size of the network layer portion of the frames transmitted and received on the interface. This maximum size includes the 2-byte DLCI address and the user data shown in figure 39-4. The size you configure must be consistent with the maximum frame size supported by the Frame Relay switch and by the other FR DTEs in the Frame Relay network. Values are 262 to 8190. The default is 2048. Since the configured frame size includes the DLCI address and the FR RFC 1490 multi-protocol encapsulation header, the maximum protocol packet size that can be

Configuring Frame Relay Interfaces

transmitted is less than the configured frame size and is protocol dependent. The following table shows how many bytes to subtract from the configured frame size to determine the maximum protocol packet size that can be transmitted and received on the interface.

IP	4 bytes
IPX	10 bytes
Appletalk Phase 2	10 bytes
DECnet Phase IV (DNA IV)	12 bytes
Banyan Vines	10 bytes
OSI	10 bytes
Bridging	10 bytes
APPN	58 bytes (see note)

Note: Assumes worst case for APPN BAN where a T/R MAC address header and LLC header are added in addition to the FR header bytes.

If FR data encryption is enabled then you must subtract up to an additional 12 bytes.

When using Frame Relay SVCs, the maximum information field size must be the same at both ends of the virtual circuit. To determine the maximum information field size, subtract 16 bytes from the frame size if encryption is enabled on the SVC and subtract 4 bytes if encryption is not enabled on the SVC.

idle [flag or mark]

Sets the transmit idle state for HDLC framing. The default value is **flag**, which provides continuous flags (7E hex) between frames. The mark option puts the line in a marking state (OFF, 1) between frames.

Note: Idle is set to **flag** for a FR interface on a HSSI adapter and is not configurable.

ir-adjustment *increment-% decrement-% minimum-IR*

Sets the minimum information rate (IR) and the percentages for incrementing and decrementing the IR in response to network congestion.

The minimum IR, expressed as a percentage of CIR, is the lower limit of the information rate. The minimum percentage is 1 and the maximum percentage is 100. The default is 25.

When network congestion clears, the information rate is gradually incremented by the IR adjustment increment percentage until the maximum information rate is reached. The minimum percentage is 1 and the maximum percentage is 100. The default is 12.

When network congestion occurs, the information rate is decremented by the IR adjustment decrement percentage each time a frame containing BECN is received until the minimum information rate is reached. The minimum percentage is 1, and the maximum percentage is 100. The default is 25.

Example:

```
set ir-adjustment
IR adjustment % increment [12]?
IR adjustment % decrement [25]?
Minimum IR as % of CIR [25]?
```

Configuring Frame Relay Interfaces

line-speed rate

For internal clocking, this command specifies the speed of the transmit and receive clock lines.

Table 67. Line Speeds When Internal Clocking is Used for 2216 Interfaces

Adapter Type	Speed Range
8-port EIA 232	9600 to 64 000 bps
6-port V.35/V.36	9600 to 460 800 bps, 1 544 000 bps, or 2 048 000 bps
8-port X.21	9600 to 460 800 bps, 1 544 000 bps, or 2 048 000 bps
1-port HSSI	22 368 000 bps or 44 736 000 bps

For external clocking, this command does not affect the hardware (in other words, the actual speed of the line) but it sets the speed of some protocols, such as IPX, used to determine routing cost parameters. Congestion monitoring also uses the configured line speed to determine the maximum information rate. Therefore, it is recommended that you set the speed to match the actual line speed.

- interface 1.
- port 1 of a 4-port WAN concentration adapter.
- ports 1 and 5 of an 8-port WAN concentration adapter.

Use Table 68 to determine the line speeds supported for the serial adapters when external clocking is used.

Table 68. Line Speeds When External Clocking is Used for 2216 Interfaces

Adapter Type	Speed Range
8-port EIA 232	2400 to 64 000 bps
6-port V.35/V.36	2400 to 2 048 000 bps
8-port X.21	2400 to 2 048 000 bps
1-port HSSI	1 544 000 bps to 52 000 000 bps

lmi-type [rev1 or ansi or ccitt]

Sets the management type for the interface. See “Enabling Frame Relay PVC Management” on page 485 for details on setting Frame Relay management. The default is type **ansi** enabled.

Table 69. Frame Relay Management Options

Command	Management Type	Description
set	lmi-type rev1	Conforms to LMI Revision 1, (Stratacom’s Frame Relay Interface Specification)
set	lmi-type ansi	Conforms to ANSI T1.617 ISDN-DSS1-Signalling Specification for Frame Relay Bearer Service (known as Annex D)
set	lmi-type ccitt	Conforms to Annex A of ITU-T/CCITT Recommendation Q.933 - DSS1 Signalling Specification for Frame Mode Basic Call Control.

n1-parameter count

Configures the number of T1 timer intervals which must expire before a complete PVC status enquiry is made. *Count* is the interval in the range 1 to 255. The default is 6.

n2-parameter max#

Configures the number of errors that can occur in the management event

Configuring Frame Relay Interfaces

window monitored by the n3-parameter before the Frame Relay interface resets. Max# is a number in the range 1 to 10. The default is 3. This parameter must be less than or equal to the n3-parameter or you will receive an error message.

n3-parameter *max#*

Configures the number of monitored management events for measuring the n2-parameter. Max# is a number in the range 1 to 10. The default is 4.

p1-parameter *max#*

Configures the maximum number of PVCs supported by the Frame Relay interface. This includes active, inactive, removed, and congested PVCs. Max# is a number in the range 0 to 992. The default is 64. 0 (zero) implies that the interface supports no PVCs.

t1-parameter *time*

Configures the interval (in seconds) between sequence number exchanges with Frame Relay management. The management's T2 timer is the allowable interval for an end station to request a sequence number exchange with the manager. The T1 interval must be less than the T2 interval of the network. *Time* is a number in the range 5 to 30. The default is 10.

transmit-delay

Allows the insertion of a delay between transmitted packets. The purpose of this command is to slow the serial line so that it is compatible with older, slower serial devices at the other end. It can also prevent the loss of serial line hello packets between the lines. # is between 0 and 15 extra flags. The default is zero (0). Setting this parameter provides 0 to 15 extra flags between transmit frames. Table 70 lists the units and range values for serial interfaces.

Note: If you configure a non-zero transmit delay for a FR interface on the 8-port EIA-232E adapter, 6-port V.35/V.36 adapter, or 8-port X.21 adapter, you must configure the line speed using the **set line-speed** command.

Table 70. Transmit Delay Units and Range for the 2216 Serial Interface

Unit	Minimum	Maximum
Extra Flags	0	15

ty-parameter *time*

Configures the interval after which the device considers an existing congestion condition indicated by the receipt of a CLLM message to be cleared. If the device receives a CLLM message before the timer expires, the device resets this timer.

Valid Values: 5 to 30 seconds.

Default Value: 11 seconds.

Accessing the Frame Relay Monitoring Prompt

To access the Frame Relay operating commands and to monitor Frame Relay on your router, perform the following steps:

1. At the OPCON prompt (*), type **talk 5**.

Configuring Frame Relay Interfaces

2. At the GWCON prompt (+), enter the **interface** command to see a list of interfaces configured on the router.
3. Enter the **network** command followed by the network number of the frame relay interface. For example:

```
+ net 2
Frame Relay Monitoring
FR 2 >
```

Frame Relay Monitoring Commands

This section summarizes and then explains the Frame Relay Monitoring commands. Use these commands to gather information from the database. Table 71 shows the commands.

Table 71. Frame Relay Monitoring Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Clear	Clears statistical information on the Frame Relay interface.
Disable	Disables CIR monitoring and congestion monitoring on the Frame Relay interface.
Enable	Enables CIR monitoring and congestion monitoring on the Frame Relay interface.
List	Displays statistics specific to the data-link layer and Frame Relay management.
LLC	Displays the LLC monitoring prompt.
Notrace	Disables packet tracing capability for individual circuits or for the entire interface.
Set	Sets CIR, Committed Burst Size, and Excess Burst Size for a Frame Relay VC.
Trace	Enables packet tracing capability for individual circuits or for the entire interface.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Note: In this section, the terms *circuit number* and *PVC* are equivalent to the term *data link circuit identifier (DLCI)*.

Clear

Use the **clear** command to zero statistical counters on the Frame Relay interface.

Note: Statistics can also be cleared by using the OPCON **clear** command.

Syntax:

clear

Disable

Use the **disable** command to disable the Frame Relay CIR monitoring and congestion monitoring features.

The **disable** command dynamically changes the router configuration. These changes will be lost when the router is restarted.

Syntax:

```
disable                cir-monitor
                        cllm
                        congestion-monitor
                        notify-fecn-source
                        throttle-transmit-on-fecn
```

Enable

Use the **enable** command to enable the Frame Relay CIR monitoring and congestion monitoring features.

The **enable** command dynamically changes the router configuration. These changes will be lost when the router is restarted.

Syntax:

```
enable                cir-monitor
                        cllm
                        congestion-monitor
                        notify-fecn-source
                        throttle-transmit-on-fecn
```

List

Use the **list** command to display statistics specific to the data-link layer and the Frame Relay interface.

Syntax:

```
list                all
                        circuit . . .
                        lmi
                        permanent-virtual-circuits
                        pvc-groups
                        switched-virtual-circuit
                        svcs
                        virtual-circuits
```

all Displays circuit, management, and VC statistics on the Frame Relay interface. The output displayed for this command is a combination of the **list lmi** and **list permanent-virtual-circuit** commands.

circuit *name or number*

Displays detailed virtual circuit configuration and statistical information for the specified VC using the input circuit name or DLCI.

Example:

Monitoring Frame Relay Interfaces

list circuit 347

Circuit name = Valencia

Circuit state	=	Active	Circuit is orphan	=	No
Frames transmitted	=	0	Bytes transmitted	=	0
Frames received	=	0	Bytes received	=	0
Total FECNs	=	0	Total BECNs	=	0
Times congested	=	0	Times Inactive	=	0
CIR in bits/second	=	64000	Potential Info Rate	=	56000
Committed Burst (BC)	=	1200	Excess Burst (Be)	=	54800
Minimum Info Rate	=	16000	Maximum Info Rate	=	64000
Required	=	Yes	PVC group name	=	group1
Compression capable	=	Yes	Operational	=	Yes
R-Rs received	=	0	R-Rs transmitted	=	0
R-As received	=	0	R-As transmitted	=	0
R-R mode discards	=	0	Enlarged frames	=	0
Decompress discards	=	0	Compression errors	=	0
Compression ratio	=	1.72 to 1	Decompression ratio	=	1.10 to 1
Encryption capable	=	Yes	Operational	=	Yes
Encryption errors	=	0	Decryption errors	=	0
Rcv error discards	=	0			
Current number of xmit frames queued	=	0			
Xmit frames dropped due to queue overflow	=	0			

Circuit state

Indicates the state of the circuit: inactive, active, or congested. Inactive indicates that the circuit is not available for traffic because either the Frame Relay interface is down or the Frame Relay management entity has not notified the Frame Relay protocol that the circuit is active. Active indicates that data is being transferred. Congested indicates that data flow is being controlled.

Circuit is orphan

Indicates if the circuit is a non-configured PVC learned through LMI management or a callin-in for a non-configured SVC.

Frames/Bytes transmitted

Indicates how many frames and bytes this VC has transmitted.

Frames/Bytes received

Indicates how many frames and bytes this VC has received.

Total FECNS

Indicates the number of times that this VC has been notified of inbound or downstream congestion.

Total BECNs

Indicates the number of times that this VC has been notified of outbound or upstream congestion.

Times congested

Indicates the number of times that this VC has become congested.

Times inactive

Indicates the number of times that this VC was inoperable.

CIR in bits/sec

Indicates the information rate of the VC between the range 300 bps to 2048000 bps. A value of 0 is also supported.

Potential Info Rate

Indicates the current maximum rate in bits per second at which data will be transmitted for the circuit. The actual data rate will depend on the queue depths and priorities associated with the circuit.

Monitoring Frame Relay Interfaces

If this field has a value of "Line Speed", then the maximum data rate is the actual line speed even if the line speed was not configured or was configured incorrectly for this interface.

Committed Burst (BC)

Maximum amount of data, in bits, that the router can transmit during the *time interval* (Tc). ($Tc=Bc/CIR.$)

Excess Burst (Be)

Maximum amount of uncommitted data in bits the router can transmit on a VC in excess of the Bc during the time interval (Tc).

Minimum Info Rate

Minimum Information Rate. The minimum data rate for a VC that the router throttles down to when it is notified of congestion.

Maximum Info Rate

Maximum Information Rate. The maximum data rate at which the router transmits for a VC.

Required

Yes or No. If yes, the PVC is a Required PVC.

PVC group name

If the PVC is a member of a required PVC group, the name appears here; otherwise, "Unassigned" appears.

Compression capable

Indicates whether the circuit can compress data packets.

Operational

Indicates whether compression is active on the circuit. When this is yes, data is being compressed on this link.

R-Rs received

Indicates the number of Reset-Request packets sent by the peer decompressor. A peer decompressor sends a Reset-Request whenever the peer detects that it is out of synch with its peer compressor. If this number increases rapidly, packets are being lost or corrupted on this circuit.

R-Rs transmitted

Indicates the number of Reset-Request packets sent since compression started on the circuit. If this number increases rapidly, packets are being lost or corrupted on this circuit.

R-As received

Indicates the number of Reset-Acknowledgements received in response to Reset-Requests. The compressor also sends out this packet to signal that it has reset its compression history.

R-As transmitted

This is the number of Reset-Acknowledgements sent to the peer.

R-R mode discards

Indicates the number of compressed data frames that were discarded while waiting for an R-A after sending out an R-R.

Enlarged frames

This is a count of the frames that could not be compressed. Usually an incompressible frame is sent in its uncompressed format within a special compression frame type allowing the compressor and decompressor to remain synchronized.

Monitoring Frame Relay Interfaces

Decompress discards

Indicates the number of compressed frames that were discarded because of decompression errors.

Compression errors

Indicates the number of frames that had compression errors which were transmitted in an uncompressed form.

Compression ratio

Indicates the approximate effectiveness of the compressor.

Decompression ratio

Indicates the approximate effectiveness of the decompressor.

Encryption capable

Indicates whether this circuit is encryption enabled.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See "Load" on page 90 .

Operational

Indicates whether encryption is active on the circuit. When this is yes, data is being encrypted on this link.

Encryption errors

Indicates the number of frames that had encryption errors.

Decryption errors

Indicates the number of frames that had decryption errors.

Rcv error discards

Indicates the number of compressed frames that were discarded because of reception problems.

Current number of xmit frames queued

Indicates the number of frames currently queued for this circuit by FR. These frames are waiting for space to become available on the serial device handler transmit queue for this interface.

Xmit frames dropped due to queue overflow

Indicates the number of frames that could not be transmitted for this VC due to output queue overflow.

lmi Displays statistics relevant to the logical management on the Frame Relay interface.

Example:

list lmi

Management Status:

```
-----  
LMI enabled           = Yes  LMI DLCI           = 0  
LMI type              = ANSI LMI Orphans OK    = Yes  
CLLM enabled         = No  
  
SVC local net number = 12345678  
SVC Number type      = International  
SVC Numbering plan   = E.164  SVC Call-out retries = 2  
SVC Call-ins allowed = Yes  SVC Network emulation mode = No  
  
Protocol broadcast    = Yes  Congestion monitoring = Yes  
Emulate multicast     = Yes  CIR monitoring         = No  
Notify FECN source    = No   Throttle transmit on FECN = No  
Number VCs P1 allowed = 64   Interface down if no PVCs = No  
Line speed (bps)      = 1000000 Maximum frame size (bytes) = 2048  
Timer T1 seconds      = 10   Counter N1 increments   = 6  
LMI N2 threshold      = 3    LMI N3 threshold window = 4  
MIR % of CIR          = 25   IR % Increment           = 12
```

Monitoring Frame Relay Interfaces

```
IR % Decrement          = 25  DECnet length field      = No
Default CIR              = 64000 Default Burst Size   = 64000
  Default Excess Burst   = 0
Current receive sequence = 0
Current transmit sequence = 1
Total status enquiries   = 9  Total status responses = 0
Total sequence requests  = 0  Total responses       = 0

Data compression enabled = No
Data encryption enabled  = No

Virtual Circuit Status:
-----
Total allowed            = 64  Total configured      = 2
Total active              = 0  Total congested       = 0
Total PVCs left net     = 0  Total PVCs join net   = 0
```

Management Status:

LMI enabled

Indicates if Frame Relay management is active (yes or no).

LMI DLCI

Indicates the management circuit number. This number is either 0 (ANSI default or ITU-T/CCITT) or 1023 (interim LMI REV1).

LMI type

Indicates the type of frame relay management being used, ANSI, ITU-T/CCITT, or LMI Revision 1.

LMI orphans OK

Indicates if all non-configured circuits learned from Frame Relay LMI management are available for use (yes or no).

CLLM enabled

Specifies whether this circuit will throttle transmission on receiving CLLM frames.

Timer Ty seconds

Indicates the value of the CLLM Ty timer. This field is only displayed if CLLM is enabled.

Last CLLM cause code

Indicates the congestion cause code given in the last CLLM message received or **None** if no CLLM messages have been received. This field is only displayed if CLLM is enabled.

SVC network number

Specifies the network number for the SVCs on this interface.

SVC number type

Specifies the SVC number type, unknown or international.

SVC numbering plan

Specifies whether the numbering plan is E.164 or X.121.

SVC call-out redial attempts

Specifies the number of call-out redial attempts on this interface.

SVC network emulation mode

Specifies whether this interface operates in network emulation mode for SVCs.

SVC call-ins allowed

Specifies whether call-ins are allowed on this interface.

Monitoring Frame Relay Interfaces

Protocol broadcast

Indicates if protocols such as IP RIP are able to operate over the Frame Relay interface.

Congestion monitoring

Indicates whether the congestion monitor feature that responds to network congestion is enabled (yes or no).

Emulate multicast

Indicates whether the multicast emulation feature is enabled on each active PVC (yes or no).

CIR monitoring

Indicates whether the circuit monitoring feature that enforces the transmission rate is enabled (yes or no).

PVCs P1 allowed

Indicates the number of allowable VCs for use with this interface. This number is the maximum number of active, congested, inactive, and removed VCs that can be supported on the interface.

Interface down if no PVCs

Indicates whether the router considers the interface unavailable when there are no active PVCs.

Line speed (bps)

Indicates the configured data rate of the Frame Relay interface.

Timer T1 seconds

Indicates the frequency with which the Frame Relay interface performs a sequence number exchange with the Frame Relay switch LMI entity.

Counter N1 increments

Indicates the number of T1 timer intervals which must expire before a complete PVC LMI status enquiry is made.

LMI N2 error threshold

Indicates the number of management event errors occurring within the N3 window that will cause a reset of the Frame Relay interface.

LMI N3 error threshold window

Indicates the number of monitored management events used to measure the N2 error threshold.

MIR % of CIR

Minimum IR, expressed as a percentage of CIR.

IR % Increment

Percentage by which the router increments the IR each time it receives a frame without BECN until it reaches the maximum IR.

IR % Decrement

Percentage by which the router decrements the IR each time it receives a frame that contains BECN until it reaches the minimum IR.

DECnet length field

Indicates whether or not the DECnet length field feature is enabled. Some Frame Relay DECnet Phase IV implementations require a length field between the Frame Relay multiprotocol encapsulation header and the DECnet packet. A length field is inserted if the DECnet length field feature is enabled.

Monitoring Frame Relay Interfaces

Default CIR

Specifies the default CIR for this interface.

Default Burst Size

Specifies the default burst size for this interface.

Default Excess CIR

Specifies the default excess burst size for this interface.

Current receive sequence

Indicates the current receive sequence number that the Frame Relay interface has received from the Frame Relay management entity.

Current transmit sequence

Indicates the current transmit sequence number that the Frame Relay interface has sent to the Frame Relay management entity.

Total status enquiries

Indicates the total number of status enquiries that the Frame Relay interface has made of the Frame Relay management entity.

Total status responses

Indicates the total number of responses that the Frame Relay interface has received from the Frame Relay management entity in response to status enquiries.

Total sequence requests

Indicates the total number of sequence number requests that the Frame Relay interface has sent to the Frame Relay management entity.

Total responses

Indicates the total number of sequence number responses that the Frame Relay interface has received from the Frame Relay management entity.

Data compression enabled

Indicates whether data compression is enabled on this interface.

Orphan compression

Indicates whether orphan circuits on this interface will have data compression enabled.

Note: Enabling compression on orphan circuits will decrease the number of available compression contexts available for the native VCs on the device.

Orphan compression applies to both PVCs and SVCs.

Compression circuit limit

Specifies the maximum number of VCs that can compress data on this interface.

Active compression circuits

Specifies the number of VCs currently compressing data on this interface.

Data encryption enabled

Indicates whether data encryption is enabled on this interface.

Monitoring Frame Relay Interfaces

Note: Encryption support is optional and must be added to your software load using the **load add** command. See "Load" on page 90 .

Active encryption circuits

Indicates the number of VCs that are currently encrypting data.

Virtual Circuit Status:

Total allowed

Indicates the number of allowable VCs (including orphans) whose state is active, congested, removed, or inactive for use with this interface.

Total configured

Indicates the total number of currently configured VCs for this interface.

Total active

Indicates the number of active VCs on this interface.

Total congested

Indicates the number of VCs that are throttled down because of congestion within the network.

Total PVCs left net

Indicates the total number of PVCs that have been removed from the network.

Total PVCs joined net

Indicates the total number of PVCs that have been added to the network.

permanent-virtual-circuit

Displays general link-layer statistics and configuration information for all configured PVCs on the Frame Relay interface.

Example:

list permanent-virtual-circuit

Circuit#	Circuit Name	Orphan Circuit	Type/State	Frames Transmitted	Frames Received
16	Valencia	No	%@*P/A	2	1
17	Raleigh	No	@#P/A	15	14
18	Boston	No	&#P/A	0	0
19	Orlando	No	*P/A	0	0
20	Port Royal	No	\$P/A	0	0
21	New York	No	@P/A	2	0

A - Active I - Inactive R - Removed P - Permanent C - Congested
* - Required # - Required and belongs to a PVC group
@ - Data compression capable but not operational
& - Data compression capable and operational
\$ - Data encryption capable but not operational
% - Data encryption capable and operational

Circuit#

Indicates the DLCI of the PVC.

Circuit Name

Name of the circuit, an ASCII string.

Orphan Circuit

Indicates whether the PVC is a non-configured circuit (yes or no).

Type/State

Indicates the state of the circuit, A (active), I (inactive), P (permanent), C (congested), or R (removed).

Monitoring Frame Relay Interfaces

Frames Transmitted

Indicates how many frames this PVC has transmitted.

Frames Received

Indicates how many frames this PVC has received.

pvc-groups

Displays required PVC group information for all required PVC groups. For each group this consists of the group name, the circuits in the group and the state (active, inactive, or removed) of each circuit.

Example:

```
list pvc-groups
Group name          Circuits in group  Circuit status
-----
group1              16                active
                   44                inactive
                   240               removed
```

svcs Displays all SVCs, either configured or orphaned, on the interface regardless of state.

Example:

```
FR 1>list svcs

          Circuit Name          Remote party number  Circuit State  Call State  DLCI
-----
flotsam          911                R             N             0
jetsam           666                R             N             0
Circuit states: A - Active  I - Inactive  R - Removed  C - Congested
Call states: N - Null      I - Call Initiated  O - Outgoing call proceeding
                  A - Active  D - Disconnect request  R - Release request
```

switched-virtual-circuit

The following example displays configuration and operational information for a single SVC by name.

Example:

```
FR 1>list switched-virtual-circuit flotsam
Circuit Name          Opt-Idle          Outgoing Incoming
Name                 ions  Timer          Value     Value
-----
flotsam              ILM    60          CIR:      0         0
Call state: Null          Burst:     0         0
Call Initiated by: None  DLCI: 0    Excess:    0         0
Remote party number: IE911
Remote subaddress: None

Options: I - call-ins allowed, L - learn protocols, M - multicast required
         C - compression capable and operational, c - compression capable
         E - encryption capable and operational, e - encryption capable

Address type: I - International, U - Unknown
Numbering plan: E - E.164, X - X.121
Subaddress format: N - NSAP, P - private
```

virtual-circuits

Displays all PVCs and all active SVCs with associated information that is identical to the **list permanent-virtual-circuit** command.

Monitoring Frame Relay Interfaces

```
FR 1>list virtual-circuits
```

Circuit Number	Circuit Name	Orphan Circuit	Type/State	Frames Transmitted	Frames Received
16	circ16	No	P/A	4	8
17	Unassigned	Yes	@ P/I	0	0
18	flotsam	No	S/A	12	10
19	Unassigned	Yes	@ P/A	7	2
24	circ24	No	P/R	0	0

P - PVC S - SVC A - Active I - Inactive R - Removed C - Congested

* - Required # - Required and belongs to a PVC group
@ - Data compression capable but not operational
& - Data compression capable and operational

LLC

Use the **LLC** command to access the LLC monitoring prompt. LLC commands are entered at this new prompt. See “LLC Monitoring Commands” on page 239 for an explanation of each of these commands.

Syntax:

llc

Note: The LLC command is supported only if APPN is in the software load.

Notrace

Use the **notrace** command to disable packet tracing for individual circuits or the entire interface. This command can be used as a filter when tracing specific circuits or interfaces is required. The default setting is to trace all circuits.

Syntax:

```
notrace                circuit#  
                        circuitname  
                        all
```

Example:

```
notrace 16           Disables packet tracing on circuit (PVC or SVC) with DLCI 16.  
notrace circuit phoenix Disables packet tracing on circuit (PVC or SVC) named phoenix.  
notrace circuit all   Disables packet tracing on all circuits on this interface.
```

Set

Use the **set** command to set the values for Committed Information Rate (CIR), Committed Burst Rate, and Excess Burst Rate for the specified VC. You also can set values for IR adjustment rates.

Monitoring Frame Relay Interfaces

BECN is received until the minimum information rate is reached. The minimum percentage is 1, and the maximum percentage is 100. The default is 25.

Example:

```
set ir-adjustment
  IR adjustment % increment [12]?
  IR adjustment % decrement [25]?
  Minimum IR as % of CIR [25]?
```

Trace

Use the **Trace** command to enable packet tracing for individual circuits or the entire interface and to list the tracing capability of all circuits on this interface. This command can be used as a filter when tracing specific circuits or interfaces is required. The default setting is to trace all circuits.

Syntax:

```
trace          all
_             circuitname
             circuit#
             list
```

Example:

```
trace 16
  Enables packet tracing on circuit (PVC or SVC) with DLCI 16.
trace circuit phoenix
  Enables packet tracing on circuit (PVC or SVC) named phoenix.
trace circuit all
  Enables packet tracing on all circuits on this interface.
```

```
trace list
The following circuits are available for packet trace
Circuit Name          Circuit Number
-----
Unassigned            16
phoenix                25
jetsam                 0
```

Lists the packet tracing capability of all circuits on this interface.

Frame Relay Interfaces and the GWCON Interface Command

While Frame Relay interfaces have a monitoring process for monitoring purposes, the router also displays complete statistics for installed interfaces when you use the **interface** command from the GWCON environment. (For more information on the **interface** command, refer to “Chapter 10. The Operating/Monitoring Process (GWCON - Talk 5) and Commands” on page 105)

Statistics Displayed For Frame Relay Interfaces

Statistics similar to the following are displayed when you execute the **interface** command from the GWCON environment for Frame Relay interfaces:

```
+interface 10
Nt Nt' Interface Slot-Port          Self-Test Self-Test Maintenance
10 10  FR/0      Slot: 8 Port: 0          Passed   Failed   Failed
                               2         1         0
```

Monitoring Frame Relay Interfaces

Frame Relay MAC/data-link on V.35/V.36 interface

Adapter cable: V.35 DTE

V.24 circuit: 105 106 107 108 109
Nicknames: RTS CTS DSR DTR DCD
PUB 41450: CA CB CC CD CF
State: ON ON ON ON ON

Line speed: 64.000 Kbps

Last port reset: 1 hour, 20 minutes, 42 seconds ago

Input frame errors:

CRC error	0	alignment (byte length)	0
missed frame	182	too long (> 2062 bytes)	0
aborted frame	0	DMA/FIFO overrun	0

Output frame counters:

DMA/FIFO underrun errors	0	Output aborts sent	0
--------------------------	---	--------------------	---

Nt Indicates the interface number as assigned by software during initial configuration.

Nt' Indicates the interface number as assigned by software during initial configuration.

Note: For FR dial circuit interfaces, Nt' is different from Nt. Nt' indicates the base interface (ISDN) that the dial circuit is running over.

Interface

Indicates the type of interface and its instance number. Frame relay has a FR designation.

Slot Indicates the slot of the interface running Frame Relay

Port Indicates the port of the interface that is running Frame Relay

Self-test Passed

Indicates the total number of times the Frame Relay interface passed self-test.

Self-test Failed

Indicates the total number of times the Frame Relay interface failed self-test.

Maintenance Failed

Indicates the total number of times the interface was unable to communicate with Frame Relay management.

V.24 circuit, Nicknames, and State

The circuits, control signals, pin assignments and their state (ON or OFF).
Note: The symbol - - - in monitoring output indicates that the value or state is unknown.

Line speed

The transmit clock rate.

Last port reset

The length of time since the last port reset.

Input frame errors:

CRC error

The number of packets received that contained checksum errors and as a result were discarded.

Monitoring Frame Relay Interfaces

Alignment

The number of packets received that were not an even multiple of 8 bits in length and as a result were discarded.

Too short

The number of packets that were less than 2 bytes in length and as a result were discarded.

Too long

The number of packets that were greater than the configured size, and as a result were discarded.

Aborted frame

The number of packets received that were aborted by the sender or a line error.

DMA/FIFO overrun

The number of times the serial interface could not send data fast enough to the system packet buffer memory to receive them from the network.

Missed frame

When a frame arrives at the device and there is no buffer available, the hardware drops the frame and increments the missed frame counter.

L & F bits not set

On serial interfaces, the hardware sets input-descriptor information for arriving frames. If the buffer can accept the complete frame upon arrival, the hardware sets both the last and first bits of the frame, indicating that the buffer accepted the complete frame. If either of the bits is not set, the packet is dropped, the L & F bits not set counter is incremented, and the buffer is cleared for reuse.

Note: It is unlikely that the L & F bits not set counter will be affected by traffic.

Output frame counters:

DMA/FIFO underrun errors

The number of times the serial interface could not retrieve data fast enough from the system packet buffer memory to transmit them to the network.

Output aborts sent

The number of transmissions that were aborted as requested by upper-level software.

Statistics similar to the following are displayed for Frame Relay dial circuits when you execute the interface command from the GWCON environment:

+interface 3

Nt	Nt'	Interface	Passed	Self-Test Failed	Self-Test Failed	Maintenance
3	2	FR/1		1	0	0

Frame Relay MAC/data-link on ISDN Primary Rate interface

Chapter 39. Using Point-to-Point Protocol Interfaces

This chapter describes how to use the Point-to-Point Protocol for interfaces on the device. Sections in this chapter include:

- “PPP Overview”
- “The PPP Link Control Protocol (LCP)” on page 533
- “PPP Authentication Protocols” on page 537
- “Using AAA with PPP” on page 542
- “The PPP Network Control Protocols” on page 542
- “Using and Configuring Virtual Connections” on page 545

See “Chapter 41. Using the Multilink PPP Protocol” on page 593 and “Chapter 42. Configuring and Monitoring Multilink PPP Protocol (MP)” on page 599 for information about using the Multilink PPP Protocol.

PPP Overview

PPP provides a method for transmitting protocol datagrams at the Data Link Layer over serial point-to-point links. PPP provides the following services:

- Link Control Protocol (LCP) to establish, configure, and test the link connection.
- Encapsulation protocol for encapsulating protocol datagrams over serial point-to-point links.
- Authentication protocols (APs) to validate the identity of a peer (remote) unit, and to submit your own identity to the peer for validation.
- Network Control Protocols (NCPs) for establishing and configuring different network layer protocols. PPP allows the use of multiple network layer protocols.

Figure 44 on page 532 shows some examples of point-to-point serial links.

Using PPP

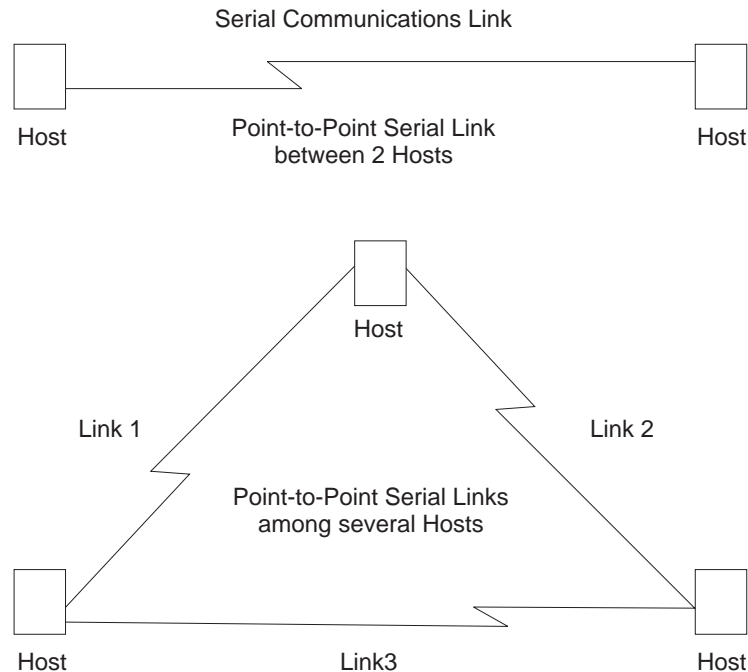


Figure 44. Examples of Point-to-Point Links

PPP currently supports the following control protocols:

- AppleTalk Control Protocol (ATCP)
- DECnet Protocol Control Protocol (DNCP)
- Banyan VINES Control Protocol (BVCP)
- Bridging protocols (BCP, NBCP, and NBFCP)
- Internet Protocol Control Protocol (IPCP)
- Internet Protocol Version 6 Control Protocol (IPv6CP)
- IPX Control Protocol (IPXCP)
- APPN HPR Control Protocol (APPN HPRCP)
- APPN ISR Control Protocol (APPN ISRCP)
- OSI Control Protocol (OSICP)

Each end starts by sending LCP packets to configure and test the data link. After the link has been established, PPP sends NCP packets to choose and configure one or more network layer protocols. After network layer protocols have been configured, datagrams from each network layer can be sent over the link. The next sections explain these concepts in more detail.

PPP Data Link Layer Frame Structure

PPP transmits data frames that have the same structure as High-level Data Link Control (HDLC) frames. PPP uses a byte-oriented transmission method with a single-frame format for all data and control exchanges. Figure 45 on page 533 illustrates the PPP frame structure and is followed by a detailed description of each field.

Flag	Address	Control	Protocol	Information	FCS	Flag
8 bits	8 bits	8 bits	16 bits	variable	16 bits	8 bits

Figure 45. PPP Frame Structure

Flag Fields

The flag field begins and ends each frame with a unique pattern of 01111110. Generally a single flag ends one frame and begins the next. The receiver attached to the link continuously search for the flag sequence to synchronize the start of the next frame.

Address Field

The address field is a single octet (8 bits) and contains the binary sequence 11111111 (0xff hexadecimal). This is known as the All-Station Address. PPP does not assign individual station addresses.

Control Field

The control field is a single octet and contains the binary sequence 00000011 (0x03 hexadecimal). This sequence identifies the Unnumbered Information (UI) command with the P/F bit set to zero.

Protocol Field

The protocol field is defined by PPP. The field is 2 octets (16 bits) and its value identifies the protocol datagram encapsulated in the Information field of the frame.

Protocol field values in the range '0xC000'–'0xFFFF' indicate Layer 3 data (protocol datagrams) such as LCP, PAP, CHAP,

Information Field

The information field contains the datagram for the protocol specified in the protocol field. This is zero or more octets.

When the protocol type is LCP, exactly one LCP packet is encapsulated in the information field of PPP Data Link Layer frames.

Frame Check Sequence (FCS) Field

The frame check sequence field is a 16-bit cyclic redundancy check (CRC).

PPP links can negotiate the use of various options which may modify the basic frame format; the description below applies to the frame format prior to any such modifications. PPP LCP packets are always sent in this format as well, regardless of negotiated options, so that LCP packets can be recognized even when there is a loss of synchronization on the line.

The router supports two such options: Address and Control Field Compression (ACFC) and Protocol Field Compression (PFC). These are described in detail in a later section.

The PPP Link Control Protocol (LCP)

PPP's Link Control Protocol (LCP) establishes, configures, maintains, and terminates the point-to-point link. This process is carried out in four phases:

1. Before exchanging any network layer datagrams, PPP first opens the connection through an exchange of LCP configuration packets. As part of this negotiation process, the PPP processes at each end of the link agree on

Using PPP

various basic link level parameters such as the maximum packet size that can be transferred and whether the ends must use an authentication mechanism to identify themselves to their peers before carrying network traffic.

If this negotiation is unsuccessful, the link is considered to be “down” and incapable of carrying any network traffic. If the negotiation is successful, LCP goes to an “Open” state and PPP goes on to the next phase.

2. After LCP successfully reaches an Open state, the next step in establishing the link is to perform authentication where each end of the link identifies itself to the other end using the “authentication protocol” that the other end dictated as part of the LCP negotiation.

If authentication fails, the link is marked “down” and cannot carry any network traffic. If authentication succeeds or if authentication is not required, the PPP link moves to the next phase.

3. After authentication is negotiated, the peers negotiate encryption for the link. After authentication phase is complete, the router negotiates the use of encryption using Encryption Control Protocol (ECP) packets where each end of the link negotiates which encryption algorithm will be used to encrypt the data over this PPP link. If ECP did not reach “Open” state then the link is marked “down” and cannot carry any network traffic. If ECP successfully reaches “Open” state, or if encryption is not required, the PPP link moves to the next phase, NCP negotiation (except ECP, which is technically also an NCP). The link is considered to be “open” or “up” at this time, though it cannot yet carry layer-3 protocol datagrams.

4. Once the link is open, the router negotiates the use of various layer-3 protocols (for example, IP, IPX, DECnet, Banyan Vines) using Network Control Protocol (NCP) packets. Each layer-3 protocol has its own associated network control protocol. For example IP has IPCP and IPX has IPXCP. The basic format and mechanisms for all these NCP packets is the same for all protocols, and is basically a superset of the LCP mechanisms as described later in this section.

Each layer-3 protocol is negotiated independently. When a particular NCP successfully negotiates, the link is “up” for that protocol's traffic. As with LCP, configuration information can be exchanged as part of this negotiation; for example, IPCP can exchange IP addresses or negotiate the use of “Van Jacobson IP header compression”.

As with LCP, it is possible for an NCP to fail to negotiate successfully with its peer. This might happen because the peer does not support a particular protocol or because some configuration option was unacceptable. If an NCP fails to reach the “Open” state, no layer-3 protocol packets can be exchanged for that protocol even though other layer-3 protocols are successfully passing traffic across the PPP link.

5. Finally, LCP has the ability to terminate the link at any time. This is usually done at the request of the user but may occur for other reasons such as: an administrative closing of the link, idle timer expiration, or failure to re-authenticate on a CHAP rechallenge.

For complete details about PPP LCP, authentication, and the general NCP negotiation mechanisms, consult RFCs 1331, 1334, 1570, and 1661.

LCP Packets

LCP packets are used to establish and manage a PPP link and can be loosely divided into three categories:

- *Link establishment packets* that exchange configuration information and establish the link.
- *Link termination packets* that shut down the link or signal that a link is not accepting connections at a particular time. They also can be used to signal that a particular protocol is unrecognized (for example, during NCP negotiations).
- *Link maintenance packets* that monitor and debug a link.

Exactly one LCP packet is encapsulated in the information field of PPP Data Link Layer frames. In the case of LCP packets, the protocol field reads “Link Control Protocol” (C021 hexadecimal). Figure 46 illustrates the structure of the LCP packet and is followed by a detailed description of each field.

Code	Identifier	Length	Data(option)
------	------------	--------	--------------

Figure 46. LCP Frame Structure (in PPP Information Field)

Code The code field is one octet in length and identifies the type of LCP packet. The codes in Table 72 distinguish the packet types. They are described in more detail in later sections.

Table 72. LCP Packet Codes

Code	Packet Type
1	Configure-Request (Link Establishment)
2	Configure-Ack (Link Establishment)
3	Configure-Nak (Link Establishment)
4	Configure-Reject (Link Establishment)
5	Terminate-Request (Link Termination)
6	Terminate-Ack (Link Termination)
7	Code-Reject (Link Establishment)
8	Protocol-Reject (Link Establishment)
9	Echo-Request (Link Maintenance)
10	Echo-Reply (Link Maintenance)
11	Discard-Request (Link Maintenance)

Identifier

The identifier field is one octet in length and is used to match packet requests to replies.

Length

The length field is two octets in length and indicates the total length (that is, including all fields) of the LCP packet.

Data (Option)

The data field is zero or more octets as indicated by the length field. The format of this field is determined by the code.

NCP packets are structured identically to LCP packets and are distinguished by having different PPP “Protocol” values. Each LCP packet type (distinguished by the code field) has the same meaning for each NCP, though an individual NCP may not implement all possible LCP packet types. NCPs normally implement all of the link establishment type packets that LCP defines. They may implement some of the additional LCP packet types, and they also may define additional packet types beyond what LCP uses. Unlike LCP packets, the structure of an NCP frame may be modified according to options negotiated by LCP during the link establishment phase.

Using PPP

Link Establishment Packets

Link Establishment Packets establish and configure a point-to-point link including the following packet types:

Configure-Request

LCP packet code field is set to 1. LCP transmits this packet type when it wants to open a point-to-point link. Upon receiving a Configure-Request, a peer station's LCP entity sends an appropriate reply, depending on whether it is ready to process packets.

Configure-Ack

LCP packet code field is set to 2. The peer transmits this packet type when every configuration option in a Configure-Request packet is acceptable. Upon receiving the Configure-Ack (ack = acknowledgment), the originating station checks the Identifier field. This field must match the one from the last-transmitted Configure-Request or the packet is invalid.

Both ends send Configure-Request and both ends must receive a Configure-Ack before the link opens. Options negotiated for one direction may differ from that negotiated for the other direction. There is no "master-slave" relationship. Rather, each end works symmetrically.

Configure-Nak

LCP packet code field is set to 3. The peer transmits this packet type when some part of the configuration option in a Configure-Request packet is unacceptable. The Identifier field is copied from the received Configure-Request and the Data (option) field is filled with the received unacceptable configuration options. The Identifier field must match the one from the last-transmitted Configure-Request or the packet is invalid and is discarded.

When the originator receives a Configure-Nak packet, a new Configure-Request packet is sent that includes modified, acceptable configuration options.

Configure-Reject

LCP packet code field is set to 4. The peer transmits this packet type when some part of the configuration options in a Configure-Request packet is unacceptable. The Identifier field is copied from the received Configure-Request and the Data (option) field is filled with the received unacceptable configuration options. The Identifier field must match the one from the last-transmitted Configure-Request or the packet is invalid and is discarded.

When the originator receives a Configure-Reject packet, a new Configure-Request packet is sent that does not include any of the configuration options received in the Configure-Reject packet.

Code-Reject

LCP packet code field is set to 7. The transmission of this packet type indicates that the LCP "code" field on a received packet is not recognized as a valid value. While this can indicate an error, it also can indicate that the peer does not implement some feature that you are trying to use.

Protocol-Reject

LCP packet code field is set to 8. The transmission of this packet type indicates that a PPP frame has been received that contains an unsupported or unknown protocol (the PPP "protocol" field was unrecognized for some packet). This usually occurs if you try to negotiate some NCP for a protocol

that the other end doesn't support. For example, if DECnet CP (DNCP) sends a Config-Request and the other end does not know about DECnet, the other end replies with an LCP Protocol-Reject on DNCP. Upon receiving a Protocol-Reject packet, the link stops transmitting the incorrect protocol.

Note: NCP packet types and structure are the same as LCP, although there are a few additional "code" fields associated with some NCPs.

Link Termination Packets

Link Termination Packets terminate a link and include the following packet types:

Terminate-Request

LCP packet code field is set to 5. LCP transmits this packet type when a point-to-point link needs to be closed. These packets are sent until a Terminate-Ack packet is sent back, or until a retry counter is exceeded while waiting for an Ack.

Terminate-Ack

LCP packet code field is set to 6. Upon receiving a Terminate-Request packet, this packet type must be transmitted with the code field set to 6. Reception of a Terminate-Ack packet that was not expected indicates that the link has been closed.

Link Maintenance Packets

Link Maintenance Packets manage and debug a link, and include the following packet types:

Echo-Request and Echo-Reply

LCP packet code fields are set to 9 and 10 respectively. LCP transmits these packet types in order to provide a Data Link Layer loopback mechanism for both directions on the link. This feature is useful, for example, in debugging a faulty link to determine link quality. These packets are sent only when the link is in the Open state.

Discard-Request

LCP packet code field is set to 11. LCP transmits this packet type to provide a data sink for Data link Layer testing. A peer that receives a Discard-Request *must* throw away the packet. This is useful in debugging a link. These packets are sent only when the link is in the Open state.

PPP Authentication Protocols

PPP authentication protocols provide a form of security between two nodes connected via a PPP link. If authentication is required on a box, then immediately after the two boxes successfully negotiate the use of the link at the LCP layer (LCP packets are exchanged until LCP goes into an "open" state), they go into an "authentication" phase where they exchange authentication packets. A box is neither able to carry network data packets nor negotiate the use of a network protocol (NCP traffic) until authentication negotiation completes successfully.

There are different authentication protocols in use: Password Authentication Protocol (PAP) and Challenge/Handshake Authentication Protocol (CHAP). Microsoft PPP CHAP (MS-CHAP) is also available to authenticate Windows workstations and peer routers. PAP and CHAP are described in detail in RFC 1334, and briefly described later in this section. MS-CHAP is described in RFC 1994.

Using PPP

On remote dial-in access ports, a third authentication protocol is available. This is Shiva Password Authentication Protocol (SPAP), which is a Shiva proprietary protocol. See “Shiva Password Authentication Protocol (SPAP)” on page 539 for more information.

Whether a box requires the other end to authenticate itself (and if so, with what protocol) is determined during the LCP negotiation phase. Authentication could be considered to “fail” even at the link establishment phase (LCP negotiation), if one end does not know how, or refuses to use, the authentication protocol the other end requires.

Each end of a link sets its own requirements for how it wants the other end to authenticate itself. For example, given two routers “A” and “B”, connected over a PPP link, side A may require that B authenticate itself to A using PAP, and side B may require that A similarly identify itself using CHAP. It is valid for one end to require authentication while the other end requires none.

In addition to initial authentication during link establishment, with some protocols an authenticator may demand that the peer reestablish its credentials periodically. With CHAP, for example, a rechallenge may be issued at any time by the authenticator and the peer must successfully reply - or lose the link.

If more than one authentication protocol is enabled on a link, the router initially attempts to use them in the following priority order:

1. MS-CHAP
2. CHAP
3. PAP
4. SPAP

Note: SPAP is only available on interfaces that have IBM DIALs Dial-In circuits configured.

If the remote side responds to the authentication request with NAK and suggests an alternative, the router uses the alternative, provided that it is enabled on the link. If the remote side continues responding to the router’s suggestions with NAK but does not provide an alternative that the router has enabled, the link is terminated.

Password Authentication Protocol (PAP)

The Password Authentication Protocol (PAP) provides a simple method for the peer to establish its identity using a two-way handshake. This is done only upon initial link establishment. Following link establishment, the peer sends an ID/Password pair to the authenticator until authentication is acknowledged or the connection is terminated. Passwords are sent over the circuit “in the clear,” and there is no protection from playback or repeated trial and error attacks. The peer controls the frequency and timing of the attempts.

Challenge-Handshake Authentication Protocol (CHAP)

The Challenge-Handshake Authentication Protocol (CHAP) is used to periodically verify the identity of the peer using a three-way handshake. This is done upon initial link establishment, and *may* be repeated anytime after the link has been established. After the initial link establishment, the authenticator sends a “challenge” message to the peer. The peer responds with a value calculated using a “one-way

hash” function. The authenticator checks the response against its own calculation of the expected hash value. If the values match, the authentication is acknowledged; otherwise the connection is terminated.

Microsoft PPP CHAP Authentication (MS-CHAP)

MS-CHAP is an extension to PPP CHAP that is used to authenticate remote Windows workstations and peer routers. Both MS-CHAP and CHAP use PPP’s Link Control Protocol (LCP) to negotiate the desired authentication protocol in one or both directions; both use the CHAP protocol identifier as the PPP protocol; and each protocol uses a random challenge which is encrypted as part of the response.

MS-CHAP can be used with the internal PPP user Local List database, but *not* with the external AAA authentication server that is described in the chapter “Using Local or Remote Authentication” in *Using and Configuring Features*. If you plan to use Microsoft PPP Encryption (MPPE) on a PPP interface, you must enable MS-CHAP on that interface before you configure MPPE. Use the talk 6 command **enable mschap** to enable MS-CHAP.

Shiva Password Authentication Protocol (SPAP)

Note: SPAP is only available on interfaces that have IBM DIALs Dial-In circuits configured.

The Shiva Password Authentication Protocol (SPAP) provides a simple method for the peer to establish its identity using a 2-way handshake similar to PAP. After the Link Establishment phase is complete, an Id/Password is repeatedly sent by the peer to the authenticator until authentication is acknowledged, the connection is terminated, or a retry counter expires.

SPAP is a moderately strong authentication protocol that uses a proprietary encryption algorithm for the password. In addition to authentication, SPAP offers:

- The ability to change a password.

Note: SPAP change password support is not available on the 2216.

- The ability for the router to send a configurable banner requiring acknowledgment from the client after password authentication.
- The ability to use callback as an additional security feature.
- Virtual connections.

Configuring PPP Authentication

The following sections describe configuring PPP authentications for two situations:

- Configuring the 2216 to authenticate a remote device.
- Configuring the 2216 to be authenticated by a remote device.

These two situations are independent. You can do one or the other.

Configuring a PPP Interface to Authenticate a Remote Device

To authenticate a remote device or dial-in client:

1. Enable authentication on the PPP interface

Using PPP

- At the Config> prompt, enter the **network** command to select the PPP interface to configure.
- At the PPP Config> prompt, enable the authentication protocol you want to use.

You can use any of the following protocols:

- PAP
- MS-CHAP

Note: MS-CHAP can use the PPP local database to authenticate, but cannot use an authentication server.

- CHAP
- SPAP

Note: SPAP is only available on interfaces that have IBM DIALs Dial-In circuits configured.

2. Decide whether to authenticate locally or through an authentication server.

- To authenticate locally, enter the name and password into the PPP user database.

At the Config> prompt, use the **add ppp_user** command. See “Add” on page 68 for more information.

A 2216 maintains a single PPP user database. When the remote router or device sends its name and password to the device during the authentication phase, the device checks to see if that name and password are in the PPP user database.

- To authenticate through an authentication server using TACACS, TACACS+, or RADIUS, you must configure the device to reach the authentication server and the name and password must be in the server’s database. Refer to “Using Local or Remote Authentication” in *Using and Configuring Features*.

Configuring a PPP Interface to be Authenticated by a Remote Device

To configure the device to be authenticated by a remote device or dial-in client, configure the device’s name and password:

1. At the Config> prompt, select the interface you are configuring using the **network** command.
2. At the PPP Config> prompt, type the **set name** command and provide the name and password that the device will use to identify itself to the remote router or device during the authentication phase.

Attention: Do not use the following commands unless you want the device to perform authentication as described in “Using Local or Remote Authentication” in *Using and Configuring Features*.

- **enable pap**
- **enable chap**
- **enable spap**

Note: SPAP is only available on interfaces that have IBM DIALs Dial-In circuits configured.

- **enable mschap**

Configuring PPP Callback

Callback is a PPP feature associated with single user dial-in solutions. It attempts to accomplish two objectives. These objectives are:

- Callback can be used as a form of security. When used in this way, callback is generally referred to as required callback. When required callback is negotiated the user will be dialed back at a predetermined number. Only then will the PPP link be allowed to come up.
- Callback can also be implemented as a toll-saver feature. When used in this way, callback is generally referred to as roaming callback. Unlike required callback, roaming callback is requested by the client. The primary function of roaming callback is to bill the company maintaining the DIALs Server the toll charges instead of the user.

Callback is supported only on dial-in dial circuits over ISDN networks.

Example 1: Required callback enabled

```
Config>add PPP
Enter user name: [ ]? nocalldback
Password:
Enter password again:
Is this a Single-User or a Network? (Single-User, Network): [Single-User]

IP address for user nocalldback [0.0.0.0]?
Enter HostName: [ ]?
Give 'nocalldback' default time allotted ? (Yes, No): [Yes]
Enable Callback for 'nocalldback' ? (Yes, No): [No] yes
Type of Callback (Roaming Callback, Required Callback): [Roaming Callback] Requ
Dialback number for this user [ ]? 555-1234
Will 'nocalldback' be able to dial-out ? (Yes, No): [No]

PPP User Name: nocalldback
Type: Single User
User IP Address: Interface Default
SubNetMask: 255.255.255.255
Hostname: <undefined>
Time-Allotted: Box Default
Call-Back Type: Required Callback
Phone Number: 543-3186
Dial-Out: Not Enabled
Encryption: Not Enabled

Is information correct? (Yes, No, Quit): [No] yes
```

Example 2: Callback disabled

```
Config>add PPP
Enter user name: [ ]? sallydoe
Password:
Enter password again:
Is this a Single-User or a Network? (Single-User, Network): [Single-User]

IP address for user nocalldback [0.0.0.0]?
Enter HostName: [ ]?
Give 'no callback' default time allotted ? (Yes, No): [Yes]
Enable Callback for 'no callback' ? (Yes, No): [No]
Will 'no callback' be able to dial-out ? (Yes, No): [No]

PPP User Name: no callback
Type: Single User
User IP Address: Interface Default
SubNetMask: 255.255.255.255
Hostname: <undefined>
Time-Allotted: Box Default
Call-Back Type: Not Enabled
Dial-Out: Not Enabled
Encryption: Not Enabled

Is information correct? (Yes, No, Quit): [No] yes
```

Example 3: Roaming callback enabled

Using PPP

```
Config>add PPP roaming_callback
Password:
Enter password again:
Is this a Single-User or a Network? (Single-User, Network): [Single-User]

IP address for user roaming_callback [0.0.0.0]?
Enter HostName: []?
Give 'roaming_callback' default time allotted ? (Yes, No): [Yes]
Enable Callback for 'roaming_callback' ? (Yes, No): [No] yes
Type of Callback (Roaming Callback, Required Callback): [Roaming Callback]

Will 'roaming_callback' be able to dial-out ? (Yes, No): [No]n

PPP User Name: roaming_callback
Type: Single User
User IP Address: Interface Default
SubNetMask: 255.255.255.255
Hostname: <undefined>
Time-Allotted: Box Default
Call-Back Type: Roaming Callback
Dial-Out: Not Enabled
Encryption: Not Enabled

Is information correct? (Yes, No, Quit): [No]yes
```

Using AAA with PPP

See “Using Local or Remote Authentication” and “Configuring Authentication” in *Using and Configuring Features* for this information.

The PPP Network Control Protocols

PPP has a family of Network Control Protocols (NCPs) for establishing and configuring different network layer protocols. The NCPs are responsible for configuring, enabling, and disabling the network layer protocols on both ends of the point-to-point link. NCP packets cannot be exchanged until LCP has opened the connection and the link reaches the OPEN state.

PPP supports the following Network Control Protocols:

- AppleTalk Control Protocol (ATCP)
- Banyan VINES Control Protocol (BVCP)
- Bridging protocols (BCP, NBCP, and NBFCP),
- Callback Control Protocol
- DECnet Control Protocol (DNCP)
- IP Control Protocol (IPCP)
- IPv6 Control Protocol (IPv6CP)
- IPX Control Protocol (IPXCP)
- OSI Control Protocol (OSICP)
- APPN High Performance Routing Control Protocol (APPN HPRCP)
- APPN Intermediate Session Routing Control Protocol (APPN ISRCP)

AppleTalk Control Protocol

ATCP is specified in Request for Comments (RFC) 1378. IBM's implementation of ATCP supports the AppleTalk-Address option. The implementation supports both full router mode and half router mode. For additional information, refer to “AppleTalk over PPP” in *Protocol Configuration and Monitoring Reference Volume 2*

Banyan VINES Control Protocol

RFC 1763 describes BVCP. IBM's implementation of BVCP does not support any options.

Bridging Control Protocol

BCP is specified in RFC 1638. IBM's implementation of BCP supports the IEEE 802.5 Line Identification Option and the Tinygram Compression Option.

NetBIOS Control Protocol (NBCP) is a proprietary NCP developed by Shiva Corporation and used by the IBM Dial In Access to LAN Client for OS/2, DOS and Windows for single-user dial-in. NBCP is used to transport NetBIOS and LLC/802.2 bridged traffic from these clients, dialed into a 2216 DIALs Server, onto an attached LAN. IBM's implementation of NBCP supports the MAC-Address and NetBIOS Name Projection options.

NetBIOS Frame Control Protocol (NBFCP) is specified in RFC 2097. NBFCP is used by Microsoft Windows 95 and Windows NT Dial-Up Networking clients for single-user dial-in. NBFCP is used to transport NetBIOS bridged traffic from these clients, dialed into a 2216 DIALs Server, onto an attached LAN. IBM's implementation of NBFCP supports the Name-Projection, Peer-Information and IEEE-MAC-Address-Required options.

Callback Control Protocol

Note: CBCP is only available on interfaces that have IBM DIALs Dial-in circuits configured.

Callback Control Protocol (CBCP) is used by Microsoft Dial-Up Networking clients to negotiate callback. The 2216 supports callback to a single user-specified number (roaming callback) and callback to an administrator-specified number (required callback). The CBCP option of calling a list of numbers is not supported.

PPP users that want to use CBCP callback must have some form of authentication enabled (like PAP, CHAP, SPAP or MS-CHAP). There are no configuration parameters for CBCP. (The client determines when it is used.) See "Configuring PPP Callback" on page 541 for information about configuring PPP users for callback.

DECnet IV Control Protocol

DNCP is specified in RFC 1762. IBM's implementation does not support any DNCP options.

IP Control Protocol

IPCP is specified in RFC 1332. IBM's implementation supports the following options:

- Van Jacobsen IP Header Compression as described in RFC 1144.
- IP Address

The router can send its IP address, as well as accept an IP address, from a peer, or supply an IP address to a peer, if requested. If the router is configured to

Using PPP

“Send Our Address” on a particular interface, and that interface has a valid, numbered IP address, then IPCP sends the address in its initial Configure-Request as option 3 (IP Address). IPCP also sends its address if the peer sends a Configure NAK with 0.0.0.0 for option 3 (IP Address), if a valid numbered address is configured for that PPP interface. IPCP will not send an unnumbered address to its peer.

A peer may specify its address (referred to as “Client Specified”), or request an address from the router by sending 0.0.0.0 for Option 3 in its initial Configure Request. The router may obtain this address from the authenticated user profile or from the interface itself. The user profile address takes precedence over the interface address. If you do not want to offer an address from the user profile, simply leave the address for that user in the profile as 0.0.0.0, and the router will offer the remote address configured for that interface. If there is no remote address configured for the interface or user profile, and the peer continues to request an address, IPCP will fail.

The router automatically adds a static route directed to the PPP interface for the address that is successfully negotiated, allowing data to be routed properly to the dial-in client. When the IPCP connection is ended for any reason, this static route is subsequently removed. By default, the net mask for this route is 255.255.255.255 (hostroute); however, if a net mask is specified in the authenticated user’s profile (see “Configuring PPP Authentication” on page 539) a net mask other than this may be used to allow routing to more than a single host across the PPP link (RIP or other routing protocols could also be used to discover routes if desired).

IPv6 Control Protocol

IPv6 Control Protocol is specified in RFC 2023. In IBM’s implementation of IPv6CP, the router can send its IP address, as well as accept an IP address, from a peer, or supply an IP address to a peer, if requested. If the router is configured to “Send Our Address” on a particular interface, and that interface has a valid, numbered IP address, then IPv6CP sends the address in its initial Configure-Request as option 3 (IP Address). IPv6CP also sends its address if the peer sends a Configure NAK with ::/0 for option 3 (IP Address), if a valid numbered address is configured for that PPP interface. IPv6CP will not send an unnumbered address to its peer.

A peer may specify its address (referred to as “Client Specified”), or request an address from the router by sending ::/0 for Option 3 in its initial Configure Request. The router obtains this address from the interface. If there is no remote address configured for the interface, and the peer continues to request an address, IPv6CP will fail.

The router automatically adds a static route directed to the PPP interface for the address that is successfully negotiated, allowing data to be routed properly to the dial-in client. When the IPv6CP connection is ended for any reason, this static route is subsequently removed. By default, the prefix length for this route is 128 (hostroute).

IPX Control Protocol

IPXCP is specified in RFC 1552. IBM’s implementation does not support any IPXCP options.

OSI Control Protocol

OSICP is specified in RFC 1377. IBM's implementation of OSICP does not support any options.

APPN HPR Control Protocol

Advanced Peer-to-Peer Networking (APPN) High Performance Routing (HPR) control protocol is specified in RFC 2043. No options are negotiated for this control protocol.

APPN ISR Control Protocol

Advanced Peer-to-Peer Networking (APPN) Intermediate Session Routing (ISR) control protocol is specified in RFC 2043. No options are negotiated for this control protocol.

See "Overview of Encryption" in *Using and Configuring Features* for information about configuring encryption for a PPP interface.

Using and Configuring Virtual Connections

Virtual Connections (VC) are DIALs dial-in circuits that can be suspended when they become inactive for a predetermined period of time. The ability to suspend the connections can help control your networking costs by saving line charges for DIALs dial-in clients that are not active; instead of keeping the connections active, the system saves information about the session and then closes the call. When the same DIALs dial-in client reconnects to the server, the session information is restored and the connection resumes as if there were no interruption. See "Configuring a VC" on page 546 for more information.

You can configure DIALs servers to end VCs that have been suspended for a specified amount of time. You can also manually end a VC at any time. See the **set DIALs** command and "DIALs Global Monitoring Commands" in *Using and Configuring Features* for related commands.

VC Considerations

Keep the following in mind as you configure VCs:

- You can only use AAA local-list or RADIUS authentication when using VCs.
- A VC will not support IPX. When you configure a user to use VCs, IPX support for that user is disabled.
- The client configuration controls the suspension and resumption of a VC. The DIALs server cannot control that aspect of the connection.
- A VC can be established through an MP bundle.
- VCs cannot run over L2TP.
- Suspended VCs cannot be displayed with current network management tools.
- Do not assign an IP address to remote users by interface. Because another client could use an interface with which a client establishes a VC, when the VC attempts to reconnect with the server the connection will fail because the IP address is in use.
- A dial-in client must use SPAP for authentication.

Using PPP

Configuring a VC

Configure VCs when you add a DIALs client at the Config> prompt. When you configure the user, you can either use the DIALs dial-in defaults (see the **set DIALs** command in the *Using and Configuring Features*) for the maximum suspend time and inactivity timeout, or configure specific values for the particular client. The following example shows the minimum configuration for a VC for DIALs dial-in client "jose."

```
Config>
Config> add ppp
Enter user name: []? jose
Password:
Enter password again:
Is this a 'DIALs' user? (Yes, No): [Yes]
Type of route? (hostroute, netroute): [hostroute]
IP address: [0.0.0.0]?
Enter hostname for dynamic DNS: []?
Allow Virtual Connections ? (Yes, No): [No] Yes
  Use Box Default inactivity timeout value and maximum suspended time? (Yes, No): [Yes] No
  User-based Max Suspend Time (hours)
  0-48 0=unlimited: [12] ? 10
  User-based Inactivity Timeout (seconds)
  10-1024: [30] ? 60
Give 'jose' default time allotted ? (Yes, No): [Yes]
Enable callback for 'jose' ? (Yes, No): [No]
Will 'jose' be able to dial-out ? (Yes, No): [No]
```

```
PPP user name: jose
User IP address: Interface Default
Netroute Mask: 255.255.255.255
Hostname:
Time allotted: Box Default
Callback type: Not Enabled
Dial-out: Not Enabled
```

```
Is information correct? (Yes, No, Quit): [Yes]
```

```
User 'jose' has been added
Config>
```

To display the box-level default values for maximum virtual connections, idle timeout period, and the global default maximum suspend time, use the DIALs `config>list vc-parameters` command in the DIALs feature. To display these parameters along with the maximum suspend time and inactivity timeout for all virtual connections, use the **list all** command in the DIALs feature. See "DIALs Global Monitoring Commands" in *Using and Configuring Features*.

Chapter 40. Configuring and Monitoring Point-to-Point Protocol Interfaces

This chapter describes Point-to-Point Protocol interface configuration and operational commands in the device. Sections in this chapter include:

- “Accessing the Interface Configuration Process”
- “Point-to-Point Configuration Commands” on page 548
- “Accessing the Interface Monitoring Process” on page 565
- “Point-to-Point Monitoring Commands” on page 566
- “Point-to-Point Protocol Interfaces and the GWCON Interface Command” on page 589

Accessing the Interface Configuration Process

Use the following procedure to access the router’s configuration process. This process gives you access to a specific interface’s *configuration* process.

1. At the OPCON prompt (*), enter the **status** command to find the PID for CONFIG. (See page 9 for sample output of the **status** command.)
2. At the OPCON prompt, enter the OPCON **talk** command and the PID for CONFIG. (For more detail on this command, refer to “Chapter 4. The OPCON Process” on page 29.) For example:

```
* talk 6
```

After you enter the talk 6 command, the CONFIG prompt (Config>) displays on the console. If the prompt does not appear when you first enter **CONFIG**, press **Return** again.

3. At the CONFIG prompt, enter the **list devices** command to display the network interface numbers for which the router is currently configured.
4. Record the interface numbers.
5. Enter the CONFIG **network** command and the number of the interface you want to configure. For example:

```
Config> network 1
```

The appropriate configuration prompt (such as TKR Config> for token-ring), now displays on the console.

Note: Not all network interfaces are user-configurable. For interfaces that cannot be configured, you receive the message:

```
That network is not configurable
```

Accessing the PPP Interface Configuration Prompt

To display the PPP config> prompt:

1. Enter **list devices** at the Config> prompt to display a list of interfaces.
2. If you have not already done so, set the data link protocol on one of the serial interfaces to PPP by entering **set data-link ppp** at the Config> prompt. For example:

Configuring PPP Interfaces (Talk 6)

```
Config> set data-link ppp  
Interface Number [0]? 2
```

3. Enter **network** followed by the number of the PPP interface. For example:

```
Config> network 2  
PPP config>
```

Point-to-Point Configuration Commands

Table 73 summarizes the PPP configuration commands, and the rest of this section explains these commands. Enter the commands at the PPP config> prompt.

Table 73. Point-to-Point Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Disable	Disables data compression (CCP), DTR line handling, CHAP, PAP, ECP. Also disables SPAP authentication in Remote LAN Access Features images.
Enable	Enables data compression (CCP), DTR line handling, CHAP, PAP, ECP. Also enables SPAP authentication in Remote LAN Access Features images.
List	Lists all information related to the point-to-point interfaces protocols, parameters, and options.
Set	Sets physical line (HDLC) parameters, LCP parameters, generic NCP parameters, and various NCP-specific options.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Disable

Disables data compression, authentication protocols, multilink PPP, and the Lower DTR feature.

Syntax:

```
disable                ccp  
                        chap  
                        enp  
                        lower-dtr  
                        mp  
                        mppe  
                        mschap  
                        pap
```

ccp Disables the use of data compression on the interface. Refer to “Using the Data Compression Subsystem” in the *Using and Configuring Features* for more information.

chap Disables the use of the Challenge-Handshake Authentication Protocol. Refer to “Challenge-Handshake Authentication Protocol (CHAP)” on page 538 for more information.

Configuring PPP Interfaces (Talk 6)

ecp This allows the router not to force the use of ECP encryption on this interface. The interface will still accept and execute Encryption Control Protocol (ECP) if the peer is using ECP.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See the CONFIG process **load** command in *Nways Multiprotocol Access Services Software User's Guide*.

lower-dtr

Determines the way the data terminal ready (DTR) signal is handled for leased serial-line interfaces that are disabled. If this parameter is set to "disabled" (the default) and the interface is disabled, the DTR signal is not dropped.

mp Disables the Multilink Protocol (MP) on this interface. See "Chapter 41. Using the Multilink PPP Protocol" on page 593 for more information.

Example:

```
disable mp
Disabled as a MP link
```

mppe Disables Microsoft Point-to-Point Encryption (MPPE) on this interface.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See "Load" on page 90.

mschap

Disables MS-CHAP authentication on this interface. Disabling MS-CHAP has two effects upon MPPE, depending upon whether MPPE is configured as mandatory or optional. If MPPE is mandatory, disabling MS-CHAP brings down the link. If MPPE is optional, disabling MS-CHAP disables MPPE over the link. See "Microsoft PPP CHAP Authentication (MS-CHAP)" on page 539 for more information.

pap Disables the use of the Password Authentication Protocol. Refer to "Password Authentication Protocol (PAP)" on page 538 for more information.

spap Disables the use of the Shiva Password Authentication Protocol (SPAP).

Note: SPAP is only available on interfaces that have IBM DIALs Dial-In circuits configured.

Enable

Enables data compression, encryption, authentication protocols, lower-DTR, and the multilink PPP protocol on this PPP interface. If multiple authentication protocols are enabled, the device attempts to use them in the following priority order:

1. MS-CHAP
2. CHAP
3. PAP

Syntax:

```
enable                ccp
                        chap
                        ecp
```

Configuring PPP Interfaces (Talk 6)

lower-dtr

mp

mppe

mschap

pap

ccp Enables the use of data compression on the interface.

Note: It is not recommended that you enable data compression for a PPP interface on a HSSI adapter.

chap Enables the use of the Challenge-Handshake Authentication Protocol. You are prompted for a rechallenge interval. Specify 0 if you do not want to rechallenge periodically after the initial authentication phase is complete. Refer to “Challenge-Handshake Authentication Protocol (CHAP)” on page 538 for more information.

Example:

```
enable chap
Rechallenge Interval in seconds (0=NONE) [0] 10
CHAP enabled
```

ecp Enables the use of data encryption on this interface by negotiating Encryption Control Protocol (ECP). Once this is done, all PPP users with encryption enabled and with a valid encryption key must use ECP to connect to this port unless MS-CHAP is the active authentication protocol for the link. If the authentication protocol is MS-CHAP, ECP cannot be used; encryption must be accomplished using MPPE. PPP users without encryption enabled will still be able to connect to this interface.

When you enable ECP, you are prompted to enter the ECP encryption key for the local router. You must also provide the encryption key for the remote user when you use the talk 6 **add ppp-user** command at the Config> prompt to configure the remote user. MPPE does not require you to configure an encryption key on either the local or the remote user.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See “Load” on page 90.

lower-dtr

Determines the way the data terminal ready (DTR) signal is handled for leased serial-line interfaces that are disabled. If this parameter is set to “disabled” (the default) and the interface is disabled, the DTR signal is not dropped.

If Lower DTR is set to “enabled”, then the DTR signal will be dropped when the interface is disabled. This behavior may be desirable in situations where the interface has been configured as an alternate link for WAN Reroute and the interface is connected to a dial-out modem which maintains its dial connection based on the state of the DTR signal.

When the interface is disabled, the DTR signal is low and the modem keeps the dial connection down. When the interface is enabled, due to a WAN Reroute backup scenario, DTR is raised and the modem dials a stored number to the backup site. When the primary interface is restored, the alternate interface is disabled, DTR is lowered, and the modem hangs up the dial connection.

The following cable types are supported:

RS-232

V.35

V.36

Note: The **enable lower-dtr** command is not supported on PPP dial circuit interfaces.

mp Enables the Multilink Protocol (MP) on this interface. See “Chapter 41. Using the Multilink PPP Protocol” on page 593 for more information.

Example:

```
enable mp
Enabled as a MP link
Is this link a dedicated MP link? [no] yes
MP interface for this MP link? [0] 3
```

mppe *[mandatory/optional] [stateless/stateful]*

Enables Microsoft Point-to-Point Encryption (MPPE). If MS-CHAP is not enabled on the interface, then MPPE cannot be enabled on that interface. See “Microsoft Point-to-Point Encryption (MPPE)” in the chapter “Overview of Encryption” in *Using and Configuring Features* for more information.

mandatory

The client and the server must negotiate MPPE or the link will drop.

optional

The client will attempt to negotiate MPPE, but if the negotiation fails, the PPP link will remain active.

stateless

Session keys will be regenerated after transmitting each packet. This function is currently not supported by Microsoft Dial-Up Networking (DUN) clients.

stateful

Session keys will be regenerated after transmitting every 256 packets.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See “Load” on page 90.

mschap

Enables MS-CHAP authentication. When you enable MS-CHAP, you are prompted to provide the authenticator rechallenge interval. This value in seconds defines the length of time that will pass before the authenticator sends another challenge to the receiver of the authentication request to reconfirm the authentication. The value 0 indicates that no further challenges will be sent after the initial authentication.

Use the **set name** command to configure the name of the 2216 if the peer router is configured to authenticate the 2216’s local name.

Note that MS-CHAP cannot be enabled if an external authentication server, as described in the chapter “Using Local or Remote Authentication” in *Using and Configuring Features*, has been configured. See “Microsoft PPP CHAP Authentication (MS-CHAP)” on page 539 for more information.

pap

Enables the use of the Password Authentication Protocol. Refer to “Password Authentication Protocol (PAP)” on page 538 for more information.

Configuring PPP Interfaces (Talk 6)

List

Use the **list** command to display information related to the PPP interface and its protocol parameters and options.

Syntax:

```
list                all  
                    bcp  
                    ccp  
                    ecp  
                    hdlc  
                    ipcp  
                    ipv6cp  
                    lcp  
                    ncp
```

all Lists all options and parameters related to the PPP interface.

The **list all** command displays the output of *all* the individual **list...** parameters described below.

bcp Lists the Bridging Network control protocol options.

Example:

```
list bcp  
BCP Options  
-----  
Tinygram Compression:DISABLED
```

Tinygram Compression:

Displays whether Tinygram Compression is enabled/disabled.

ccp Displays the currently selected data compression options if data compression has been enabled. For additional information, see “Using the Data Compression Subsystem” in *Using and Configuring Features* .

If Microsoft Point-to-Point Encryption (MPPE) and data compression are both enabled, the type of data compression is MPPC.

ecp Displays the current Encryption Control Protocol state.

Example:

```
list ecp  
ECP Options  
-----  
Data Encryption enabled  
Algorithm list: DESE-CBC  
DESE (Data Encryption Standard Encryption Protocol)
```

Note: Encryption support is optional and must be added to your software load using the **load add** command. See “Load” on page 90.

Data Encryption Enabled/Disabled

Indicates whether data encryption is enabled or disabled on interface.

Algorithm List

Displays the supported encryption algorithms. DES, as described by RFC 1969, is the only encryption algorithm currently supported.

Configuring PPP Interfaces (Talk 6)

hdlc Lists parameters related to the High-Level Data Link Control (HDLC) protocol. On PPP dial circuit interfaces, the “list hdlc” option is not available. For dial circuits, hardware data link parameters are a function of the base net rather than the PPP dial circuit. For additional information, see “Chapter 50. Configuring and Monitoring Dial Circuits” on page 689.

Example:

```
list hdlc
Encoding: NRZ
Idle State: Flag
Clocking: Internal
Cable type: V.35 DCE
Speed (bps): 6400

Transmit Delay Counter: 0
Lower DTR: Disabled
```

Encoding:

HDLC transmission encoding scheme, either NRZ (non-return to zero) or NRZI (non-return to zero inverted).

Idle State:

Bit pattern, either Flag or Mark, transmitted on the point-to-point link when the interface is not transmitting data.

Clocking:

Interface clocking, either external or internal.

Cable type:

Specifies the type of cable in use (RS-232, V.35, or V.36).

Speed (bps):

The physical data rate of the interface. When clocking is internal, this is the data rate generated by the internal clock.

Transmit Delay Counter:

Number of flags sent between frames.

Lower DTR:

Enabled or Disabled. If Lower DTR is enabled, the router drops the DTR signal when a WAN Reroute alternate link is no longer needed. Dropping the DTR signal causes the modem to terminate the leased-line connection for the alternate link.

Notes:

1. The **list hdlc** command is not supported on PPP dial circuit interfaces.
2. This command displays the Lower DTR state only if Lower DTR is supported for the configured cable type.
3. This command for a PPP interface on a HSSI adapter displays a subset of the HDLC parameters listed above.

ipcp Lists the Internet Protocol control protocol options.

Example:

```
list ipcp
IPCP Options
-----
IPCP Compression:          None
Send Our IP Address:      Yes
Remote IP Address to Offer if Requested: 10.0.0.3
```

IPCP compression

Indicates whether the PPP handler accepts compressed IP headers. PPP supports Van Jacobson TCP/IP header compression (RFC 1144). Enable this option when the point-to-point link is running at a low baud rate.

Configuring PPP Interfaces (Talk 6)

A value of "Van Jacobson" indicates that header compression is supported. A value of "NONE" indicates that compressed headers are not being accepted.

Send Our IP Address

Indicates whether IPCP is configured to send the local IP address for this PPP interface to the remote end of the link in our initial "Configure Request". Some PPP implementations require this information.

ipv6cp

Lists the Internet Protocol version 6 control protocol options.

Example:

```
list ipv6cp
IPv6CP Options
-----
Send Our IP Address:          Yes
```

Send Our IP Address

Indicates whether IPv6CP is configured to send the local IP address for this PPP interface to the remote end of the link in our initial "Configure Request". Some PPP implementations require this information.

lcp

Lists the parameters and options for the Link Control Protocol.

Example:

PPP 7 Config>list lcp

```
LCP Parameters
-----
Config Request Tries:          20  Config Nak Tries:          10
Terminate Tries:              10  Retry Timer:              3000

LCP Options
-----
Max Receive Unit:             1522  Magic Number:             Yes
Peer to Local (RX) ACCM:      A0000
Protocol Field Comp(PFC):     No   Addr/Cntl Field Comp(ACFC): No

Authentication Options
-----
Authenticate remote using:    none
Identify self as:             ibm
```

Link Control Protocol includes the authentication protocols used to authenticate the remote peer. If the authentication protocol is either CHAP or Microsoft PPP CHAP (MS-CHAP), the rechallenge interval is displayed.

Example:

PPP 7 Config>list lcp

```
LCP Parameters
-----
Config Request Tries:          20  Config Nak Tries:          10
Terminate Tries:              10  Retry Timer:              3000

LCP Options
-----
Max Receive Unit:             1522  Magic Number:             Yes
Peer to Local (RX) ACCM:      A0000
Protocol Field Comp(PFC):     No   Addr/Cntl Field Comp(ACFC): No

Authentication Options
```

Configuring PPP Interfaces (Talk 6)

```
-----  
Authenticate remote using:  MSCHAP or SPAP or CHAP or PAP [Listed in priority order]  
CHAP Rechallenge Interval:  0  
MSCHAP Rechallenge Interval: 0  
Identify self as:          ibm
```

Config Request Tries:

Number of times that LCP sends configure-request packets to a peer station while attempting to open a PPP link.

Config Nak Tries:

Number of times that LCP sends configure-nak (“not acknowledged”) packets to a peer station while attempting to open a PPP link.

Terminate Tries:

Number of times that LCP sends terminate-request packets to a peer station to close a PPP link.

Retry Timer:

Number of milliseconds that elapse before packet transmission continues according to the number of times set by the “Config tries” parameter.

Max Receive Unit:

Displays the maximum information field (packet) size handled by the link.

Peer to Local (Rx) ACCM

Displays the characters that the peer must “escape” when transmitting packets to the router on asynchronous lines.

Magic Number:

Indicates whether the magic number loopback detection option is enabled.

Protocol Field Comp (PFC):

Indicates whether the PFC option is enabled.

Addr/Cntl Field Comp(ACFC):

Indicates whether ACFC is enabled.

Authenticate remote using:

A list of enabled authentication protocols.

Identify Self As:

The name set with the **set name** command.

ncp Lists the parameters for all Network Control Protocols.

Example:

```
list ncp  
NCP Parameters  
-----  
Config Request Tries:    20  Config Nak Tries:      10  
Terminate Tries:        10  Retry Timer:           3000
```

Config Request Tries:

Number of times NCP sends configure-request packets to a peer station while attempting to open a PPP link.

Terminate Tries:

While awaiting a Terminate-Ack, the number of times NCP sends Terminate-Request before it closes a PPP link.

Configuring PPP Interfaces (Talk 6)

add zeroes between the data and the frame checksum to pad the Protocol Data Unit (PDU) to the minimum size. Tinygram compression removes the zeroes and preserves the frame checksum at the transmitting end. At the receiving end, it restores the packet to the minimum length.

ccp options

Prompts you for the configurable options of the compression algorithms. Some of the options may be modified later by PPP negotiations with the peer router on the WAN link. For additional information, see “Using the Data Compression Subsystem” in *Using and Configuring Features* .

Example:

```
set ccp options
STAC: # histories [1]?
STAC: check mode (0=none, 1=LCB, 2=CRC, 3=Seq) [3]?
```

STAC: # histories

This sets the number of compression “contexts” or “histories” that are used by the STAC compression engine.

A nonzero value means that the compression engine maintains the specified number of histories where it keeps information about previous data sent in packets. This historical data is used to improve the effectiveness of the compression.

The receiver maintains a similar history and as long as the transmitter and receiver keep their histories in sync, the receiver can properly decompress the packets it receives. If the histories get out of sync, packets are discarded as unusable data. Normally, you should set the number of histories to 1 unless the link quality is very poor.

A value of zero means that each packet sent is compressed without regard to any past packets sent and may always be reliably decompressed by the receiver. However, because the compressor cannot exploit any information derived from examining prior packets, the effectiveness of the compression usually is not as good.

Some implementations support more than one history, subdividing the data stream into separate streams that are compressed independently. The router does not support the use of more than one history on a PPP link.

STAC: check mode (0=none, 1=LCB, 2=CRC, 3=Seq)

STAC compressed datagrams normally include a check value used by the two ends of the link to recognize when a compressed packet has been lost or corrupted, and some action is needed to re-synchronize the sender’s and receiver’s histories.

Note: Failure to detect a bad packet can cause all subsequent data to be decompressed incorrectly.

This option sets the exact form of check value used. Choose one of the following:

- 0** None: No check value is used. Without a check value, there is no way to determine that a packet has been lost,

Configuring PPP Interfaces (Talk 6)

out-of-sequence, or corrupted. Do not use this mode unless the underlying data link provides reliable, sequenced packet delivery.

- 1 LCB: A “Longitudinal Control Byte” is used. This is a simple, 8-bit exclusive-OR checksum. *Its usage is strongly discouraged* because the receiver cannot detect a lost or an out-of-sequence packet, and the PPP frame checksum is a more reliable test of the packet’s integrity.
- 2 CRC: A 16-bit cyclic redundancy checksum is used. Although this is a better test of a packet’s integrity than the LCB, its use is still discouraged because the receiver still cannot use it to detect lost or out of sequence packets, and otherwise it becomes largely redundant with the frame checksum.
- 3 SEQ: An 8-bit sequence number is used (default). This is the preferred method of operation. If the number of histories is not 0, use of any other mode is strongly discouraged though another mode may be necessary for interoperability with certain non-RFC-compliant routers.
- 4 EXT: An extended mode that is similar to the sequence number mode, in that each packet includes a sequence number, but the compressed frame format is altered more radically. In extended mode, re-synchronization with a peer is performed differently than with the other modes; the signaling between the two nodes is based upon flags passed in the headers of compressed datagrams rather than distinct CCP control packets.

Extended mode is provided for compatibility with certain non- RFC-compliant implementations. It should be used only with clients that do not support mode 3.

ccp algorithms *list-of-algorithms*

Specifies an exact list of compression protocols to use. The order of preference depends on the order of entry in the list. When MPPE is activated on the link, the order of the CCP algorithms is ignored and only Microsoft Point-to-Point Compression (MPPC) is used.

When the link negotiates compression with another node, it offers the entire list of protocols to the peer node in preference order. The peer node should select the first protocol it can use from the preference list. Enabling multiple protocols allows the peer to dictate which compression algorithm will be used on the link. If you need to avoid an algorithm, do not specify the algorithm in the list.

Specifying **none** disables the use of any protocol effectively disabling compression. The valid compression algorithms are:

STAC-LZS

The STAC-LZS algorithm as described in RFC 1974

MPPC The Microsoft Point-to-Point Compression algorithm as described in RFC 2118.

Example:

```

set ccp protocols
Enter a prioritized list of enabled compressors
(first is preferred), all on one single line.
Choices (can be abbreviated) are:
Stac-LZS, MPPC
Compressor list [Stac-LZS:]?
    
```

hdlc cable *cable type*

Set the HDLC cable type (that is connected to the interface) to one of the following types:

```

RS-232 DTE
RS-232 DCE
V35 DTE
V35 DCE
V36 DTE
V36 DCE
X21 DTE
X21 DCE
HSSI DTE
HSSI DCE
    
```

Table 74 lists the cable types you can configure on the various adapters.

Table 74. Cable types for 2216 Interfaces

Adapter Type	Cable type
8-port EIA 232	RS-232 DTE and RS-232 DCE
6-port V.35/V36	V.35 DCE, V.35 DTE, V.36 DCE, or V.36 DTE
8-port X.21	X.21 DCE and X.21 DTE
1-port HSSI	HSSI DCE and HSSI DTE*

***Note::** When a HSSI DCE cable is used, the other device must also be configured to use a HSSI DCE cable.

Example: set hdlc cable rs-232 dce

A DTE cable is used when you are attaching the router to some type of DCE device (for example, a modem or a DSU/CSU).

A DCE cable is used when the router is acting as the DCE and providing the clocking for direct attachment.

hdlc clocking *external or internal*

To connect to a modem or DSU, configure clocking as external. To connect directly to another DTE device, use a DCE cable and set the clocking to “internal” at one end and to “external” at the other.

Configure the clock speed at the end using internal clocking. Use Table 75 on page 560 to determine the clock speeds you can set for the various adapters when internal clocking is used.

Example: set hdlc clocking internal

Note: **Clocking** is set to *external* if the cable type is *HSSI DTE* and is set to *internal* if the cable type is *HSSI DCE* and is not configurable.

Configuring PPP Interfaces (Talk 6)

hdlc encoding *NRZ or NRZI*

Sets the HDLC transmission encoding scheme for an interface. Encoding may be set for NRZ (non-return to zero) or NRZI (non-return to zero inverted). NRZ is the more widely used encoding scheme while NRZI is used in some IBM configurations. The default value is NRZ.

Note: Encoding is set to NRZ for a PPP interface on a HSSI adapter and is not configurable.

Example: set hdlc encoding nrz

hdlc idle *flag or mark*

Sets the data link idle state to either Flag or Mark.

The flag option provides continuous flags (7E hex) between frames.

The mark option puts the line in a marking state (OFF, 1) between frames.

Note: Idle is set to *flag* for a PPP interface on a HSSI adapter and is not configurable.

Example: set hdlc idle flag

hdlc speed *value*

For internal clocking, this command specifies the speed of the transmit and receive clock lines. Refer to Table 75.

Table 75. Line Speeds When Internal Clocking is Used for 2216 Interfaces

Adapter Type	Speed Range
8-port EIA 232	9600 to 64 000 bps
6-port V.35/V.36	9600 to 460 800 bps, 1 544 000 bps, or 2 048 000 bps
8-port X.21	9600 to 460 800 bps, 1 544 000 bps, or 2 048 000 bps
1-port HSSI	22 368 000 bps or 44 736 000 bps

For external clocking, this command does not affect the hardware but it sets the speed of some protocols, such as IPX, used to determine the routing parameters. In these cases, set the speed to match the actual line speed. Use Table 76 to determine the clock speeds you can set for the various adapters.

Table 76. Line Speeds When External Clocking is Used for 2216 Interfaces

Adapter Type	Speed Range
8-port EIA 232	2400 to 64 000 bps
6-port V.35/V.36	2400 to 2 048 000 bps
8-port X.21	2400 to 2 048 000 bps
1-port HSSI	1 544 000 bps to 52 000 000 bps

- interface 1.
- port 1 of a 4-port WAN concentration adapter.
- ports 1 and 5 of an 8-port WAN concentration adapter.

Example: set hdlc speed 56000

hdlc transmit-delay *value*

Sets the number of flags sent between frames. The purpose of this command is to slow the serial line so that it is compatible with older, slower serial devices at the other end.

Configuring PPP Interfaces (Talk 6)

The range is 0 to 15. The default is 0.

Note: If you configure a nonzero transmit delay for a PPP interface on the 8-port EIA- 232E adapter, 6-port V.35/V.36 adapter, or 8-port X.21 adapter, you must configure the line speed using the **set hdlc speed** command.

Example: set hdlc transmit-delay 15

ipcp Sets all Internet Protocol Control Protocol options for that link.

Example:

```
set ipcp
IP COMPRESSION [yes]:
Number of Slots: [16]?
Send our IP address [yes]:
Note: unnumbered interface addresses will not be sent.
Interface remote IP address to offer if requested (0 for none) [0.0.0.0]? 10.0.0.3
```

IPCP compression

Selects whether or not the PPP handler will accept compressed IP data. PPP supports Van Jacobson (VJ) TCP/IP header compression as described in RFC 1144. You should enable this option when the point-to-point link is running at a low baud rate.

Setting this value to **yes** enables the compression option. Setting this value to **no** disables the option. The default setting is **no**.

Slots Sets the number IP headers that are saved for referential purposes when determining the type of compression that is enabled. The range is 1 to 16. The default is 16.

Send Our IP address

Specifies whether or not to send the local IP address to the remote end of the link. You should set this option to **yes** if the other end of the link requires the IP address.

If this value is set to **yes**, IPCP will send the IP address of the PPP interface, if the interface is configured with a numbered IP address, (that is, the address does not begin with 0). If this option is set to **no** and the peer sends us a Configure NAK with 0.0.0.0 for the IP Address option, the 2216 will respond with the address of the PPP interface if it is configured with a numbered address.

ipv6cp

Sets the IPv6 Control Protocol option for the link.

Example:

```
set ipv6cp
Send Our IP address [no]:
```

Send Our IP address

Specifies whether or not to send the local IPv6 address to the remote end of the link. Set this option to **yes** if the other end of the link requires the IPv6 address.

If this parameter is set to **yes**, IPv6CP will send the IPv6 address of the PPP interface, if the interface is configured with a numbered IPv6 address, (that is, the address does not begin with 0). If this option is set to **no** and the peer sends us a Configure NAK with ::/0 for the IPv6 address option, the 2216 will respond with the address of the PPP interface if it is configured with a numbered address.

Configuring PPP Interfaces (Talk 6)

lcp options or parameters

Sets the Link Control Protocol options and parameters for the PPP link.

Example:

```
set lcp options
Maximum Receive Unit (bytes) [2048]?
Magic Number [yes]:
Peer-to-Local Async Control Character Map (RX ACCM) [A0000] ?
Protocol Field Compression (PFC) [no]?
Addr/Cntl Field Compression (ACFC) [no]?
```

Maximum receive unit

Sets the maximum size of the information field that are transferred in a single datagram. The range is 576 to 4089 bytes. The default is 2048.

Magic number

Specifies whether or not the magic number option is enabled. The magic number provides a way of detecting looped back links in serial line configurations. When this option is enabled, the link uses the system clock as a random number generator. The random numbers that are generated are referred to as magic numbers.

When the LCP receives a Configure Request with a magic number present (i.e., the magic number option is enabled), the received magic number is compared with the magic number in the last Configure-Request sent to the peer. If the two magic numbers are different, the link is not considered looped back. If the two numbers are the same, the PPP handler attempts to bring the link down and up again to renegotiate magic numbers.

Setting this value to Yes enables the magic number option. Setting this value to No disables the option. The default setting is Yes.

Async Control Character Map

Indicates which characters that the peer must “escape” when transmitting packets to the router on asynchronous lines. This allows certain sensitive ASCII control characters, such as XON and XOFF, to be transmitted transparently over the link.

Specify a 32-bit bit mask in hexadecimal. If a bit in position 'N' of the mask is set, the corresponding ASCII character 'N' must be escaped (the LSB is bit number 0, corresponding to the ASCII NUL character).

The default value for this option is '0A0000', indicating that XON and XOFF (control-Q and control-S) need to be escaped. This is for the benefit of modems that use XON/XOFF to perform software handshaking. If this is not an issue, then it is recommended that you change the ACCM to zero (no characters escaped).

LCP is always willing to negotiate the ACCM, even on synchronous lines, and the **list lcp** command in the PPP monitoring process will display the negotiated value. However, synchronous lines employ a “bit-stuffing” mechanism rather than an “escaping” mechanism, so the ACCM is not normally meaningful on synchronous lines. It may be meaningful if the router is connected to a modem that performs sync-to-async conversion, in which case its value should reflect the requirements of the attached modem on the asynchronous side.

Addr/Cntl Field Compression (ACFC)

Specifies whether the peer can employ address and control field compression.

Configuring PPP Interfaces (Talk 6)

If the ACFC option is successfully negotiated by LCP, it means that the Address and Control field bytes which start off each packet may be omitted in the datagrams sent back and forth on the link. These bytes are always 0xFF 03, so there is no real information provided by them, and enabling ACFC means that the datagrams that are transmitted will be two bytes shorter.

To be precise, if you enable ACFC, you are indicating a receive-side capability. If you enable ACFC and LCP successfully negotiates it, the other end can employ ACFC in the packets it transmits to the local end (most PPP options work like this). The local end will only transmit packets *without* the address and control fields if the other end also indicates its ability to handle such packets.

Enabling ACFC does not obligate the other end to send packets without the address and control fields, even if it accepts the option. Enabling ACFC merely tells the peer that it optionally *may* use ACFC, and the router will be able to handle the incoming packets. If the peer indicates that it can handle ACFC, then the router always performs ACFC on the packets it transmits regardless of whether ACFC is enabled locally.

LCP packets always are sent with address and control fields present. This guarantees that LCP packets will be recognized even if there is a loss of link synchronization.

Protocol Field Compression (PFC)

Specifies whether the peer is to employ protocol field compression.

When you specify “yes”, if the PFC option is negotiated successfully by LCP, the leading zero byte may be omitted from the “Protocol” field for those protocol values in the range '0x0000'–'0x00FF', for a one byte savings in the packets being transmitted. This range includes the majority of layer-3 protocol datagrams.

PPP protocol values are all assigned such that the upper byte of the protocol is an even value and the lower byte is an odd value (a limited use of the more generalized mechanism described by the ISO 3309 extension mechanism for address fields). Thus, the receiver can readily detect when the leading byte of a protocol value has been omitted (the first byte of the protocol field is odd rather than even), so there is no ambiguity interpreting frames in the presence of PFC.

PFC, like ACFC, is a receive side capability and the previous description of ACFC applies to PFC.

Example:

```
set lcp parameters
Config tries [20]?
NAK tries [10]?
Terminate tries [10]?
Retry timer (mSec) [3000]?
```

Note: The value immediately following the command option prompt is the current setting of that option. It is not always the default value illustrated in this chapter.

Retry timer

Sets the amount of time in milliseconds that elapses before LCP's transmission of configure-request (to open the link) and

Configuring PPP Interfaces (Talk 6)

terminate-request (to close the link) packets is timed out. Expiration of this timer causes a timeout and the halting of configure-request and terminate-request packet transmission. The range is 200 to 30000 milliseconds. The default setting is 3000 milliseconds.

Config tries

Sets the number of times that LCP sends configure-request packets to a peer station to establish the opening of a PPP link. The default value is 20. The range is 1 to 100.

The retry timer starts after the first configure-request packet is transmitted. This is done to guard against packet loss.

NAK tries

Sets the number of times that LCP sends configure-nak (nak = not acknowledged) packets to a peer station while attempting to open a PPP link. The default value is 10. The range is 1 to 100.

LCP sends configure-nak packets upon receiving configure-request packets with some unacceptable configuration options. These packets are sent to refuse the offered configuration options and to suggest modified, acceptable values.

Terminate tries

Sets the number of times that LCP sends terminate-request packets to a peer station to close a PPP link. The default value is 10. The range is 1 to 100.

The retry timer starts after the first terminate-request packet is transmitted. This is done to guard against packet loss.

name Sets the name that the router uses when responding to authentication requests from another router.

Notes:

1. While the “case” that you use for names and passwords sent to the peer on the link are preserved for this product, interoperability with other vendor products is easier if all names and passwords are entered in *lowercase*.
2. Other implementations may not handle names with the same maximum length as supported in this product. The only indication is a message from the authenticator stating that there is a bad name. If you receive this type of message, try shortening the routerid.
3. This command sets the name of the local router. Use the talk 6 **add ppp-user** command at the Config> prompt to add each remote user to the local data base, if you want to use the local data base to track the remote users. The alternative is to configure the external AAA authentication server that is described in the chapter “Using Local or Remote Authentication” in *Using and Configuring Features* .

Note: The external AAA authentication server cannot be used by MS-CHAP.

Example:

```
set name
PPP 7 Config>set name
Enter Local Name: [ ]? newyork
Password:
Enter password again:
PPP Local Name = newyork
```


ncp parameters

Sets the basic operational parameters for most NCPs.

Note: Although you access this command through a particular interface, this command will reset the parameters for all PPP interfaces.

Example:

```
set ncp parameters
Config tries [20]
NAK tries [10]?
Terminate tries [10]?
Retry timer (mSec) [3000]?
```

Config tries

Sets the number of configure-request packets sent by NCP to a peer station to attempt to open a PPP link. The range is 1 to 100. The default is 20.

This action indicates the desire to open an NCP connection with a specified set of configuration options. The retry timer starts after a configure-request packet is transmitted. This is done to guard against packet loss.

NAK tries

Sets the number of configure-nak (nak = not acknowledged) packets that NCP sends to a peer station while attempting to open a PPP link. The range is 1 to 100. The default value is 10.

Upon receiving configure-request packets with some unacceptable configuration options, NCP sends configure-nak packets. These packets are sent to refuse the offered configuration options and to suggest modified, acceptable values.

Terminate tries

Sets the number of terminate-request packets sent by NCP to a peer station to close a PPP link. The range is 1 to 100. The default value is 10.

This action indicates the desire to close an NCP connection. The retry timer is started after a terminate-request packet is transmitted. This is done to guard against packet loss.

Retry timer

Sets the amount of time, in milliseconds, that elapses before NCP's transmission of configure-request (to open the link) and terminate-request (to close the link) packets is timed out. Expiration of this timer causes a timeout and the halting of configure-request and terminate-request packet transmission. The range is 200 to 30000 milliseconds. The default is 3000 milliseconds.

Accessing the Interface Monitoring Process

To access the PPP interface monitoring process, do the following:

1. Enter **interface** at the + prompt to display a list of configured interfaces.
2. Enter **network** followed by the number of the PPP interface.

```
+ network 2
PPP>
```


Monitoring PPP Interfaces (Talk 5)

spap - SPAP Authentication CP
ccp - PPP Compression CP
cdp - PPP compression
compression - PPP compression
bcp - Bridging (ASRT) CP
brg - Bridging (ASRT)
stp - Spanning Tree Protocol
nbcsp - NetBios
nbcfp - NetBios Frame
ipcp - Internet Protocol CP
ip - Internet Protocol
ipv6cp - Internet Protocol version 6 CP
ipv6 - Internet Protocol version 6
ipxcp - Novell IPX CP
ipx - Novell IPX
atcp - AppleTalk (Phase 2) CP
ap2 - AppleTalk (Phase 2)
dncp - DECnet IV CP
dn - DECnet IV
osicp - ISO's OSI CP
osi - ISO's OSI
bvcsp - Banyan VINES CP
vines - Banyan VINES
isrcp - APPN ISR CP
isr - APPN ISR
hprcp - APPN HPR CP
hpr - APPN HPR

all Lists all information and counters related to the point-to-point interface and PPP options and parameters. The output displayed for this command is a combination of the displays from all of the individual **list item** commands.

Note: If a network control protocol is not available on an interface, a message is displayed indicating that no protocol or statistics information is available for that network control protocol's list commands.

cbcp Lists statistics for the Callback Control protocol.

Example: list cbcp

CBCP Statistics	In	Out
-----	---	----
Packets:	0	0
Octets:	0	0
Callback attempts:	0	
Successful callbacks:	0	

Monitoring PPP Interfaces (Talk 5)

Packets

Indicates the total number of CBCP packets transmitted (out) and received (in) over the current point-to-point interface.

Octets

For CBCP frames, indicates the total number of bytes in Octets transmitted and received over the current point-to-point interface.

Callback attempts

The number of CBCP callbacks attempted, including those in progress.

Successful callbacks

The number of successful callbacks completed.

control

Lists negotiated options or other state information for a control protocol.

ccp

ecp

lcp

bcp

nbcP

nbfcP

ipcp

ipxcp

atcp

dncp

osicp

bvcp

isrcp

hrcp

Examples of the List Control CCP Command

Example for STAC-LZC compression:

```
list control ccp
CCP State:          Open
Previous State:     Ack Sent
Time Since Change:  264 hours, 56 minutes and 58 seconds

Compressor:  STAC-LZS histories 1, check_mode SEQ
Decompressor: STAC-LZS histories 1, check_mode SEQ

Max size of compression dictionary: 12494.
Max size of decompression dictionary: 4424.
```

Example for MPPC compression:

```
list control ccp
CCP State      :      Open
Previous State  :      Listen
Time Since Change:  167 minutes

Compressor : none
Decompressor : none

MPPE : Negotiated 40 bit stateful
```

Definitions of Terms in the List Control CCP Example

CCP state

The current state of the point-to-point link. If “Open”, then compression was successfully negotiated on this link. If not open, compression is not running on the link. It will also show as “Open” if MPPE has been successfully negotiated.

Previous State

State of the point-to-point link before the state displayed in the current state field.

Compressor

Shows which compressor was negotiated and the options it is using.

Decompressor

Shows which decompressor was negotiated and the options it is using.

Max size of compression dictionary

The size of the data space allocated for the compression “context” or “history”.

Max size of decompression dictionary

The size of the data space allocated for the decompression “context” or “history”.

MPPE MPPE options negotiated. See the talk 6 **enable mppe** command for descriptions of these parameters and “Microsoft Point-to-Point Encryption (MPPE)” in the chapter “Overview of Encryption” in *Using and Configuring Features* for more information.

Example of the List Control ECP Command

Example:

```
PPP x>list control ecp
ECP State:                Open
Previous State:           Ack Sent
Time Since Change:       16 minutes and 40 seconds
Local (transmit) encrypter: DES
Remote (receive) encrypter: DES
```

Definitions of Terms in the List Control ECP Example

ECP State:

The current state of the point-to-point link. If “Open” then encryption was successfully negotiated on this link. If not “Open”, encryption is not running on the link.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See “Load” on page 90 .

Previous State:

The state of the point-to-point link before the state displayed in the current state field.

Time Since Change:

The elapsed time between the above two state changes.

Monitoring PPP Interfaces (Talk 5)

Local (transmit) encrypter:

This encryption algorithm is used for encrypting the data being sent on this PPP interface.

Remote (receive) encrypter:

The encryption algorithm is used for decrypting the received data on this interface.

Example of the List Control LCP Command

Example:

```
list control lcp
```

```
Version:                1
Link phase:             Establishing connection (LCP)
LCP State:              Listen
Previous State:         Req Sent
Time Since Change:      1 minute and 57 seconds
Remote Username:        - No Authentication -
Last Identification Rx'd
Time Connected:         - No Connection -

LCP Option              Local              Remote
-----
Max Receive Unit:       2048                1500
Async Char Mask:        FFFFFFFF          FFFFFFFF
Authentication:         None                None
Magic Number:           7A8CBFD7            None
Protocol Field Comp:    No                    No
Addr/Cntl Field Comp:   No                    No
32-Bit Checksum:       No                    No
```

Definitions of Terms in the List Control LCP Example

Version

Displays the current version of the Point-to-Point Protocol.

Link phase

Displays the current activity on the link. This can have one of the following values:

Dead There is no activity on the link; the interface is down.

LCP The link is in LCP negotiation. This state occurs when first bringing up an interface. The interface may be in self-test at this time.

Authenticate

The link is performing initial authentication.

ECP The link is negotiating an ECP encryption algorithm.

Note: Encryption support is optional and must be added to your software load using the **load add** command. See the CONFIG process **load** command in *Nways Multiprotocol Access Services Software User's Guide*.

Ready Link is operating normally. NCPs can negotiate and data traffic associated with can flow after successful NCP negotiation.

Terminate

The link is being shut down.

LCP State

Displays the current state of the point-to-point link. These states include the following:

OPEN - Indicates that a connection has been made and data can be sent. The retry timer does not run in this state.

CLOSED - Indicates that the link is down and no attempt is being made to open it. In this state, all connection requests from peers are rejected.

LISTEN - Indicates that the link is down and no attempt is being made to open it. In contrast to the **CLOSED** state, however, all connection requests from peers are accepted.

REQUEST-SENT - Indicates that an active attempt is being made to open the link. A Configure-request packet has been sent but a Configure-Ack has not yet been received nor has one been sent. The retry timer is running at this time.

ACK-RECEIVED - Indicates that a Configure-request packet has been sent and a Configure-Ack packet has been received. The retry timer is still running since a Configure-Ack packet has not been transmitted.

ACK-SENT - Indicates that a Configure-Ack packet and a Configure-request packet have been sent but a Configure-Ack packet has not been received. The retry timer always runs in this state.

CLOSING - Indicates that an attempt is being made to close the connection. A Terminate-request packet has been sent but a Terminate-Ack packet has not been received. The retry timer is running in this state.

Previous State

Displays the state of the point-to-point link prior to the state displayed in the Current state field. These states are the same as those described in the Current state field.

Time since change

Displays the amount of time that has elapsed since the last link state change.

Remote Username

When authentication is required on the link, this field shows the name that the peer supplied.

Last Identification Rx'd

An optional packet type that is defined for LCP is an "Identification" packet. The contents of this packet are undefined but are normally expected to be a human-readable string provided by the peer to give some identifying information such as a name, manufacturer, model number, or other information the manufacturer wishes to provide. If the router receives such a packet, the contents of the last such packet received are displayed here.

Time Connected

Indicates how long the peer has been connected on this link.

Monitoring PPP Interfaces (Talk 5)

LCP Option

These fields indicate the values of options that have been negotiated with the peer when LCP is in the Open state. When LCP is not open, these values represent initial defaults or configured values that will be used in subsequent LCP negotiations.

Max Receive Unit

Indicates the maximum length for the packet size that the local and remote ends can transmit. This is the maximum length of the payload portion of a PPP packet and it does not include PPP header and trailer bytes.

When LCP is in an Open state, the values indicate the lengths that have been negotiated with the peer. The router does not support differing MRU lengths for the peer and local end, so these values will be the same.

Async Character Mask

This indicates the asynchronous control character mask that has been negotiated. The router accepts ACCM negotiation even on synchronous lines, although this does not affect the actual packet data sent. See the **set lcp options** command on page 561 for more information about the ACCM.

Authentication

Indicates which authentication protocol, if any, each end of the link requires. Multiple protocols may be available at each end; this value indicates which protocol the units agreed to use.

Magic number

Displays the current magic number being used for both the local and remote ends of the link for loopback detection.

Protocol compression

Indicates whether PFC has been negotiated.

Address/Control compression

Indicates whether ACFC has been negotiated.

32-bit checksum

Not currently supported. PPP will reject this option if it is received.

Example of the List Control BCP Command

Example:

```
list control bcp
BCP State:          Closed
Previous State:     Closed
Time Since Change:  5 hours, 25 minutes and 3 seconds

BCP Option          Local          Remote
Tinygram Compression  DISABLED        DISABLED
Source-route Info:
Remote side does not support source-route bridging
```

Definitions of Terms in the List Control BCP Example

The BCP State fields are the same as those described under the **list control lcp** command.

Tinygram Compression

Displays whether or not Tinygram Compression is enabled or disabled on the local and remote ends of the link.

Source-route Info

Displays whether or not source route bridging is enabled for the local and remote ports that correspond to this interface.

Example of the List Control NBFCP Command

Example:

```
list control nbfcp
NBFCP State:          Closed
Previous State:      Closed
Time Since Change:   4 hours, 5 minutes and 58 seconds

NetBIOS Frame Control Protocol Info:
Local MAC Address = 0x000000000000
Remote MAC Address = 0x444553540000
Remote NetBIOS Names: (0)

Remote Peer Class:   0
Remote Peer Version Major: 0
Remote Peer Version Minor: 0
```

Definitions of Terms in the List Control NBFCP Example

The NBFCP State fields are the same as those described under the **list control lcp** command.

Local MAC Address

The Local MAC Address is the MAC Address that is used by the Win 95/NT Dial-Up Networking client. It is a pseudo-random number, or a Locally Administered Address (LAA), if you configured an LAA in the client.

Remote MAC Address

The Remote MAC Address is the MAC Address that the 2216 DIALS Server has assigned to this client for use on the LAN.

Remote NetBIOS Name

The list of NetBIOS names of LAN resources to which the client has requested access.

Remote Peer

The Remote Peer Class, Version Major, and Version Minor is the information passed back to the 2216 by the NBFCP Peer Information option.

Example of the List Control IPCP Command

Example:

```
list control ipcp
IPCP State:          Listen
Previous State:      Closed
Time Since Change:   1 hour, 57 minutes and 52 seconds

IPCP Option          Local          Remote
-----
IP Address           0.0.0.0          10.0.0.152
Compression Slots    None              None

DHCP State:          BOUND
Lease Server:        10.0.0.111
Leased IP Address:   10.0.0.152
```

Monitoring PPP Interfaces (Talk 5)

```
Lease Time:          4 minutes and 0 seconds
Renewal Time:        2 minutes and 0 seconds
Rebind Time:         3 minutes and 30 seconds
Lease Time Elapsed:  1 second
Lease Time Remaining: 3 minutes and 59 seconds

DHCP Client ID:     0100120B0000
```

Definitions of Terms in the List Control IPCP Example

The IPCP state fields are the same as those described under the **list control lcp** command.

IP Address:

Indicates if this interface's IP address (Local) and the negotiated address of the remote (Remote), if any.

Compression Slots

Indicates the number of IP headers saved for referential purposes when determining the type of compression that is enabled.

DHCP State

This is the Proxy DHCP as described in RFC 1541.

Lease Server

The server from which the lease was acquired.

Leased IP address

The address leased to the client. This address should be equivalent to the "Remote IP Address" listed above.

Lease Time

Length of lease from the DHCP server for this address. When "Lease Time Elapsed" equals this time, the lease will be expire and the IPCP connection closed.

Renewal Time

Time after which Proxy DHCP attempts to extend this lease from the server. When "Lease Elapsed Time" equals this time, Proxy DHCP attempts to renew the lease, resetting the "Lease Time," "Lease Elapsed Time," and "Lease Time Remaining," if successful.

Rebind Time

Time before Proxy DHCP attempts to obtain a new lease from any configured DHCP server. When "Lease Elapsed Time" equals this time, Proxy DHCP attempts to obtain a new lease, resetting the "Lease Time," "Lease Elapsed Time," and "Lease Time Remaining," if successful.

Leased Time Elapsed

Time elapsed for this lease. This is not necessarily the time for this particular dial-in session, as the lease may have been renewed. When the lease is renewed, this timer is set back to 0.

Leased Time Remaining

Time remaining for this lease. This parameter is equal to "Lease Time" minus "Lease Time Elapsed."

DHCP client ID

A unique ID for this client (dial-in user). All DHCP messages are identified to and from the DHCP server by this client ID.

Example of the List Control IPXCP Command

Example:

```
list control ipxcp
IPXCP State:      Closed
Previous State:   Closed
Time Since Change: 2 hours, 9 minutes and 9 seconds
```

The IPXCP state fields are the same as those described under the **list control lcp** command.**Example of the List Control ATCP Command**

Example:

```
list control atcp
ATCP State:      Closed
Previous State:   Closed
Time Since Change: 6 hours, 27 minutes and 7 seconds

AppleTalk Address Info:
Common network number = 12
Local node ID = 49
Remote node ID = 76
```

Definitions of Terms in the List Control ATCP Example

The ATCP State fields are the same as those described under the **list control lcp** command.

Common Network Number

Network number of the two ends of the point-to-point link. (You must statically configure both ends of the link to have the same network number.)

Local Node ID

Unique node number of the local end of the link.

Remote Node ID

Unique node number of the remote end of the link.

Example:

```
list control dnpc
DNCP State:      Closed
Previous State:   Closed
Time Since Change: 2 hours, 2 minutes and 58 seconds
```

The DNCP state fields are the same as those described under the **list control lcp** command.

Example:

```
list control osicp
OSICP State:      Closed
Previous State:   Closed
Time Since Change: 6 hours, 28 minutes and 32 seconds
```

The OSICP State fields are the same as those described under the **list control lcp** command.**Example of the List Control BVPC Command**

Example:

```
list control bvcp
BVCP State:      Open
Previous State:   Ack Sent
Time Since Change: 403 hours, 49 minutes and 2 seconds
```

The BVCP State fields are the same as those described under the **list control lcp** command.

Monitoring PPP Interfaces (Talk 5)

Note: The command word **bvcp** and the acronym BVCP stand for the Banyan VINES Control Protocol (BVCP).

Example of the List Control ISRCP Command

Example:

```
list control isrcp
APPN ISRCP State:      Open
Previous State:       Ack Rcvd
Time Since Change:    1 hour, 48 minutes and 5 seconds
```

The APPN ISR control protocol (ISRCP) state fields are the same as those described under the list control lcp command. **Example of the List Control HPRCP Command**

Example:

```
list control hprcp
APPN HPRCP State:     Open
Previous State:      Ack Rcvd
Time Since Change:   1 hour, 48 minutes and 10 seconds
```

The APPN HPR control protocol (HPRCP) state fields are the same as those described under the list control lcp command

error Lists information related to all error conditions tracked by the PPP software.

Example:

list error	Count	Last One
Error Type	-----	-----
Bad Address:	0	0
Bad Control:	0	0
Unknown Protocol:	0	0
Invalid Protocol:	0	0
Config Timeouts:	0	0
Terminate Timeouts:	0	0

Bad address

Indicates the total number of bad addresses encountered over the point-to-point link. "Bad addresses" refers to the HDLC framing byte at the start of the packet.

Bad control

Indicates the total number of bad control packets encountered over the point-to-point link. "Bad control" refers to the 0x03 prefix on HDLC encapsulated PPP packets ("UI" value that follows the 0xFF).

Unknown protocol

Indicates the total number of unknown protocol packets encountered by the current link.

Invalid protocol

Indicates the total number of invalid protocol packets encountered by the current link.

Config timeouts

Indicates the total number of configuration timeouts experienced by the link.

Terminate timeouts

Indicates the total number of link termination timeouts experienced by the link.

interface

Lists PPP interface statistics.

Example:

Monitoring PPP Interfaces (Talk 5)

```
list interface
Interface Statistic      In      Out
-----
Packets:                 0        0
Octets:                  0        0
```

Packets

Indicates the number of packets received and transmitted on this interface.

Octets

Indicates the number of octets received and transmitted on this interface.

lcp Lists statistics for the Link Control Protocol.

Example:

```
list lcp
LCP STATISTIC          IN      OUT
-----
PACKETS:               42      42
OCTETS:                1260    1260
CFG REQ:               0        0
CFG ACK:               0        0
CFG NAK:               0        0
CFG REJ:               0        0
TERM REQ              0        0
TERM ACK              0        0
ECHO REQ:             21      21
ECHO RESP:            21      21
DISC REQ:              0        0
CODE REJ:              0        0
```

Packets

Indicates the total number of LCP packets transmitted (out) and received (in) over the current point-to-point interface.

Octets

For LCP frames, indicates the total number of bytes in octets transmitted and received over the current point-to-point interface.

CFG REQ

Indicates the total number of configure-request LCP packets transmitted and received over the current point-to-point interface.

CFG ACK

Indicates the total number of configure-ack (acknowledged) LCP packets transmitted and received over the current point-to-point interface.

CFG NAK

Indicates the total number of configure-nak (not acknowledged) LCP packets transmitted and received over the current point-to-point interface.

CFG REJ

Indicates the total number of configure-reject LCP packets transmitted and received over the current point-to-point interface.

TERM REQ

Total number of terminal request LCP packets transmitted and received over the current point-to-point interface.

TERM ACK

Total number of terminal ack LCP packets transmitted and received over the current point-to-point interface.

Monitoring PPP Interfaces (Talk 5)

ECHO REQ

Indicates the total number of echo-request LCP packets transmitted and received over the current point-to-point interface.

ECHO RESP

Indicates the total number of echo-response LCP packets transmitted and received over the current point-to-point interface.

DISC REQ

Indicates the total number of discard-request LCP packets transmitted and received over the current point-to-point interface.

CODE REJ

Indicates the total number of code-reject LCP packets transmitted and received over the current point-to-point interface.

pap Lists statistics for the Password Authentication Protocol.

Example:

```
list pap
PAP Statistics          In          Out
-----
Packets:                0            0
Octets:                 0            0
Requests:               0            0
Acks:                   0            0
Naks:                   0            0
```

Packets

The total number of PAP packets sent or received.

Octets

The number of bytes of data that were sent or received in those packets.

Requests

The number of PAP "Request" packets sent or received. These are the packets which contain the PAP name/password pairs.

Acks The number of Acks (success replies) sent or received for the PAP requests (for example, if the peer sends a valid Request packet, the router replies with an Ack).

Naks The number of Naks sent or received for the PAP requests (for example, if the peer sends an invalid Request packet, the router replies with a Nak).

chap Lists statistics for the Challenge-Handshake Authentication Protocol.

Example:

```
list chap
CHAP Statistics          In          Out
-----
Packets:                0            0
Octets:                 0            0
Challenges:             0            0
Responses:              0            0
Successes:              0            0
Failures:               0            0
```

Packets

The total number of CHAP packets sent or received.

Octets

The number of bytes of data that were sent or received in the packets.

Monitoring PPP Interfaces (Talk 5)

Challenges

The number of CHAP “Challenge” packets sent or received. A CHAP Challenge packet includes a randomly generated encryption key and is a demand on the peer to generate a suitable response based on that key and on stored password information.

Responses

The number of CHAP “Response” packets sent or received. A Response packet contains a peer’s answer to a “Challenge” request.

Successes/Failures

The number of Success or Failure packets sent or received. A unit sends out a Challenge packet and waits for the peer’s Response reply. It then examines the Response packet and sends a Success or Failure packet to indicate whether the Response was valid.

These counters reflect the number of Success or Failure packets sent. A peer gets several tries to respond successfully before authentication is considered to have failed.

mschap

Lists MS-CHAP statistics for each direction.

Packets

Total number of MS-CHAP packets.

Octets

Total number of bytes contained in MS-CHAP packets.

Challenges

Number of MS-CHAP challenge packets.

Responses

Number of MS-CHAP response packets.

Successes

Number of MS-CHAP success packets.

Failures

Number of MS-CHAP failure packets.

Failure: Restricted Hours

Number of failure packets sent due to the PPP user’s attempt to access the 2216 outside of that user’s permitted hours. This counter is not supported and will always be 0.

Failure: Account Disabled

Number of failure packets sent because the PPP user’s ID has been disabled at the 2216.

Failure: Password Expired

Number of failure packets sent because the PPP user’s password has expired.

Failure: No Dialin Permission

Number of failure packets sent because the PPP user is not authorized to dial in to this 2216.

Failure: Authentication

Number of failure packets sent because the PPP user’s credentials (ID or password) are not known to the 2216.

Monitoring PPP Interfaces (Talk 5)

Failure: Change Password

Number of failure packets sent as a result of error encountered while processing the Change Password packet.

Change Password

Number of change password packets. The router will never send a change password packet; therefore, the outbound counter will always be 0.

ecp Lists statistics for ECP (encryption control protocol) packets sent or received on the interface.

Example:

```
PPP x>list ecp
```

```
ECP Statistic          In          Out
-----
Packets:                2            2
Octets:                 26           26
Reset Reqs:             0            0
Reset Acks:             0            0
Prot Rejects:           0            -
Local (transmit) encrypter: DES
Remote (receive) encrypter: DES
```

Note: Encryption support is optional and must be added to your software load using the **load add** command. See “Load” on page 90.

Packets

Indicates the total number of ECP packets transmitted (out) and received (in) over the current point-to-point interface.

Octets

Indicates the total number of bytes transmitted and received in the ECP packets.

Reset Reqs

Indicates the number of Reset requests transmitted and received on this interface. A Reset Request will be sent whenever ECP discard an EDP packet.

Note: Because DES, the only supported encryption algorithm, does not send reset requests this number will be zero.

Reset Acks

Indicates the reset acknowledgments transmitted and received on this interface. A Reset Ack packet will be sent for every Reset Request packet received.

Note: Because DES, the only supported encryption algorithm, does not send any Reset Requests this number will be zero.

Prot Rejects

Indicates the total number of protocol reject packets transmitted and received over the current point-to-point interface.

Local (transmit) encrypter

This encryption algorithm will be used to encrypt the data being sent on this point-to-point interface.

Remote (receive) encrypter

This encryption algorithm will be used to decrypt the received data on this point-to-point interface.

Monitoring PPP Interfaces (Talk 5)

edp Lists statistics associated with the ECP-encrypted packets being sent or received on the interface.

Example:

```
PPP x>list edp
```

Encryption Statistic	In	Out
-----	--	---
Packets:	20	30
Octets:	29164	44790
Encrypted Octets:	29280	44880
Discarded Packets:	0	0
Prot Rejects:	0	-

Note: Encryption support is optional and must be added to your software load using the **load add** command. See “Load” on page 90.

Packets

Indicates the total number of IP packets transmitted (out) and received (in) over the current point-to-point interface.

Octets

Indicates the total number of octets of data bytes transmitted and received over the current IP connection.

Encrypted Octets

Indicates the number of encrypted octets transmitted or received on this interface.

Discarded Packets

Indicates the number of packets that were discarded because they could not be successfully decrypted.

Prot Rejects

Indicates the total number of protocol reject packets transmitted and received over the current point-to-point interface.

mppe Displays encryption data statistics for Microsoft PPP Encryption (MPPE) configuration.

Example:

```
list mppe
MPPE Statistic      In      Out
-----
Encrypted Octets :   0       0
Encrypted Packets :   0       0
Discarded Packets :   0       0
```

spap Lists statistics for the Shiva Password Authentication Protocol.

Example:

```
list spap
SPAP Statistic      In      Out
-----
Packets:            0       0
Octets:             0       0
Requests:          0       0
Acks:               0       0
Naks:               0       0
Dialbacks:         0       0
PleaseAuthenticates: 0       0
Change Passwords:  0       0
Alerts:             0       0
MCCP Call Reqs     0       0
MCCP Callbacks     0       0
MCCP ACKs          0       0
MCCP NAKs          0       0
```

Packets

The total number of SPAP packets sent or received.

Monitoring PPP Interfaces (Talk 5)

Octets

The number of bytes of data that were sent or received in those packets.

Requests

The number of SPAP "Request" packets sent or received. These are the packets which contain the SPAP name/password pairs.

Acks

The number of Acks (success replies) sent or received for the SPAP requests (for example, if the peer sends a valid Request packet, the router replies with an Ack).

Naks

The number of Naks sent or received for the SPAP requests (for example, if the peer sends an invalid Request packet, the router replies with a Nak).

Dialbacks

The number of times a user:

- Requested a callback (roaming callback) and it was granted.
- Dialed-in and they were configured for required callback and dialed back at the predetermined number stored in the user profile.

PleaseAuthenticates

The number of SPAP please authenticate packets that have been sent or received on this interface. An SPAP please authenticate packet is sent as the result of a timeout when waiting for the other end to send an SPAP authenticate request.

Change Passwords

The number of change password requests that sent or received on this interface.

Alerts

The number of SPAP banners that have been sent or received.

MCCP Call Reqs

Indicates that the sender requested another phone number to dial a second MP link.

MCCP Callbacks

Indicates that the sender supplied a phone number on which to be called back to establish a second MP link.

MCCP ACKs

The number of acknowledgments sent or received by MCCP.

MCCP NAKs

The number of negative acknowledgments sent or received by MCCP.

ccp

Lists statistics for compression control protocol.

Example:

```
list ccp
CCP  Statistic      In           Out
-----
Packets:           24           25
Octets:            174          177
Reset Reqs         0            0
Reset Acks         0            0
Prot Rejects:     0            0
```

Packets

Indicates the number of packets received and transmitted on this interface.

Octets

Indicates the number of octets received and transmitted on this interface.

Reset Reqs

The number of CCP dictionary “Reset Requests” that were transmitted or received.

Reset Acks

The number of CCP dictionary “Reset Acknowledgments” that were transmitted or received.

Reset Request and Reset Acknowledgment packets are control packets passed between the CCP entities at each end, used to maintain synchronization of the data dictionaries at each end of the link.

Prot Rejects

Indicates the number of protocol rejects of CCP packets sent by the peer (reception of a protocol reject would signify that the peer does not support CCP).

cdp Displays statistics associated with compressed data packets sent or received on this interface.

Example:

```
list cdp
Compression Statistic      In                Out
-----
Packets:                   31035             46550
Octets:                    1614885           2421137
Compressed Octets:         931416            1521039
Incompressible Packets:    0                 0
Discarded Packets:         0                 0
Copied Packets:            1                 0
Prot Rejects:              0                 -

Compressor (transmit) statistics:
  Recent compression ratio: 1.7:1
Decompressor (receive) statistics:
  Recent compression ratio: 1.7:1
```

Packets

These counters indicate the number of compressed datagrams sent and received. On the output side, the count includes only those packets that were actually sent as PPP compressed datagrams; it does not include packets that were found to be incompressible and sent in their original uncompressed form.

These counters count the packets sent or received that had the PPP protocol type of X'00FD' (CDP). When STAC extended mode or MPPC has been negotiated, incompressible packets may be encapsulated in CDP datagrams. This encapsulation would include the incompressible packets in these counts.

Octets

These counters indicate the number of bytes effectively transmitted or received in compressed form. These counts reflect the lengths of the original datagrams before compression or after decompression.

Compressed octets

These counters indicate the number of bytes for all of the

Monitoring PPP Interfaces (Talk 5)

compressed datagrams sent and received. These counts are the lengths of the actual CDP packets after compression or before decompression.

Incompressible packets

These counters indicate the number of packets that were incompressible and therefore sent in original uncompressed form.

Discarded packets

These counters indicate how many packets were discarded because they could not be successfully decompressed. Typically these packets will be packets that the peer was transmitting just after the router has sent a Reset-Request, but before the peer has received and processed the Reset-Request. Packets are also dropped if the router detects that data in the packets is incorrect. An example of incorrect data is a packet that contains a bad sequence number.

If the number of discarded packets increases too rapidly, then packets are being lost or corrupted on the line, probably due to noise on the line, and the link performance may be degraded.

Protocol rejects

This counter indicates the number of Protocol-Rejects of CDP packets that have been received from a peer. This count should be zero, because the link will not send CDP packets if the use of compression has not already been negotiated.

Compression ratios

The ratios give an approximate indication of the effectiveness of the compressor and decompressor. These ratios are based on the number of plain-text bytes divided by the number of corresponding compressed bytes, so values greater than 1 are preferable for both input and output. The higher the number, the more effective the compression.

The output ratio is computed as the ratio of the number of original plain-text bytes divided by the number of bytes sent as a result of attempting compression - whether the packet actually was compressed or sent as a CDP packet. If a data stream does not compress well and most of the packets are sent in their original form or in enlarged CDP packets, the compression output ratio will drop. If the ratio drops below 1.0, the compressor is actually reducing the effective bandwidth of the line rather than increasing it, and should be disabled on that interface if the state persists for a long time.

The input ratio is computed based on the number of bytes received in CDP frames divided into the number of decompressed bytes. Unlike the output ratio, this count does not include any packets that were incompressible and sent in plain-text form. This is because the router cannot determine if a received non-CDP packet was an incompressible packet that the peer sent in plain-text form, or just a packet that the peer did not attempt to compress.

Because of the method of calculation, the output ratio on one end of the link does not necessarily match the input ratio at the other end.

compression

This command displays the same information as `list cdp`.

bcg Lists statistics for the Bridging control protocol. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list bcp
BCP Statistic          In          Out
-----
Packets:                0            0
Octets:                 0            0
Prot Rejects:          0            -
```

brg Lists statistics on the bridge packets received and transmitted over the PPP interface. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list brg
BRG Statistic          In          Out
-----
Packets:                0            0
Octets:                 0            0
Prot Rejects:          0            -
```

stp Lists statistics for the spanning tree protocol. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list stp
Spanning Tree Statistic In          Out
-----
Packets:                0            0
Octets:                 0            0
```

nbcg Lists NetBIOS Control Protocol statistics for the point-to-point interface. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list nbcg
NBCP Statistic          In          Out
-----
Packets:                0            0
Octets:                 0            0
Prot Rejects:          0            -
```

nbfcg Lists NetBIOS Frame Control Protocol statistics for the point-to-point interface. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list nbfcg
NBFCP Statistic          In          Out
-----
Packets:                0            0
Octets:                 0            0
Prot Rejects:          0            -
```

ipcp Lists Internet Protocol Control Protocol statistics for the point-to-point interface. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

Monitoring PPP Interfaces (Talk 5)

```
list ipcp
IPCP STATISTIC      IN      OUT
-----
PACKETS:            0        0
OCTETS:             0        0
PROT REJECTS:      0
```

ip Lists all information related to IP packets over the point-to-point link.

Example:

```
list ip
IP Statistic      In      Out
-----
Packets:          349     351
Octets:           128488 129412
Prot Rejects:     0
```

Packets

Indicates the total number of IP packets transmitted (out) and received (in) over the current point-to-point interface.

Octets

Indicates the total number of octets transmitted and received over the current IP connection.

Prot Rejects

Indicates the total number of protocol reject packets transmitted and received over the current point-to-point interface.

ipv6cp

Lists Internet Protocol version 6 Control Protocol statistics for the point-to-point interface. These fields are the same as those described under the **list ip** command. (See “ip”.)

Example:

```
list ipv6cp
IPv6CP STATISTIC  IN      OUT
-----
PACKETS:          0        0
OCTETS:           0        0
PROT REJECTS:    0
```

ipv6 Lists all information related to IPv6 packets over the point-to-point link. These fields are the same as those described under the **list ip** command. (See “ip”.)

Example:

```
list ipv6
IPv6 Statistic    In      Out
-----
Packets:          0        0
Octets:           0        0
Prot Rejects:     0
```

ipxcp Lists statistics for the IPX control protocol. These fields are the same as those described under the **list ip** command. (See “ip”.)

Example:

```
list ipxcp
IPXCP Statistic   In      Out
-----
Packets:          0        0
Octets:           0        0
Prot Rejects:     0
```

ipx Lists IPX statistics for the point-to-point interface. These fields are the same as those described under the **list ip** command. (See “ip”.)

Example:

Monitoring PPP Interfaces (Talk 5)

```
list ipx
IPX Statistic      In      Out
-----
Packets:           0        0
Octets:            0        0
Prot Rejects:      0        -
```

atcp Lists statistics for the AppleTalk control protocol. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list atcp
ATCP Statistic     In      Out
-----
Packets:           0        0
Octets:            0        0
Prot Rejects:      0        -
```

ap2 Lists AppleTalk Phase 2 statistics for the point-to-point interface. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list ap2
AP2 Statistic      In      Out
-----
Packets:           349      351
Octets:            128488  129412
Prot Rejects:      0
```

dncp Lists statistics on the DECnet control protocol packets. These fields are the same as those described under the **list ip** command. (See “ip” on page 586 .)

Example:

```
list dncp
DNCP Statistic     In      Out
-----
Packets:           0        0
Octets:            0        0
Prot Rejects:      0        -
```

dn Lists statistics on the DECnet packets received and transmitted over the PPP interface. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list dn
DN Statistic       In      Out
-----
Packets:           0        0
Octets:            0        0
Prot Rejects:      0        -
```

osicp Lists statistics for the OSI control protocol. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list osicp
OSICP Statistic    In      Out
-----
Packets:           0        0
Octets:            0        0
Prot Rejects:      0        -
```

osi Lists statistics on the OSI packets received and transmitted over the PPP interface. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list osi
OSI Statistic      In      Out
-----
```

Monitoring PPP Interfaces (Talk 5)

```
Packets:          0          0
Octets:           0          0
Prot Rejects:    0          -
```

bvcp Lists statistics on the Banyan VINES control protocol. These fields are the same as those described under the **list ip** command. (See “ip” on page 586 .)

Example:

```
list bvcp
BVCP Statistic      In          Out
-----
Packets:           0          0
Octets:            0          0
Prot Rejects:     0          -
```

vines Lists statistics for the Banyan VINES packets received and transmitted over the PPP interface. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list vines
Vines Statistic     In          Out
-----
Packets:            10         13
Octets:            320        340
Prot Rejects:      0          -
```

isrcp Lists statistics for APPN ISRC Control Protocol packets. These fields are the same as those described under the **list ip** command. (See “ip” on page 586 .)

Example:

```
list isrcp
APPN ISRC Statistic In          Out
-----
Packets:            3          3
Octets:            12         12
Prot Rejects:      0          -
```

isr Lists statistics on the APPN ISR packets received and transmitted over the PPP interface. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list isr
APPN ISR Statistic  In          Out
-----
Packets:           220        219
Octets:           1266       1157
Prot Rejects:      0          -
```

hprcp Lists statistics for APPN HPR Control Protocol packets. These fields are the same as those described under the **list ip** command. (See “ip” on page 586 .)

Example:

```
list hprcp
APPN HPRCP Statistic In          Out
-----
Packets:            3          3
Octets:            12         12
Prot Rejects:      0          -
```

hpr Lists statistics on the APPN HPR packets received and transmitted over the PPP interface. These fields are the same as those described under the **list ip** command. (See “ip” on page 586.)

Example:

```
list hpr
APPN HPR Statistic  In          Out
-----
```


Packets:	780	715
Octets:	131907	69685
Prot Rejects:	0	-

LLC

Use the **LLC** command to access the LLC monitoring prompt. LLC commands are entered at this new prompt. See “LLC Monitoring Commands” on page 239 for an explanation of each of these commands.

Note: This command is available only when APPN is included in the software load.

Syntax:

llc

Point-to-Point Protocol Interfaces and the GWCON Interface Command

The PPP interface traffic is carried by an underlying data-link level device driver. Additional statistics that can be useful when monitoring PPP links may be obtained from the device driver statistics which are displayed using the **interface** command from the GWCON environment. (For more information on the **interface** command, refer to “Chapter 10. The Operating/Monitoring Process (GWCON - Talk 5) and Commands” on page 105.)

The statistics in this section are displayed when you run the **interface** command from the GWCON environment (talk 5) for the following interfaces used in point-to-point configurations:

Example:

```
+ interface 12
Net Net' Interface Slot-Port Self-Test Self-Test Maintenance
12 12 PPP/0 Slot: 8 Port: 2 Passed Failed Failed
2 1 0
Point to Point MAC/data-link on V.35/V.36 interface
Adapter cable: V.35 DTE
V.24 circuit: 105 106 107 108 109
Nicknames: RTS CTS DSR DTR DCD
PUB 41450: CA CB CC CD CF
State: ON ON ON ON ON
Line speed: 64.000 Kbps
Last port reset: 1 hour, 20 minutes, 42 seconds ago
Input frame errors:
CRC error 0 alignment (byte length) 0
missed frame 182 too long (> 2062 bytes) 0
aborted frame 0 DMA/FIFO overrun 0
Output frame counters:
DMA/FIFO underrun errors 0 Output aborts sent 0
```

Net Interface number as assigned by software during initial configuration.

Net' Base interface number as assigned by software during initial configuration.

Note: For dial circuit interfaces, Net' is different from Net. For dial circuit interfaces, Net' indicates the base interface (ISDN or V.25bis) that the dial circuit uses.

Monitoring PPP Interfaces (Talk 5)

Interface No

Type of interface and its instance number. The Point-to-Point interface type is PPP.

Slot The slot number of the interface over which PPP is running.

Port The port number of the interface that is running PPP.

Self-Test: Passed

Total number of times the point-to-point interface passed its self-test.

Self-Test: Failed

Total number of times the point-to-point interface failed its self-test.

Maintenance: Failed

Total number of maintenance failures.

Adapter cable

Type of adapter cable that has been configured; for example, V.35 DTE.

V.24 circuit

Circuits being used on the V.24. Note: The symbol - - - in monitoring output indicates that the value or state is unknown.

Nicknames

Control signals Note: The symbol - - - in monitoring output indicates that the value or state is unknown.

PUB 41450

Pin assignments Note: The symbol - - - in monitoring output indicates that the value or state is unknown.

State State of the V.24 circuits (on or off). Note: The symbol - - - in monitoring output indicates that the value or state is unknown.

Line speed

Configured line speed or default value assumed (if line speed is configured as 0).

Last port reset

Length of time since the port was reset.

CRC error

The number of packets received that contained checksum errors and as a result were discarded.

Alignment (byte length)

The number of packets received that were not an even multiple of 8 bits in length and as a result were discarded.

Too long (> 2048 bytes)

The number of packets that were greater than the configured frame size, and as a result were discarded.

Aborted frame

The number of packets received that were aborted by the sender or a line error.

DMA/FIFO overrun

The number of times the serial interface could not send data fast enough to the system packet buffer memory to receive them from the network.

Missed frame

When a frame arrives at the device and there is no buffer available, the hardware drops the frame and increments the missed frame counter.

Monitoring PPP Interfaces (Talk 5)

L & F bits not set

On serial interfaces, the hardware sets input-descriptor information for arriving frames. If the buffer can accept the complete frame upon arrival, the hardware sets both the last and first bits of the frame, indicating that the buffer accepted the complete frame. If either of the bits is not set, the packet is dropped, the L & F bits not set counter is incremented, and the buffer is cleared for reuse.

Note: It is unlikely that the L & F bits not set counter will be affected by traffic.

Output Frame Counters:

DMA/FIFO underrun errors

The number of times the serial interface could not retrieve data fast enough from the system packet buffer memory to transmit them onto the network.

Output aborts sent

The number of transmissions that were aborted as requested by upper-level software.

Statistics similar to the following are displayed for PPP dial circuits when you execute the **interface** command from the GWCON environment:

```
+interface 29
Net Net' Interface           Self-Test Self-Test Maintenance
29 10 PPP/20                Passed    Failed    Failed
                             2         1         0
Point to Point MAC/data-link on V.25bis Dial Circuit interface
```

Monitoring PPP Interfaces (Talk 5)

Chapter 41. Using the Multilink PPP Protocol

This chapter describes how to use the Multilink PPP Protocol (MP). It includes the following sections:

- “MP Considerations” on page 594
- “Multi-Chassis MP” on page 595
- “Configuring a Multilink PPP Interface” on page 595

The Multilink PPP Protocol allows you to increase the bandwidth of:

- PPP leased lines, including channelized and I43x ISDN circuits
- PPP ISDN dial circuits
- PPP V.25bis dial circuits
- PPP Layer 2 Tunneling circuits

Increased bandwidth is accomplished by defining a *virtual link* made up of multiple links. The bandwidth of the resulting MP bundle is almost equal to the sum of the bandwidths of the individual links. The advantage is that large data packets transmitted across a single link can now be fragmented, transmitted across multiple links, and rebuilt at the receiving end station. MP uses both the Bandwidth Allocation Protocol and the Bandwidth Allocation Control Protocol to dynamically add and drop PPP dial circuits to a virtual link. MP also uses Bandwidth-On-Demand (BOD) to add “dedicated” MP dial links to an existing bundle.

There are two types of MP links: those that are dedicated and those that are simply enabled. A dedicated MP link is an MP-enabled interface configured as a link to a particular MP interface. If the link attempts to join another MP bundle, or if MP is not negotiated at all, the software terminates the link. All PPP links except for layer-2-tunneling interfaces can be configured as dedicated MP links. PPP leased links must be configured as dedicated MP links.

PPP dial-circuits and Layer 2-Tunneling can be configured as MP enabled. An MP-enabled link that is not dedicated can become a link in any MP bundle. If MP is not negotiated, the link operates as an independent interface using the link’s configured protocols.

You can configure a Multilink PPP interface that consists of multiple PPP dial circuits as part of the MP bundle.

There are also two types of MP interfaces: those that have a dedicated link and those that do not. An MP interface needs a dedicated link in any one of the following situations:

- The link is only for the MP interface
- The MP interface is configured for outbound calls. The dedicated link must then be configured with the destination phone number and caller identification.
- The MP interface is configured to receive a particular inbound call. In this case, the dedicated link is configured with the inbound destination phone number and caller identification.
- The MP interface needs to perform outbound authentication. In this case, all links use the same authentication name.

Using MP

MP interfaces that do not have a dedicated link must be inbound-only interfaces. These interfaces are similar to the any inbound dial circuit.

The Bandwidth Allocation Protocol (BAP) and its control protocol (BACP) allow an MP interface to increase and decrease its bandwidth by adding and dropping dial circuits. When the bandwidth utilization algorithm determines that a link should be added to the bundle, if there is an available PPP dial-circuit, and the peer agrees, an additional call is placed.

BAP first searches for any idle dedicated PPP dial circuits for the MP interface, and then for any MP-enabled PPP dial circuit. It will not, however, use a dedicated PPP dial circuit of another MP circuit. The configured maximum number of links on the MP interface will never be exceeded.

BOD uses configured dial-circuit phone numbers to place calls when needed to add dedicated MP dial links to an existing bundle. Links are added to the bundle one at a time, if needed, during a polling period. BOD adds any PPP serial links to the bundle first and will retain the serial links throughout the life of the bundle. BOD only drops dial links.

MP supports the following features:

- BRS
- WRR
- WRS
- Dial-on-Demand
- DIALs

However, WRS, Dial-on-Demand, and DIALs are only supported on MP bundles that contain only dial circuits.

MP Considerations

When configuring an MP bundle, keep the following in mind:

- Mixing dial circuits with “leased” lines causes the software to disable BAP on the bundle and use BOD instead. Only mix dial circuits with “leased” circuits when you desire to use BOD to manage the bundle.
- You cannot use Dial-on-Demand or WRS for MP bundles that contain either PPP “leased” lines or Layer 2 Tunneling circuits.
- You cannot use DIALs on bundles that contain PPP “leased” lines.
- All devices joining an MP bundle must have link speed configured.

Important:

1. Do not configure a bundle with media with extremely dissimilar properties. For example, configuring a bundle that contains a HSSI link and a V.25bis link is not effective use of a bundle. The largest link should have no more than 4 times the capacity of the smallest link. If the speeds of the links in an MP bundle differ greatly, you may need to add receive buffers to the faster link.
2. When bundling ISDN B-channels with slower media types, you may need to increase the number of ISDN buffers. Bundling ISDN B-channels with slower links is not recommended for ISDN primary.

Multi-Chassis MP

An MP bundle with a Layer 2 Tunnel that contains a phone hunt group that spans multiple physical Network Access Servers is known as a *multi-chassis MP*. Multi-chassis MP uses rhelm or user-based tunneling (see “Using Local or Remote Authentication” in *Using and Configuring Features*) to establish the MP endpoint destination. See “Using Layer 2 Tunneling Protocol (L2TP)” in *Using and Configuring Features* for more information about L2TP.

Configuring a Multilink PPP Interface

Configuring an MP interface depends on the type of interface used in the MP bundle. The following sections contain examples of the various configurations.

After configuring the MP interface, you may configure bandwidth-on-demand (BOD). The following example configures BOD on existing MP interface 17:

```
Config> net 17
MP config: 17> enable bod
Enable BAP? [N]

MP config: 17> set bandwidth-on-demand parameters
Add bandwidth % [90]:
Drop bandwidth % [70]:
Bandwidth test interval (sec) [15]

MP config: 17>
```

Configuring MP on PPP Dial Circuits

This section shows how to configure a Multilink PPP interface by using an example that configures Multilink PPP with two ISDN dial circuits.

1. Add the two dial circuits and the multilink PPP interface.

```
*t 6

Config>add dev dial-circuit
Adding device as interface 7
Defaulting Data-link protocol to PPP
Use "net 7" command to configure circuit parameters
Config>add dev dial-circuit
Adding device as interface 8
Defaulting Data-link protocol to PPP
Use "net 8" command to configure circuit parameters
Config>add dev multilink-ppp
Enter the number of multilink PPP interfaces [1]?
Adding device as interface 9
Defaulting Data-link protocol to PPP
Use "net intf" command to configure circuit parameters
Config>
```

2. Configure each PPP dial circuit. (See “Chapter 50. Configuring and Monitoring Dial Circuits” on page 689.) In this example, the destination, call direction, and LIDs are set for one of the dial circuits.

```
Config>net 7
Circuit configuration
Circuit config: 7>set dest out
Circuit config: 7>set calls outbound
Circuit config: 7>set net 6
Circuit config: 7>
```

3. Enable MP on each dial circuit to be used for MP as follows:

```
Circuit config: 7>encapsulator
Point-to-Point user configuration
PPP 7 Config>enable mp
```

Using MP

```
Enabled as a Multilink PPP Link,  
Use as a dedicated Multilink PPP link? [No]: yes  
Multilink PPP net for this Multilink PPP link [1]? 9  
NOTE: PPP configuration will be obtained from the Multilink PPP  
net. It is NOT necessary to configure PPP for this net!
```

Note: You cannot configure PPP parameters for dedicated links from this prompt. Dedicated links use the existing MP interface's PPP configuration.

By answering "Yes" to the question "Use as a dedicated Multilink PPP link?" the link becomes dedicated to the specified Multilink PPP interface (9 in this example). In this case, the link **must** be used for an MP bundle and **must** join the specified MP interface. The link cannot be used as a regular PPP dial circuit.

Answering "No" to "Use as a dedicated Multilink PPP link?" will allow this PPP dial-circuit to join any MP interface. At least one PPP dial-circuit **must** be a dedicated link to an outbound MP interface.

A dedicated PPP dial circuit obtains all PPP parameters (LCP options, authentication, and others) from its MP interface. MP enabled PPP dial circuits joining the same MP bundle **must** negotiate the same LCP parameters and authentication name.

4. Configure the MP interface. Protocols, BAP, BRS, WAN restoral, WAN reroute, and dial-on-demand are all run on the MP interface and not the PPP dial circuits.

Configuring MP on PPP Serial Links

To configure MP on a PPP serial link, you enable MP on the interface using the **net** command. The link obtains its PPP configuration from the MP net.

Example:

```
Config> net 1  
PPP 1 Config> enable MP  
  
Multilink PPP net for this Multilink PPP link [1]? 8  
NOTE: PPP configuration will be obtained from the Multilink PPP  
net. It is NOT necessary to configure PPP for this net!  
PPP 1 Config>
```

Configuring MP on Layer-2-Tunneling Nets

To configure MP on an L2TP net, you enable MP through the L2TP encapsulator. You then must configure the same PPP negotiation parameters (see "Configuring L2TP" in *Using and Configuring Features*) for information about all nets joining in a single bundle.

Example:

```
Config> feature layer-2-tunneling  
Layer-2-Tunneling Config> encapsulator  
PPP-L2TP Config> enable mp
```


NOTE: It IS necessary to configure PPP for this net! PPP negotiation parameters must be configured the same for all nets wishing to join the same Multilink PPP bundle.
PPP-L2TP Config>

Configuring Multi-Chassis MP

To configure MP for Multi-Chassis MP, configure the DIALs feature for multi-chassis MP. The software prompts you for the endpoint discriminator to use.

Example:

```
Config> feature DIALs
DIALs Config> set multi-chassis-mp
Enter Endpoint Discriminator to use from stacked group (0 for box S/N): 2345
DIALs Config>
```

The following example shows multichassis MP when ports RTR-2 and RTR-3 are in a hunt group.

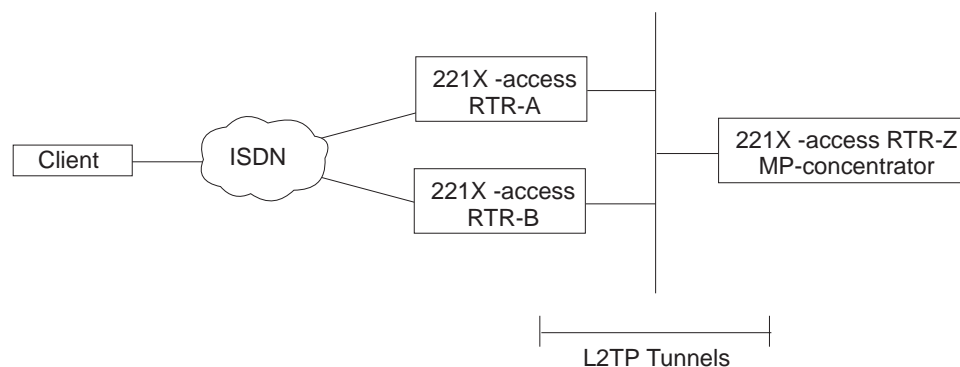


Figure 47. Multichassis MP

Because there is a many-to-many relationship between access routers and MP-concentrators, all access routers (RTR-A, RTR-B) should be kept on a separate administrative domain from “MP concentrator” routers (RTR-Z). This applies if you want to use remote authentication (that is, RADIUS), you will need two RADIUS servers, one for access routers and one for MP concentrators. If you are using local-list, you are already using separate administrative domains.

In this scenario, you can choose to tunnel based on PPP username or “rhelm” name. It is less rigorous to use rhelm-based tunneling. The idea is to configure a tunnel-profile for RTR-Z on both RTR-A and RTR-B. No additional PPP users are required on these routers. RTR-Z would require 2 tunnel-profiles: one for RTR-A and one for RTR-B and a PPP username (in the form <username>@RTRZ) for each anticipated user. All dial-in circuits are configured on the “access” routers. The “MP concentrators” would have layer-2-tunneling devices and multilink-PPP devices.

At this point, we have “statically configured” multi-chassis MP. This means that a particular PPP username will always terminate MP on a preconfigured router as opposed to supporting an additional protocol which dynamically finds MP bundle heads and tunnels when needed. This network implementation will also help avoid client PPP negotiation idiosyncrasies when using different media types for each link in a bundle (for example, tunnel one link and not the other). For example, DIALs clients cannot renegotiate LCP at any point. Also, Microsoft DUN clients do not fully

Using MP

| support LCP renegotiation.

Chapter 42. Configuring and Monitoring Multilink PPP Protocol (MP)

This chapter describes how to configure specific Multilink PPP interfaces in a device. The chapter includes:

- “Accessing the MP Configuration Prompt”
- “MP Configuration Commands for Multilink PPP Interfaces”
- “Monitoring MP Interface Status” on page 603
- “Accessing the MP Monitoring Commands” on page 603
- “Multilink PPP Protocol Monitoring Commands” on page 603

Accessing the MP Configuration Prompt

To access the MP config> prompt:

1. Enter **talk 6** at the * prompt.
2. Enter **net n**, where n is the number of the dial circuit or MP interface that you enabled to use MP.

Note: You are now configuring the Multilink PPP interface and not the PPP dial circuit that is part of the MP bundle.

MP Configuration Commands for Multilink PPP Interfaces

Table 78 lists the commands available at the MP config> prompt.

Table 78. MP Configuration Commands

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Disable	Disables the negotiation of bandwidth on demand.
Enable	Enables the negotiation of bandwidth on demand.
Encapsulator	Places you in the PPP config> prompt so you can change the data-link protocol configuration.
List	Displays the MP interface configuration parameters.
Set	Configures MP interface for inbound or outbound traffic. Also allows you to set the idle timeout and other MP and BAP parameters.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Disable

Use the **disable** command to disable the negotiation of bandwidth-on-demand (BOD). Disabling BOD prevents the link from allocating additional bandwidth when necessary.

Syntax:

disable bod

Configuring MP Enable

Use the **enable** command to enable the negotiation of BOD. Enabling BOD allows the link to allocate additional bandwidth when necessary.

Syntax:

enable bod

Encapsulator

Use the **encapsulator** command to access the PPP link-layer configuration for the Multilink PPP interface.

Syntax:

encapsulator

Example:

```
encapsulator
Point-to-Point user configuration
PPP config>
```

List

Use the **list** command to display the current MP configuration.

Syntax:

list

Example:

```
list
Idle timer = 0 (fixed circuit)
Outbound calls = allowed
Dialout MP Link net = 7
Max fragment size = 750
Min fragment size = 375
Maximum number of active links = 2
Links associated with this MP bundle:
net number 7
net number 8
BAP enabled
Add bandwidth percentage = 90
Drop bandwidth percentage = 70
Bandwidth test interval (sec) = 15
```

Idle timer

The setting of the idle timer for this circuit in seconds.

A setting of 0 indicates a fixed circuit. A nonzero setting configures a dial-on-demand MP circuit that will be brought down when the circuit is idle for the specified number of seconds. The circuit is reactivated when network traffic resumes.

Outbound calls

Specifies whether the interface is configured to initiate outbound calls. If the interface cannot initiate outbound calls, this line is not displayed.

Inbound calls

Specifies whether the interface is configured to initiate inbound calls. If the interface cannot accept inbound calls, this line is not displayed.

Max fragment size

Specifies the largest number of bytes of data a packet can contain before the packet is fragmented to be sent over MP links.

Min fragment size

This is the minimum size of the fragments (in bytes) the software creates when a packet exceeds *Max fragment size*.

Maximum number of active links

Specifies the configured maximum number of links in the MP virtual link (also known as *bundle*).

Links associated with this MP bundle

Displays the links dedicated to this MP interface.

BAP enabled

Specifies whether BAP is enabled on this interface.

Add bandwidth percentage

The amount of bandwidth utilization at which the software will try to add a new link if BAP is enabled.

Drop bandwidth percentage

The amount of bandwidth utilization at which the software will remove a link from the MP bundle if BAP is enabled.

Bandwidth test interval

The time, in seconds, after which the software will check the bandwidth utilization to determine whether to add or drop a link from the bundle.

Set

Use the **set** command to configure:

- The MP interface for inbound or outbound calls
- The idle timeout
- The MP parameters
- The BAP parameters

Syntax:

```

set          bod parameters
            calls
            idle
            mp parameters
  
```

bod parameters

Prompts you to specify the BOD add and drop bandwidth percentages and the BOD test interval.

Example:

```

set bod parameters
Add bandwidth % [90]? 80
Drop bandwidth % [70]? 50
Bandwidth test interval (sec) [15]? 25
  
```

Add bandwidth %

The amount of bandwidth utilization at which the software will try to add a new link.

Valid Values: 1 to 99

Configuring MP

Default Value: 90

Drop bandwidth %

The amount of bandwidth utilization at which the software will remove a link from the MP bundle.

Valid values: 1 to 99

Default value: 70

Bandwidth test interval (sec)

The time, in seconds, after which the software will check the bandwidth utilization to determine whether to add or drop a link from the bundle.

Valid Values: 10 to 200 seconds

Default Value: 15

calls Specifies whether this MP interface will initiate outbound calls, only accept outbound calls, or participate in both types of calls.

Valid values: inbound, outbound, or both

Default value: inbound

Note: If you specify outbound or both, the software will request the net number of the dedicated MP link that will place the first call.

Example:

```
set calls outbound
Dialout MP link net for this MP net []? 4
```

idle Specifies the time period in seconds that an interface can have no protocol traffic at which the MP interface will end calls on all the links.

Valid Values: 0 to 65535

Default Value: 0

mp parameters

Prompts you to enter the maximum and minimum fragment sizes and the maximum number of active links.

Example:

```
set mp parameters
Max frag size [750]? 675
Min frag size [375]? 300
Max number of active links [2]? 4
```

Max frag size

Specifies the largest of number of bytes of data a packet can contain before the packet is fragmented to be sent over MP links.

Valid Values: 100 to 3 000

Default Value: 750

Min frag size

This is the minimum size of the fragments (in bytes) the software creates when a packet exceeds **Max fragment size**.

Valid Values: 100 to 3 000

Default Value: 375

Max number of active links

Specifies the configured maximum number of links in the MP virtual link (also known as *bundle*).

Valid Values: 1 to 64

Default Value: 2

Monitoring MP Interface Status

To determine the status of all the MP interfaces in your device, use the **configuration** command in **talk 5** (see “Configuration” on page 108).

Accessing the MP Monitoring Commands

To access the MP monitoring commands:

1. Enter **talk 5** at the * prompt.
2. Enter **net n**, where *n* is the number of the MP interface that was created in talk 6 using **add device multilink-ppp** command.

Multilink PPP Protocol Monitoring Commands

Table 79 shows the monitoring commands available for an MP interface.

Table 79. MP Monitoring Commands

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Displays BAP, BACP, BOD, and MP statistics, errors, and other information.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

List

Use the **list** command to display information about the MP interface including bandwidth allocation statistics.

Syntax:

```
list                bacp
                   bap
                   control bacp
                   control bod
                   control mp
                   mp
```

Note: The examples that follow assume that the MP interface on this device is net number 6.

Monitoring MP

bacp The **list bacp** command lists the statistics for bandwidth allocation control packets which have been sent or received on this MP circuit.

Example:

```
PPP 6> list bacp
```

BACP Statistic	In	Out
-----	--	---
Packets:	6	8
Octets:	60	80
Rejects:	0	-

bap The **list bap** command lists the statistics for bandwidth allocation protocol packets which have been sent or received on this MP circuit.

Example:

```
PPP 6> list bap
```

BAP Statistic	In	Out
-----	--	---
Packets:	3	3
Octets:	22	37
Call Requests:	1	0
Call Response(ACK):	0	1
Call Resp(NK & FLLNK):	0	0
Call Response(Rej):	0	0
Callback Requests:	0	0
Callback Response(ACK):	0	0
Clbck Resp(NK & FLLNK):	0	0
Callback Response(Rej):	0	0
Drop Requests:	0	1
Drop Response(ACK):	1	0
Drop Resp(NK & FLLNK):	0	0
Drop Response(Rej):	0	0
Call Status(Success):	1	0
Call Status(Fail):	0	0

There are four different responses to a peer's request: ACK, NAK, FULL-NAK, and REJECT.

ACK Indicates the peer's request has been granted.

NAK (NK)

Indicates that the peer's request is supported but not desired at this time. Try again later.

FULL-NAK (FLLNK)

Indicates that the peer's request is supported but because of a resource condition, cannot be granted at this time. The request should not be sent again until the total bandwidth across the MP bundle changes.

REJECT (REJ)

Indicates that the request is not supported.

control bacp

The **list control bacp** command lists the current state of the BACP state-machine within PPP. The state information is identical to that produced for all of the PPP control protocols. Information about favored peer is also listed. Favored peer is used to alleviate BAP packet collisions (when both sides simultaneously initiate requests). During BACP negotiations, each side sends a magic-number and the one with the smallest magic number is the favored peer and should take precedence in the event of a collision. Typically, the call initiator will choose a **magic number** of X'1' and the call receiver will choose a magic number of X'FFFFFFF' establishing the call initiator as the favored peer.

```
PPP 6> list control bacp
```

```
BACP State:          Open
```


BACP Option	Local	Remote
-----	-----	-----
Magic Number:	FFFFFFF	1
Favorite Peer:	NO	YES

control bod

The **list control bod** command lists the current state of bandwidth-on-demand (BOD). This information includes BAP state, configured bandwidth-on-demand parameters for adding and subtracting bandwidth, current bandwidth, and information from the last bandwidth poll.

Valid BAP states are:

Closed

BACP is not opened – BAP is either not enabled or not supported by the peer.

Ready BACP is opened and there is no outstanding request being processed.

Call Req Sent

There is an outstanding call-request that was sent from the local machine.

Callback Req Sent

There is an outstanding callback-request that was sent locally.

Call Placed

As a result of a BAP request to add bandwidth, a call has been placed.

Retry Status Sent

The outgoing call failed to join the MP bundle, a retry status was sent.

No Retry Status Sent

The outgoing call either succeeded or exhausted all retries, a no retry status was sent.

Drop Req Sent

There is an outstanding drop request that was sent locally.

Configured bandwidth-on-demand parameters include add percentage, drop percentage, maximum number of active links in the MP bundle, and the bandwidth polling interval.

A BAP request to add a link to the bundle will be initiated if both the following conditions are met:

- The current number of active links is less than the configured maximum number of links.
- The bandwidth utilization across all links in the MP bundle is greater than the add percentage of the total available bandwidth for the MP bundle.

A BAP request to drop a link from the MP will be initiated if both the following conditions are met:

- The number of active links is greater than one.
- The bandwidth utilization across all links in the MP bundle is less than the drop percentage of the total available bandwidth for the MP bundle for the number of links minus one.

Monitoring MP

Bandwidth can be polled only when BAP is in the ready state. The information listed from the previous poll will give you an idea of the bandwidth utilization across the MP bundle.

These two sets of information are displayed when a drop can be initiated:

- Bandwidth utilization across the entire bundle
- Bandwidth utilization across number of links minus one

To prevent thrashing, the second set of information is used when determining whether to drop a link.

Example:

```
PPP 11>list control bod
BOD :                               Disabled
BAP :                               Disabled
Bandwidth test interval (sec):      15
Add bandwidth percentage:           90
Drop percentage (links-1):          70
Max # active links in MP bundle:    2
Time since last Bandwidth check (sec): 19
Currently:
  # active links in MP bundle:      0
  Total MP bandwidth (Bytes/sec):    0
Last Bandwidth Check:
  # active links in MP bundle:      0
  Avg Inbound bandwidth util (%):   0
  Avg Outbound bandwidth util (%):  0
```

control mp

The **list control mp** command lists the current state of this MP circuit including the number of active links and bandwidth, the configured maximum number of links, and statistics for number of dropped packets. Dropped MP packets are classified into four categories:

M The packet is dropped because a sequence number has not been received and it is less than the minimum sequence number across all links' last received sequence number.

Timeout

The packet is dropped because a sequence number has not been received during a timeout period.

Q depth

The packet is dropped because the maximum queue depth was exceeded.

Seq order

The packet is dropped because the sequence number received was not expected. This occurs when MP receives delayed packet that it has already declared lost.

If a packet is dropped at the network layer, it can be either an M, Timeout, or Q depth packet. These counters are incremented appropriately when a packet is dropped.

```
PPP 11> list control mp
Current # active links in MP bundle: 0
Max # active links in MP bundle:    2
Total MP bandwidth (Bytes/sec):     0
Dropped Frags (lost packets):       0
Dropped Frags (timeout or receive overflow): 0
Dropped Frags (sequence not expected): 0
```

```
PPP 11>
```

mp The **list mp** command lists the statistics for packets which have been sent or received on this MP circuit. The number of bytes displayed is for pre-decompressed packets if compression was negotiated for the multilink PPP bundle.

```
PPP 6> list mp
```

MP Statistic	In	Out
-----	--	---
Bytes (Compressed):	61230	60259

Monitoring MP

Chapter 43. Configuring SDLC Relay

This chapter describes the Synchronous Data Link Control (SDLC) Relay configuration and operational commands.

For further information on when to use DLSw SDLC versus SDLC Relay, refer to “Relationship to the SDLC Relay Function” in the “Using and Configuring DLSw” chapter of *Protocol Configuration and Monitoring Reference Volume 1*.

The chapter includes the following sections:

- “Basic Configuration Procedure”
- “Accessing the SDLC Relay Monitoring Environment” on page 616
- “SDLC Relay Monitoring Commands” on page 617
- “SDLC Relay Interfaces and the GWCON Interface Command” on page 619

Basic Configuration Procedure

This section outlines the minimum configuration steps required to get the SDLC Relay protocol up and running. For further configuration information and explanation, refer to the configuration commands described in this chapter.

Note: You must restart the router for new configuration changes to take effect.

- *Add a number.* You must add a number to a group of primary or secondary ports using the **add group** command. The default number for this command is 1.
- *Add a local port.* This identifies the interface that you are using for the local port. This also assures that no IP address is configured for the interface that you select. Use the **add local-port** command.
- *Add a remote port.* This identifies the port directly connected to the remote side of the serial line. Use the **add remote-port** command.

Accessing the SDLC Relay Configuration Environment

To access the SDLC relay (SRLY) configuration environment:

1. At the Config> prompt, enter **set data-link srlly**.
2. Enter the interface number.
3. To configure the SRLY interface, enter the **network interface#** command. The SRLY *interface#* Config> prompt is displayed when **network interface#** is entered:

```
Config>network 2
SDLC relay interface user configuration
SRLY 1 Config>
```

4. To configure the SRLY protocol parameters, enter the **protocol sdlc** command. The SDLC Relay config> prompt is displayed when **protocol sdlc** is entered:

```
Config>protocol sdlc
SDLC Relay protocol user configuration
SDLC Relay config>
```

SDLC Relay Configuration Commands

This section summarizes the SDLC Relay configuration commands. Both the **network** and **protocol** parameters for SDLC relay are documented in this chapter.

The SDLC Relay configuration commands allow you to specify router parameters for interfaces transmitting SDLC Relay frames. Restart the router to activate the configuration commands. Table 80 shows the commands for both the **network sdlc** and **protocol sdlc**.

Table 80. SDLC Relay Configuration Commands Summary

Command	Network SRLY	Protocol SDLC	Function
? (Help)	yes	yes	Lists all of the SDLC Relay configuration commands or lists the options associated with specific commands.
Add		yes	Adds groups, local ports, and remote ports.
Delete		yes	Deletes groups, local ports, and remote ports.
Disable		yes	Disables groups and ports.
Enable		yes	Enables groups and ports.
List	yes	yes	Displays entire SDLC Relay and group specific configurations.
Set	yes		Sets the link parameters and remote station parameters.
Exit	yes	yes	Exits the SDLC Relay configuration environment and returns to the CONFIG environment.

Add

Use the **add** command to add group numbers, local ports, and remote ports.

Syntax:

```
add                group group#
                   local-port
                   remote-port
```

group Assigns a number to a group of primary or secondary ports added to the router.

Example: add group

```
Group number: [1]? 1
```

Group number

The group number that you are designating for the port.

local-port

Identifies the interface that you are using for the local port.

Example: add local-port

```
Group number: [1]? 1
Interface number: [0]? 2
(P)rimary or (S)econdary: [S]? p
```

Group number

The group number for the port. This number must match one of the **add group** parameters configured previously.

Configuring and Monitoring SDLC Relay

Interface number

The interface number of the router that designates the local port.

Primary or Secondary

Designates the port type, primary (P) or secondary (S).

remote-port

Identifies the IP address of the port directly connected to the serial line on the remote router.

Example: add remote-port

```
Group number: [1]? 1
IP address of remote router:[0.0.0.0]? 128.185.121.97
(P)primary or (S)econdary:[S]? s
```

Group number

The group number for the port. This number must match one of the add group parameters configured previously.

IP address of remote router

Identifies the IP address of the interface on the remote router.

Primary or Secondary

Designates the port type, primary (P) or secondary (S).

Delete

Use the **delete** command to remove group numbers, local ports, and remote ports.

Syntax:

```
delete                group . . .
                        local-port . . .
                        remote-port
```

group *group#*

Removes a group (group#) of SDLC Relay configured ports.

Example: delete group 1

local-port *interface#*

Removes the local port for the specified interface (interface#).

Example: delete local-port 2

remote-port

Removes the remote port for the specified group.

Example: delete remote-port

```
Group number: [1]? 1
(P)primary or (S)econdary:[S]? s
```

Group number

The group number for the remote port.

Primary or Secondary

Designates the port type, primary (P) or secondary (S).

Disable

Use the **disable** command to suppress relaying for an entire relay group or a specific relay port.

Example:

```
list
Maximum frame size in bytes = 2048
Encoding: NRZ
Idle State: Flag
Clocking: External
Cable Type: RS-232 DTE
Speed (bps): 0
Transmit Delay Counter: 0
```

Maximum frame size in bytes

Maximum frame size that can be sent over the link. The maximum frame size must be large enough to accommodate the largest frame and the 15 byte SRLY header.

Encoding

The transmission encoding scheme for the serial interface. Scheme is NRZ (non-return to zero) or NRZI (non-return to zero inverted).

Idle State

The data link idle state: flag or mark.

Clocking

The type of clocking: internal, external.

Cable Type

The serial interface cable type.

Speed (bps)

Lists the speed of the transmit and receive clocks.

Transmit Delay Counter

Number of flags sent between consecutive frames.

List (for protocol SDLC)

Use the **list** command to display the configuration of a specific group or of all groups.

Syntax:

```
list                all
                   group . . .
```

all Displays the configurations of all local ports.

Example: list all

SDLC Relay Configuration				
Group Number	Port	Status	Net Number	SDLC Station address (hex) IP Address

1 (E)	Local	PRMRY (D)	2	
1 (E)	Remote	SCNDRY (E)		128.185.452.11
2 (D)	Local	PRMRY (D)	1	
2 (D)	Remote	SCNDRY (D)		128.185.450.31

Group Number

Indicates the group number and the status of the group, enabled (E) or disabled (D).

Port Status

Indicates the type of port (local/remote primary/secondary) and its status, enabled (E) or disabled (D).

Configuring and Monitoring SDLC Relay

Net Number

Indicates the device number of the local port. This number matches the number displayed using the Config list devices command.

IP Address

Indicates the IP address of the remote port.

group *group#*

Displays the configuration of a specified group.

Example: list group 1

SDLC Relay Configuration				
Group Number	Port	Status	Net SDLC Station Number address (hex)	IP Address
1 (E)	Local	PRMRY (D)	2	
1 (E)	Remote	SCNDRY (E)		128.185.452.11

Group Number

Indicates the group number and the status of the group, enabled (E) or disabled (D).

Port Status

Indicates the type of port (local/remote primary/secondary) and its status, enabled (E) or disabled (D).

Net Number

Indicates the device number of the local port. This number matches the number displayed using the Config list devices command.

IP Address

Indicates the IP address of the remote port.

Set

Use the **set** command to configure the SRLY parameters.

Syntax:

```
set cable
      clocking
      encoding
      frame-size
      idle
      speed
      transmit-delay
```

cable Sets the cable used on the serial interface. The options are:

- RS-232 DTE
- RS-232 DCE
- V35 DTE
- V35 DCE
- V36 DTE
- V36 DCE
- X21 DTE

Configuring and Monitoring SDLC Relay

- X21 DCE

Table 81 lists the cable types you can configure on the various adapters.

Table 81. Cable Types for 2216 Interfaces

Adapter Type	Cable Type
8-port EIA 232	RS-232 DTE and RS-232 DCE
6-port V.35/V36	V.35 DCE, V.35 DTE, V.36 DCE, or V.36 DTE
8-port X.21	X.21 DCE and X.21 DTE

Example:

```
set cable V35 dte
```

A DTE cable is used when you are attaching the router to some type of DCE device (for example, a modem or a DSU/CSU).

A DCE cable is used when the router is acting as the DCE and providing the clocking for direct attachment.

clocking *internal or external*

Configures the SRLY link's clocking. To connect to a modem or DSU, configure clocking as external. To connect directly to another DTE device, use a DCE cable, set the clocking to internal, and configure the clock speed. Use Table 83 on page 616 to determine the clock speeds you can set for the various adapters when internal clocking is used.

Example:

```
set clocking internal
```

encoding *nrz or nrzi*

Configures the SRLY interface's encoding scheme as NRZ (Non-Return to Zero) or NRZI (Non-Return to Zero Inverted). NRZ is the default.

Example:

```
set encoding nrz
```

frame-size

Configures the maximum size of the frames that can be transmitted and received on the data link. If this value is set to a larger value than that specified with the add remote-secondary command, then this value is changed to reflect that maximum. The IBM 2216 generates an ELS message warning the user that this value is changing. The user will continue receiving this ELS message until it is changed in the SRAM configuration. Valid entries are shown in Table 82.

Note: The frame size must be large enough to accommodate the largest frame received plus a 15-byte SRLY header.

Table 82. Valid Values for Frame Size in Set Frame-Size Command

Minimum	Maximum	Default
128	8187	2048

idle flag

Configures the transmit idle state for framing on the SRLY interface. The default is the flag option which provides continuous flags (7E hex) between frames.

Configuring and Monitoring SDLC Relay

The link will receive a flag idle transparently.

idle mark

Configures the transmit idle state for framing on the SRLY interface. The mark option puts the line in a marking state (OFF, 1) between frames.

The link will receive a mark idle transparently.

speed For internal clocking, this command specifies the speed of the transmit and receive clock lines.

- interface 1.
- port 1 of a 4-port WAN concentration adapter.
- ports 1 and 5 of an 8-port WAN concentration adapter.

Use Table 83 to determine the link speeds you can set for the various adapters.

Table 83. Line Speeds When Internal Clocking is Used for 2216 Interfaces

Adapter Type	Speed Range
8-port EIA 232	9600 to 64 000 bps
6-port V.35/V.36	9600 to 460 800 bps, 1 544 000 bps, or 2 048 000 bps
8-port X.21	9600 to 460 800 bps, 1 544 000 bps, or 2 048 000 bps

For external clocking, this command does not affect the hardware. See Table 84 for the line speeds supported when external clocking is used.

Table 84. Line Speeds When External Clocking is Used for 2216 Interfaces

Adapter Type	Speed Range
8-port EIA 232	2400 to 64 000 bps
6-port V.35/V.36	2400 to 2 048 000 bps
8-port X.21	2400 to 2 048 000 bps

transmit-delay value

Allows the insertion of a delay between transmitted packets. This command ensures a minimum delay between frames so that it is compatible with older, slower serial devices at the other end. This value is specified as the number of flag bytes that should be sent between consecutive frames. The range is 0 - 15. The default is 0.

Note: If you configure a non-zero transmit delay for a SDLC Relay interface on the 8-port EIA- 232E adapter, 6-port V.35/V.36 adapter, or 8-port X.21 adapter, you must configure the line speed using the **set speed** command.

Accessing the SDLC Relay Monitoring Environment

To monitor information related to the SDLC Relay interface, access the interface monitoring process by doing the following:

1. Enter the **status** command to find the PID for GWCON. (See page 9 for sample output of the **status** command.)
2. At the OPCON prompt, enter the **talk** command and the PID for GWCON. For example:

Configuring and Monitoring SDLC Relay

```
* talk 5  
+
```

The GWCON prompt (+) is displayed on the console. If the prompt does not appear when you first enter GWCON, press **Return** again.

3. At the GWCON prompt, enter the **configuration** command to see the protocols and networks for which the router is configured. For example:

```
+ configuration
```

See page 108 for more sample output from the **configuration** command.

4. Enter the **protocol sdlc** command. For example:

```
+ prot sdlc  
SDLC Relay>
```

The SDLC Relay prompt is displayed on the console. You can then view information about the SDLC Relay ports by entering the SDLC Relay monitoring commands.

SDLC Relay Monitoring Commands

This section summarizes and then explains the SDLC Relay monitoring commands. The SDLC Relay monitoring commands allow you to view parameters for interfaces transmitting SDLC Relay frames. The SDLC Relay> prompt is displayed for all SDLC Relay monitoring commands. Table 85 shows the commands.

Table 85. SDLC Relay Monitoring Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Clear-Port-Statistics	Clears SDLC Relay statistics for the specified port.
Disable	Temporarily suppresses groups and ports.
Enable	Temporarily turns on groups and ports.
List	Displays entire SDLC Relay and group specific configurations.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Clear-Port-Statistics

Use the **clear-port-statistics** command to discard the SDLC Relay statistics for all ports. The statistics include counters for packets forwarded and packets discarded.

Syntax:

```
clear-port-statistics
```

```
clear-port-statistics
```

Clears port statistics gathered since the last time you restarted the router or cleared statistics.

Example:

```
clear-port-statistics  
Clear all port statistics? (Yes or No): Y
```

Configuring and Monitoring SDLC Relay

Disable

Use the **disable** command to suppress data transfer for an entire group or a specific relay port. SRAM (static read access memory) does not permanently store the effects of the **disable** monitoring command. Therefore when you restart the router, the effects of this command are erased.

Syntax:

```
disable                group . . .  
                        port
```

group *group#*

Suppresses transfer of SDLC Relay frames to or from a specific group (group#).

port *interface# primary-or-secondary*

Suppresses transfer of SDLC Relay frames to or from a specific local port.

Example:

```
disable port  
Interface number: [0]? 2  
(P)rimary or (S)econdary: [s]? P
```

Interface number

Indicates the interface number of the local port that you want to disable.

Primary or Secondary

Indicates whether the port is a primary or secondary.

Enable

Use the **enable** command to turn on data transfer for an entire group or a specific local interface port. SRAM does not permanently store the effects of the **enable** monitoring command. Therefore when you restart the router, the effects of this command are erased.

Syntax:

```
enable                group . . .  
                        port
```

group *group#*

Allows transfer of SDLC Relay frames to or from the specified group (group#).

port Allows transfer of SDLC Relay frames to or from the specified local port.

Example:

```
enable port  
Interface number: [0]? 2  
(P)rimary or (S)econdary: [s]? P
```

Interface number

Indicates the interface number of the local port that you want to enable.

Primary or Secondary

Indicates whether the port is a primary or secondary.

List

Use the **list** command to display the configuration of a specific group or of all groups.

Syntax:

```
list all
      group . . .
```

all Displays the configurations of all local ports.

Example:

```
list all
      SDLC Relay Configuration
Group  Port Status      Net   Packets  IP Address
Num    Num                Num   fwr disc
1 (E)  Local PRMRY (E)      2    2880   57
1 (E)  Remote SCNDRY (E)   4860  13
2 (D)  Local PRMRY (D)      1     0     0
2 (D)  Remote PRMRY (D)     0     0    128.185.450.31
```

Group Number

Indicates the group number and the status of the group, enabled (E) or disabled (D).

Port Status

Indicates the type of port (local/remote primary/secondary) and its status, enabled (E) or disabled (D).

Net Number

Indicates the device number of the local port. This number matches the number displayed using the Config> **list devices** command.

Packets (fwr and disc)

Indicates how many packets were forwarded (fwr) and discarded (disc) for that port.

IP Address

Indicates the IP address of the remote port.

group *group#*
Displays the configurations of a specified group.

Example:

```
list group 1
      SDLC Relay Configuration
Group  Port Status      Net   Packets  IP Address
Num    Num                Num   fwr disc
1 (E)  Local PRMRY (D)      2    2880   57
1 (E)  Remote SCNDRY (E)   4860  13    128.185.452.11
```

SDLC Relay Interfaces and the GWCON Interface Command

While SDLC Relay interfaces have their own monitoring processes for monitoring purposes, the router also displays complete statistics for installed network interfaces when you use the **interface** command from the GWCON environment. (For more information on the **interface** command, refer to Chapter 10. The Operating/Monitoring Process (GWCON - Talk 5) and Commands.)

Chapter 44. Using SDLC Interfaces

This chapter how to use the SDLC interface and includes the following sections:

- “Basic Configuration Procedure”
- “Configuring Switched SDLC Call-In Interfaces”
- “SDLC Configuration Requirements” on page 622

You enter SDLC configuration commands at the SDLC # Config> prompt, where # identifies the interface you specify with the network command. Changes made to the routers configuration do not take effect immediately, but become part of the router’s static configuration memory when it is restarted.

Basic Configuration Procedure

This section outlines the minimum configuration required for SDLC to be usable by DLSw or by APPN.

Before beginning any configuration procedure, use the **list device** command from the config process to list the interface numbers of different devices. At the config prompt, select the interface you want to configure by entering either: **network interface number** or **n interface number**. If you need any further configuration command explanations, refer to the configuration commands described in this chapter.

Configuring Switched SDLC Call-In Interfaces

A switched SDLC call-in interface allows a PU type 2.0 device to dial into a 2216 using a switched SDLC line, providing an additional connectivity option to your network. The interface is restricted to PU type 2.0 devices and can run DLSw only.

Note: You cannot configure APPN over a switched SDLC call-in interface.

To configure a switched SDLC call-in interface:

1. Configure a V.25bis base network:

```
Config> set data-link v25bis 2
Config> net 2
V25bis Config>
(configuration the V25bis net)
```

See “Chapter 46. Using the V.25bis Network Interface” on page 645 for more information about configuring V25bis.

Note: Any physical layer parameters such as the **encoding type** and **full** vs. **half duplex** are configured on the V.25bis interface and not on the Switched SDLC dial circuit interface.

2. Add a dial circuit device:

```
Config> add device dial
```

3. Set the data link for the dial circuit interface to SDLC. In this example, the dial circuit is interface 3.

```
Config> set data-link sdlc 3
```

4. Configure the dial circuit:

Using SDLC Interfaces

```
Config> net 3
Dial circuit config> set net 2 1
Dial circuit config> encapsulator
sdlc config>
    (configure SDLC)
sdlc config> exit
Dial circuit config> exit
Config>
```

5. Configure DLSw:

```
Config> prot dls
DLSw protocol user configuration
DLSw config> add sdlc
Interface # [0]? 3
SDLC Address or 'sw' (switched dial-in) [sw]? sw 2
Source MAC address [4000112402C1]? 4000003174d2
Source SAP in hex [4]?
Destination MAC address [000000000000]? 400000000004 3
Destination SAP in hex [0]? 4 4

XID0 block num in hex (0-0xfff) [0]? 017
XID0 id num in hex (0-0xffff) [0]? 00001
For a switched dial-in link station .....
- PU type is forced to be 2
- Configured XID block/id num is used to override
  fields in the XID0 from the SDLC station
  - if block/id set to zeroes, XID0 is not modified
  - otherwise configured fields are put into XID0
- Poll type is not configured (not used)
DLSw config> li sdlc all
Net Addr  Status  Source SAP/MAC  Dest SAP/MAC  PU  Blk/IdNum  PollFrame
3  FF(sw) Enabled  04 4000003174D2  04 400000000004  2  017/00001  TEST

DLSw config> exit
Config>
```

1 You will not be able to set any other dial circuit parameters as the software will take defaults for all other parameter values. For information about the defaults, see “Encapsulator” on page 690.

2 Specifying “sw” indicates that this is a switched SDLC call-in interface.

3 The destination MAC address cannot be all 0s. If you specify or default to a value of 0, the software will prompt you for a valid address.

4 The destination SAP cannot be 0. If you specify or default to a value of 0, the software will prompt you for a valid address.

See the “Using and Configuring DLSw” and the “Monitoring DLSw” chapters of *Protocol Configuration and Monitoring Reference Volume 1* for additional information about configuring DLSw.

SDLC Configuration Requirements

In addition to the SDLC-specific configuration procedures and commands described in this chapter, you need to configure SDLC in the DLSw or APPN protocol. Only one protocol at a time, DLSw or APPN, may run over a given SDLC interface. In other words, link stations on a given SDLC interface cannot be divided between APPN and DLSw. If a DLSw configuration and an APPN configuration exist for the same SDLC interface, the first protocol to come active will own the SDLC interface.

Chapter 45. Configuring and Monitoring SDLC Interfaces

This chapter describes the SDLC configuration and operational commands.

This chapter includes the following sections:

- “Accessing the SDLC Configuration Environment”
- “SDLC Configuration Commands” on page 624
- “Accessing the SDLC Monitoring Environment” on page 634
- “SDLC Monitoring Commands” on page 634
- “SDLC Interfaces and the GWCON Interface Command” on page 642
- “Statistics Displayed for SDLC Interfaces” on page 642

Changes made at the configuration command console (SDLC CONFIG>) become part of the SRAM configuration when you restart the router.

Conversely, SDLC monitoring commands entered within the SDLC monitoring process take effect immediately. However, changes made with monitoring commands do not become part of the router’s static configuration. When the router is restarted, the effects of the monitoring commands are overwritten by the router’s static configuration. Monitoring consists of these actions:

- Monitoring the protocols and network interfaces that are currently in use by the router
- Making real-time changes to the SDLC configuration without permanently affecting the SRAM configuration
- Displaying ELS (Event Logging System) messages relating to router activities and performance

Accessing the SDLC Configuration Environment

Use the CONFIG process to change the configuration of the router. The new configuration takes effect when the router is restarted.

To enter the configuration process:

1. Enter **talk 6** (or **t 6**), at the OPCON (*) prompt. This brings you to the CONFIG> prompt as shown in the following example:

```
MOS Operator Control
* talk 6
CONFIG>
```

If the CONFIG> prompt does not appear immediately, press the **Enter** key again. All SDLC configuration commands are entered at the SDLC config> prompt.

2. At the Config> prompt, enter the **set data-link sdlc** command. When prompted, enter the name of the interface to associate with the SDLC device.

```
Config>set data-link sdlc
Interface number [0]? 2
Config>
```

3. Next, enter the **network** command, plus the number of an SDLC interface that you entered earlier.

```
Config>network 2
SDLC 2 Config>
```

Configuring SDLC Interfaces

Refer to “Chapter 1. Getting Started” on page 3 for information related to the configuration environment.

SDLC Configuration Commands

The SDLC configuration commands allow you to create or modify the SDLC interface configuration. This section summarizes and describes the commands you can issue from the SDLC Config> prompt within the network configuration console. Defaults for any command and its parameters are displayed on the console, they are enclosed in brackets immediately following the prompt.

Note: In addition to configuring SDLC using the commands described in this chapter, you also need to configure SDLC in the DLSw or APPN protocol.

2216 supports SDLC connections over RS-232, X.21, and V.35 serial interfaces. Table 86 lists SDLC configuration commands and their function.

Table 86. SDLC Configuration Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Add	Adds an SDLC end station.
Delete	Removes an SDLC end station.
Disable	Prevents connections to one of the SDLC link stations.
Enable	Allows connections to one of the SDLC link stations.
List	Displays configured information for one of the SDLC link stations.
Set	Configures specific interface and link-station information.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Add

Use the **add** command to add an end station. The router is, by default the primary end station. If you do not use this command and if you configured an SDLC station in DLSw or in APPN, the end station is added for you. The software assigns the following defaults to the station:

- Maximum BTU is maximum allowable by the interface
- Tx and Rx Windows are 7 for MOD 8, 127 for MOD 128

If the defaults are satisfactory, you do not need to add SDLC station.

Syntax:

```
add station
```

Example:

```
add station  
Enter station address (in hex) [C3]?  
Enter station name [SDLC_C3]?  
Include station in group pool list ([Yes] or No):  
Enter max packet size [2009]?  
Enter receive window [7]?  
Enter transmit window [7]?
```

Enter station address

The station's SDLC address in the range 01 - FE.

Configuring SDLC Interfaces

link Allows subsystems in the router (for example, DLSw) to use SDLC's facilities.

station *name or address*
Allows connections to the specified secondary remote end station (link station name).

List

Use the **list** command to display configuration information on one or all SDLC link stations.

Syntax:

```
list link
                        station name or all
```

link Displays the SDLC interface's configuration.

Example:

```
list link
Link configuration for: LINK_2 (ENABLED)

Role:          SECONDARY      Type:          POINT-TO-POINT
Duplex:        FULL           Modulo:        8
Idle state:    FLAG           Encoding:      NRZ
Clocking:      EXTERNAL       Frame Size:    2048
Speed:         0              Group Poll:    F3
Cable          V.36 DTE

Timers:  XID/TEST response:  2.0 sec
         SNRM response:      2.0 sec
         Poll response:      0.5 sec
         Inter-poll delay:   0.2 sec
         Inter-frame delay:  DISABLED
         Leading flags:      DISABLED
         Inactivity timeout  30.0 sec

Counters: XID/TEST retry:  8
          SNRM  retry:     6
          Poll  retry:     10
```

Link configuration

The name and status of SDLC link station that are in the router's configuration.

Role The primary, secondary, or negotiable role for link stations that you configure using the **set link role** command.

Type The type of link, MULTIPOINT or POINT-TO-POINT.

Duplex
Duplex configuration, HALF or FULL.

Modulo
The sequence number range to use on the link: MOD 8 (0-7) or MOD 128 (0 - 127).

Idle state
The bit pattern (FLAG or MARK) transmitted on the line when the interface is not transmitting data.

Speed The physical data rate of the interface. When the clocking is internal, this is the data rate generated by the internal clock.

Group Poll

Address used for the group poll feature for multipoint link configurations. Secondary stations having group inclusion coded as yes will respond to unnumbered polls received from this address. This address must be non-null for the group poll feature to be in effect for any secondary stations under this link. Each secondary station will still have a unique station address in addition to the group address.

Cable Specifies the type of cable in use (RS-232, V.35, V.36, or X.21).

Encoding

Configures the SDLC transmission encoding scheme as NRZ (Non-Return to Zero) or NRZI (Non-Return to Zero Inverted).

Clocking

Interface clocking, EXTERNAL or INTERNAL.

Frame Size

The maximum frame size that can be sent over the interface.

Timers:

All the timers listed below have a 100ms resolution.

XID/TEST resp.

The time to wait for an XID or TEST response message before retransmitting the XID or TEST frame. A value of 0 indicates that the router will continue to retry indefinitely.

SNRM response

The maximum time to wait for an UA response message before the station retransmits SNRM(E).

Poll response

The maximum time to wait for a response from any polled station before retrying.

Inter-poll delay

The amount of time the router (configured with a primary role) waits after receiving a response, before polling the next station.

Interframe delay

The number of flags sent between frames.

Leading Flags

The number of flags sent if the interframe delay is not sufficient for a response to the device on the other end of this link.

Inactivity timeout

For idle NRM/E secondary stations, sets the time after which the interface changes the station to its recovery state. A 0 (zero) causes the station to remain idle indefinitely.

Counters:

XID/TEST retry

The maximum number of times the router sends an XID or TEST frame without receiving a response before timing out. A value of 0 indicates that the router will retry indefinitely.

SNRM The maximum number of times the router will send an SNRM(E) frame without receiving a response before timing out. A value of 0 indicates that the router will retry indefinitely.

Configuring SDLC Interfaces

Poll retry

The maximum number of times the router polls the station without receiving a response before timing out. A value of 0 indicates that the router will continue to retry indefinitely.

Note: Physical layer parameters such as **duplex type**, **speed**, **cable type**, **encoding**, **clocking**, **leading flags**, and **inter-frame delay** do not apply for SDLC dial circuit interfaces and are not displayed by the **list link** command.

station *all or address or link station name*

Displays information for the specified SDLC link station or for all link stations.

Example:

```
list station c1
-----
Address  Name      Status  Max BTU  Rx Window  Tx Window
-----  -
C1(00)  SDLC_C1   Enabled  2005     7           7
```

Example:

```
list station all
-----
Address  Name      Status  Max BTU  Rx Window  Tx Window
-----  -
C1(00)  SDLC_C1   ENABLED  2005     7           7
C3(F3)  SDLC_C3   DISABLED  2009     7           7
```

Address

The address of the SDLC link station. The address in parentheses is the group address of the station. A (00) indicates that a group address is not defined.

Name The character string name designation of SDLC link station.

Status

The status of the SDLC link station, ENABLED or DISABLED.

Max BTU

The frame size limit of the station. This frame size must not be larger than the maximum Basic Transmission Unit (BTU) packet size configured with the **set link frame-size** command.

Rx Window

The size of the receive window.

Tx Window

The size of the transmit window.

Set

Use the **set** command to configure specific information for one or all SDLC link stations.

Syntax:

```
set                               link cable*
                                     link clocking*
                                     link duplex* . . .
                                     link encoding* . . .
                                     link frame-size
                                     link group poll* ...
```


Configuring SDLC Interfaces

`link idle* . . .`
`link inactivity ...`
`link inter-frame delay*`
`link leading flags*`
`link modulo . . .`
`link name`
`link poll . . .`
`link role* . . .`
`link snrm`
`link speed*`
`link type* . . .`
`link xid/test`
`station address . . .`

***Note:** These commands are not available for SDLC dial circuit interfaces.

link cable *type*

Sets the cable connected to this interface. The options are the following DCE and DTE types: V.36, RS-232, V.35, and X.21.

Table 87 lists the cable types you can configure on the various adapters.

Table 87. Cable types for 2216 Interfaces

Adapter Type	Cable type
8-port EIA 232	RS-232 DTE and RS-232 DCE
6-port V.35/V36	V.35 DCE, V.35 DTE, V.36 DCE, or V.36 DTE
8-port X.21	X.21 DCE and X.21 DTE

A DTE cable is used when you are attaching the router to some type of DCE device (for example, a modem or a DSU/CSU).

A DCE cable is used when the router is acting as the DCE and providing the clocking for direct attachment.

link clocking *internal or external*

Configures the SDLC link's clocking. To connect to a modem or DSU, set clocking external. To connect directly to another DTE device, use a DCE cable, set the clocking to internal, and configure the clock speed. Use Table 89 on page 632 to determine the clock speeds you can set for the various adapters when internal clocking is used.

link duplex *full or half*

Configures the SDLC line for *full-duplex* or *half-duplex* signalling. *Half-duplex* means that the 2216 raises RTS and expects to see CTS before it will transmit data. *Full-duplex* means that the 2216 does not wait for CTS to be raised before it transmits data.

Note: The duplex type does not control how SDLC operates at the SDLC protocol level. The 2216 only supports two-way alternating mode which is sometimes also referred to as SDLC half-duplex.

Configuring SDLC Interfaces

link encoding *nrz* or *nrzi*

Configures the SDLC transmission encoding scheme as NRZ (Non-Return to Zero) or NRZI (Non-Return to Zero Inverted). NRZ is the default.

link frame-size

Configures the maximum size of the frames that can be transmitted and received on the data link. Valid entries are shown in Table 88.

Table 88. Valid Values for Frame Size in Link Frame-Size Command

Minimum	Maximum	Default
128	8187	2048

Set the link frame size greater than the maximum packet size that you configured with the **set station xxx max packet** command. Otherwise, the router automatically resets the maximum packet size to the link frame size and issues the following ELS message:

```
SDLC.054: nt 3 SDLC/0 Stn xx-MaxBTU too large for Link adjusted (4096->2048)
```

Example: set link frame-size

```
Frame size in bytes (128 - 8187)[2048]?
```

link group-poll

Sets a group poll address for secondary stations on the link. The SDLC software supports the IBM 3174 group poll function. Use the **add station** or the **set station group inclusion** command to include a station in the group poll list.

Example:

```
set link group-poll
Enter group poll address (in hex) [00:]?f3
Group poll support enabled
```

link idle flag

Configures the transmit idle state for SDLC framing. The default is the flag option which provides continuous flags (7E) between frames.

Example: set link idle flag

The link will receive a flag idle transparently.

link idle mark

Configures the transmit idle state for SDLC framing. The mark option puts the line in a marking state (OFF, 1) between frames.

link inactivity *#-of-seconds*

For idle NRM/E secondary stations, sets the time after which the interface changes the station to its recovery state. The range is 0 to 7200 seconds. The default is 30. A 0 (zero) causes the station to remain idle indefinitely.

Example:

```
set link inactivity
Enter secondary link station inactivity timeout :[30.0]?
```

link inter-frame delay *seconds*

Allows the insertion of a delay between transmitted packets. This command ensures a minimum delay between frames for compatibility with older, slower serial devices at the other end. This parameter is the amount of time between frames in seconds.

Valid values: 0 to 120

Default value: 0

Example:

```
set link inter-frame delay
Transmit Delay Counter [0]?
```

link leading flags

Sets the number of leading flags. Use this command when the inter-frame delay is not sufficient to allow a response from the 2216 to another device. This command should also be used to set a leading flags delay if you are using half-duplex modems that are not capable of receiving a packet as soon as the modem raises the CTS modem signal.

Valid values: 0 to 100

Default value: 0

Example:

```
set link leading flags
Leading flags delay [0]?
```

link modulo 8 or 128

Specifies the sequence number range to use on the link: MOD 8 (0-7) or MOD 128 (0 - 127). Default is 8.

Note: When you change this value, the window sizes become invalid. Use the **set station** command to change the receive window and transmit window sizes. Valid window sizes for mod 8 are 0 through 7; for mod 128 they are 8 through 127.

Also, at connection start-up, an SNRME rather than a SNRM is used and supervisory frame headers are expanded by an additional byte.

link name

Establishes a character string for the link that you are configuring. This parameter is for informational purposes only.

Example:

```
set link name
Enter link name: [LINK_0]?
```

link poll delay

Configures the time delay between each poll that is sent over the interface.

Example:

```
set link poll delay
Enter delay between polls [0.2]?
```

link poll retry

Configures the number of times the interface retries to poll the secondary SDLC link station before it closes the connection.

Example:

```
set link poll retry
Enter poll retry count (0 = forever) [10]?
```

link poll timeout

Configures the amount of time the interface waits for a poll response before timing out.

Example:

```
set link poll timeout
Enter poll timeout [2.0]?
```

Configuring SDLC Interfaces

link role *primary or secondary or negotiable*

Configures the interface as an SDLC primary, secondary, or negotiable link station (default is primary).

Notes:

1. For DLSw, **negotiable** uses X'FF' (broadcast address) for the initial poll. When using broadcast address to negotiate the role, the link uses a default SDLC configuration. When **primary** is the link role, the link performs an initial poll to a specific address.
2. For APPN point-to-point or negotiable, the broadcast address is used for the initial poll. For primary multipoint, the specific address is used.
3. For switched SDLC, the device must be primary, so **link role type** is not configurable for SDLC dial circuit interfaces.

link snrm *timeout or retry*

Configures the following SNRM(E) information for primary stations:

timeout

The time to wait for an Unnumbered Acknowledgements (UA) response before retransmitting an SNRM(E).

retry The number of times to retransmit an SNRM(E) without receiving a response before giving up.

Example:

```
set link snrm timeout
Enter SNRM response timeout [2.0]?
```

Example:

```
set link snrm retry
Enter SNRM retry count (0=forever) [6]?
```

link speed

For internal clocking, this command specifies the speed of the transmit and receive clock lines.

- interface 1.
- port 1 of a 4-port WAN concentration adapter.
- ports 1 and 5 of an 8-port WAN concentration adapter.

The range is from 2400 to 2048000 bps. Use Table 90 to determine the clock speeds you can set for the various adapters.

Table 89. Line Speeds When Internal Clocking is Used for 2216 Interfaces

Adapter Type	Speed range
8-port EIA 232	9600 to 64 000 bps
6-port V.35/V.36	9600 to 460 800 bps, 1 544 000 bps, or 2 048 000 bps
8-port X.21	9600 to 460 800 bps, 1 544 000 bps, or 2 048 000 bps

You can also set the line speed when clocking is external though this has no affect on the hardware. See Table 90 for line speeds supported when external clocking is used.

Table 90. Line Speeds When External Clocking is Used for 2216 Interfaces

Adapter Type	Speed range
8-port EIA 232	2400 to 64 000 bps

Configuring SDLC Interfaces

Table 90. Line Speeds When External Clocking is Used for 2216 Interfaces (continued)

Adapter Type	Speed range
6-port V.35/V.36	2400 to 2 048 000 bps
8-port X.21	2400 to 2 048 000 bps

Example:

```
set link speed
Line Speed [64000]?
```

link type *multipoint or point-to-point*

Configures the SDLC link to either a multipoint link or a point-to-point link.

Note: For switched SDLC, the link is always point-to-point, so **link type** is not configurable for SDLC dial circuit interfaces.

link xid/test *timeout or retry*

Configures the following XID/test information for primary stations:

timeout

The maximum amount of time to wait for an XID or TEST frame response before retransmitting the XID or TEST frame.

retry The maximum number of times an XID or TEST frame is resent before giving up. A 0 (zero) causes the router to retry indefinitely.

remote-secondary *address or link_station_name address <argument>*

Changes the remote station's SDLC address in the range 02 - FE.

Example: `set remote-secondary SDLC_C1 address ce`

station *address or name address*

Changes the station's SDLC address in the range 01 to FE.

Example:

```
set station c1 address
Enter station address (in hex) [C1]?
```

station *address or link station name group-inclusion no or yes*

For SDLC secondary stations, set whether to include this station in the group poll list for this link. For this to be effective, add a group poll address using the **set link group-poll** command.

Example: `set station c1 group-inclusion yes`

station *address or name max-packet*

The maximum size of the packet that the station can receive (default: 2048). Do not set the maximum packet size larger than the link frame size that is configured with the **set link frame-size** command; if you do, the router automatically resets the maximum packet size to the link frame size and issues the following ELS message:

```
SDLC.054: nt 3 SDLC/0 Stn xx-MaxBTU too large for Link adjusted (4096->2048)
```

Example:

```
set station c1 max-packet
Enter max packet size [2048]?
```

station *address or name name*

The name of the SDLC station.

Example:

```
set station c1 name
Enter station name [SDLC_C1]?
```

Configuring SDLC Interfaces

station *address or name* **receive window**

The maximum number of frames the router can receive before sending a response. The range is 1 to 7. The default is 7.

Example:

```
set station c1 receive-window
Enter receive window [7]?
```

station *address or name* **transmit-window**

The maximum number of frames the router can transmit before receiving a response frame. The range is 1 to 7. The default is 7.

Example:

```
set station c1 transmit-window
Enter transmit window [7]?
```

Accessing the SDLC Monitoring Environment

The monitoring environment is the GWCON process. To enter the GWCON process:

1. Enter **talk 5** (or **t 5**) at the OPCON (*) prompt. This brings you to the GWCON (+) prompt as shown in the following example:

```
MOS Operator Control
```

```
* talk 5
+
```

2. Next, enter the **network #** command using the number that identifies the interface that you previously configured for the SDLC device.

```
+ network 2
SDLC Console
SDLC-2>
```

You enter all GWCON (Monitoring) commands at the + prompt.

Refer to “Chapter 1. Getting Started” on page 3 for information related to the monitoring environment.

SDLC Monitoring Commands

This section summarizes and then explains the SDLC console and related commands. Use these commands to gather information from the database. Table 91 lists SDLC monitoring commands and their function.

Table 91. SDLC Monitoring Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Add	Adds an SDLC link station
Clear	Clears the counters on the SDLC interface.
Delete	Dynamically removes an SDLC link station.
Disable	Disables connections to one SDLC link station.
Enable	Enables connections to one SDLC link station.
List	Displays SDLC link stations configurations and link station information.
Set	Configures specific interface and link station information.
Test	Tests the link between the router and the SDLC link station.

Table 91. SDLC Monitoring Commands Summary (continued)

Command	Function
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Add

Use the **add** command to add an end station. The router is, by default the primary end station. If you do not use this command and if you configured an SDLC station in DLSw or APPN, the end station is added for you.

Syntax:

add station

For an example and for additional information on the **add** command, see “Add” on page 624 .

Clear

Use the **clear** command to clear counters for the interface, for a station, or for all stations. Use the **list all stations** command to list stations.

Syntax: **clear** link
station ...

link *name or address*

Clears the counters for an SDLC interface.

station *name or address or all*

Clears counters for a specific station or for all stations.

Delete

Use the **delete** command to terminate an existing SDLC connection without affecting the SDLC configuration in SRAM. This command terminates any SDLC session that may be in progress on the link station. The router is considered the primary end station by default.

Syntax:

delete station *name or address*

Disable

Use the **disable** command to disable connection establishment on one or all SDLC link stations without affecting the SDLC configuration in SRAM. The **disable** command also terminates any existing connection to the station.

Syntax: disable

link
station . . .

link Prevents connection on all configured SDLC link stations on the interface by terminating all connections.

Configuring SDLC Interfaces

station *name or address*

Prevents connection to the specified end station (link station name) by terminating any existing connection.

Enable

Use the **enable** command to enable connection establishment with remote SDLC link stations without affecting the SDLC configuration SRAM.

Syntax:

```
enable                link
                        station . . .
```

link Allows subsystems (for example, DLSw) to use SDLC's facilities.

station *name or address*

Allows connections to the specified end station.

List

Use the **list** command to display statistics specific to the data link layer and the interface.

Syntax:

```
list                link configuration
                    link counters
                    station . . .
```

link configuration

Displays information for all configured SDLC link stations on the interface.

For an example and for additional information on the **list** command, see "List" on page 626.

link counters Displays information for the SDLC counters since the last router restart or the last clear counters.

I-Frames

Total number of Information frames received and transmitted.

I-Bytes

Total number of Information bytes received and transmitted.

Re-Xmit

Total number of frames that were retransmitted.

UI-Frames

Total number of Unnumbered Information frames received and transmitted.

UI-Bytes

Total number of Unnumbered Information bytes received and transmitted.

RR

Total number Receive-Ready (RRs) received and transmitted.

Configuring SDLC Interfaces

- RNR** Total number Receive-Not-Ready (RNRs) received and transmitted.
- REJ** Total number of Rejects received and transmitted.
- UP** Unnumbered Polls (group poll) received and transmitted.

station *all or address or link station name*

Displays the status of the specified SDLC link station or all stations. The software displays an * next to the stations that were not explicitly configured using the **add station** command but were added to the configuration because they were defined and activated in the protocol layer (DLSw or APPN).

Displays information for the specified SDLC link station (link station name) on the interface.

Address

The address of the SDLC link station. The address in parentheses is the group address of the station. A (00) indicates that a group address is not defined.

Name The character string name designation of SDLC link station.

Status

The status of the SDLC link station:

Enabled

Enabled, but not allocated

Idle Allocated, but not in use

Connected

Connected

Disconnected

Disconnected

Connecting

Connection establishment in progress.

Discnectng

Disconnection in progress

Recovering

Attempting to recover from a temporary data link error.

Max BTU

The frame size limit of the remote station. This frame size must not be larger than the maximum Basic Transmission Unit (BTU) packet size configured with the **set link frame-size** command. The default is 2048 bytes.

Rx Window

The size of the receive window.

Tx Window

The size of the transmit window.

station *name or address* **counters**

Displays frame transmit and receive counts for the specified link station.

Configuring SDLC Interfaces

I-Frames

Number of information frames received and transmitted

I-Bytes

Number of information bytes received and transmitted

Re-Xmit

Number of frames retransmitted

UI-Frames

Number of Unnumbered Information frames received and transmitted

UI-Bytes

Number of Unnumbered Information bytes received and transmitted

XID-Frames

Number of Exchange Identification frames received and transmitted

RR Number of Receive Ready frames received and transmitted

RNR Number of Receive Not Ready frames received and transmitted

REJ Number of Rejects received and transmitted

TEST Number of Test frames received and transmitted

SNRM Number of Set Normal Response Mode frames received and transmitted

DISC Number of Disconnect frames received and transmitted

UA Number of Unnumbered Acknowledgment frames received and transmitted

DM Number of Disconnected Mode frames received and transmitted

FRMR Number of Frame Reject frames received and transmitted

UP Unnumbered Polls (group poll) received and transmitted.

Example:

```
list link counters
  I-Frames  I-Bytes  Re-Xmit  UI-Frames  UI-Bytes
  -----  -----  -----  -----  -----
Send        0          0          0          0
Recv        0          0          0          0

      RR      RNR      REJ      UP
      -----  -----  -----  -----
Send        0          0          0          0
Recv        0          0          0          0
```

Example:

```
list station all
Address  Name      Status  Max BTU  Rx Window  Tx Window
-----  -----  -----  -----  -----  -----
C1(00)  SDLC_C1  IDLE    2048     7           7
C2(F3)  SDLC_C2  ENABLED 2048     7           7
```

Example:

```
list station c1
-----
Address  Name      Status   Max BTU  Rx Window Tx Window
-----
* C1(00) SDLC_C1  ENABLED  2048    7        7
```

Example:

```
list station c1 counters
-----
I-Frames  I-Bytes  Re-Xmit  UI-Frames  UI-Bytes  XID-Frames
-----
Send      9         384      0          0          0          6
Recv     29        42792    0          0          0          3

RR         RNR       REJ       TEST       SNRM       DISC
-----
Send     598        0         0          0          1          0
Recv     587        0         0          0          0          0

UA         DM        FRMR      UP
-----
Send      0          0         0          0
Recv      1          0         0          0
```

Set

Use the **set** command to dynamically configure specific information for one or all SDLC link stations without affecting the SRAM configuration. In the SDLC monitoring environment, the **set** command can be executed only on disabled links or stations. All time values are entered in seconds, with a 0.1 second resolution.

Syntax:

```
set                link modulo . . .
                   link name
                   link poll . . .
                   link role* . . .
                   link type* . . .
                   link xid/test
                   station . . .
```

***Note:** These commands are not supported on SDLC dial circuit interfaces.

link modulo

Dynamically changes the range of sequence numbers to be used on the data link without affecting the SRAM configuration. Modulo 8 specifies a sequence number range 0 - 7, and modulo 128 specifies 0 - 127. Default is 8.

Note: When you change this value, the transmit and receive window sizes become invalid. Use the **set station** command to change the receive-window and transmit-window sizes.

link name

Dynamically changes the name of the link without affecting the SRAM configuration. A maximum of 8 characters can be entered. This parameter is for informational purposes only.

Example:

```
set link name
Enter link name: [LINK_0]?
```

Configuring SDLC Interfaces

link poll delay or timeout or retry

Dynamically changes the following poll information without affecting the SRAM configuration.

delay Configures the delay between each poll that is sent over the interface.

timeout

Configures the amount of time the router waits for a poll response before timing out.

retry Configures the number of times the interface retries to poll the remote SDLC link station before it closes the connection.

Example:

```
set link poll delay
Enter delay between polls [0.2]?
```

link role *primary, secondary, or negotiable*

Configures the interface as an SDLC primary, secondary, or negotiable link station. The default is primary. Use of this command does not affect the SRAM configuration.

Notes:

1. For DLSw, **negotiable** uses X'FF' (broadcast address) for the initial poll. When using broadcast address to negotiate the role, the link uses a default SDLC configuration. When **primary** is the link role, the link performs an initial poll to a specific address.
2. For APPN point-to-point or negotiable, the broadcast address is used for the initial poll. For primary multipoint, the specific address is used.
3. For switched SDLC, the device must be primary, so **link role type** is not configurable for SDLC dial circuit interfaces.

link snrm *timeout or retry*

For primary stations, dynamically changes the following SNRM(E) information without affecting the SRAM configuration.

timeout

The time to wait for an Unnumbered Acknowledgment (UA) response before retransmitting an SNRM(E).

retry The number of times to retransmit an SNRM(E) without receiving a response before giving up.

Example:

```
set link snrm timeout
Enter SNRM response timeout [2.0]?
```

link type *multipoint or point-to-point*

Dynamically changes the SDLC link to either a multipoint link or a point-to-point link without affecting the SRAM configuration.

Note: For switched SDLC, the link is always point-to-point, so **link type** is not configurable for SDLC dial circuit interfaces.

link xid/test *timeout or retry*

For primary stations, dynamically changes the following XID/test information without affecting the SRAM configuration.

timeout

The maximum amount of time to wait for an XID or TEST frame response before retransmitting the test frame.

retry The maximum number of times an XID or TEST frame is resent before giving up. A 0 (zero) causes the router to retry indefinitely.

Note: Examples for, and explanations of, the following parameters can be found in the SDLC configuration chapter at “Set” on page 628.

station *address or name* address

Changes the station's SDLC address.

station *address or name* max-packet

Maximum size of packet that this station can receive.

station *address or name* name

Name of the SDLC station.

station *address or name* receive-window

Maximum number of frames router sends before responding.

station *address or name* transmit-window

Maximum number of frames router transmits before receiving a response frame.

Test

Transmits a specified number of TEST frames to the specified station and waits for a response. Use this command to test the integrity of the connection. Press any key to cancel the test.

Note: Disable the specified link station before using this command

Syntax:

test *station name or address #frames-to-send*
frame-size

Example:

```
test station c1
Number of frames to send [1]? 5
Frame length [265]?
Starting echo test -- press any key to abort
5 frames sent, 5 frames received, 0 compare errors, 0 timeouts
```

Number of test frames to send

Total number of frames to send.

Frame length

Length of frames to be sent. Frame length cannot be larger than the maximum frame length of the specified station.

The test may be aborted by pressing any key.

SDLC Interfaces and the GWCON Interface Command

While the SDLC interface has a console process for operational purposes, the 2216 also displays complete statistics for installed interfaces when you use the **interface** command from the GWCON environment. (For more information on the interface command, refer to “Chapter 10. The Operating/Monitoring Process (GWCON - Talk 5) and Commands” on page 105.)

Statistics Displayed for SDLC Interfaces

Using the **interface** command, you can display statistics for SDLC devices without entering the SDLC monitoring process. To do this, enter the **interface** command and an interface number at the + prompt.

```
+ interface 12
```

This command lists statistics in the following format:

```
Nt Nt' Interface Slot-Port Self-Test Self-Test Maintenance
12 12 SDLC/0 Slot: 8 Port: 2 Passed Failed Failed
SDLC MAC/data-link on V.35/V.36 interface
Adapter cable: V.35 DTE
V.24 circuit: 105 106 107 108 109
Nicknames: RTS CTS DSR DTR DCD
PUB 41450: CA CB CC CD CF
State: ON ON ON ON ON
Line speed: 64.000 Kbps
Last port reset: 1 hour, 20 minutes, 42 seconds ago
Input frame errors:
CRC error 0 alignment (byte length) 0
missed frame 182 too long (> 2062 bytes) 0
aborted frame 0 DMA/FIFO overrun 0
Output frame counters:
DMA/FIFO underrun errors 0 Output aborts sent 0
```

Nt Indicates the interface number as assigned by software during initial configuration.

Nt' Indicates the interface number as assigned by software during initial configuration.

Note: For SDLC interfaces, the Nt' interface number is always the same as the Nt interface number.

Slot Indicates the slot number of the interface that is running SDLC.

Port Indicates the port number of the interface that is running SDLC.

Self-test passed

Indicates the total number of times the SDLC interface passed its self-test.

Self-test failed

Indicates the total number of times the SDLC interface was unable pass its self-test.

Maintenance failed

Indicates the number of maintenance failures.

Configuring SDLC Interfaces

The following parameters are displayed only if a cable is connected. The information displayed depends on the cable that is connected. Different parameters are displayed with other cables.

Adapter cable

Indicates the type of adapter cable that the level converter is using.

V.24 circuit

Indicates the circuits being used on the V.24.

Nicknames

Indicates the signals being used on the V.24 circuit.

RS-232

The EIA 232 (RS 232) circuit names.

State Indicates the state of V.24 circuits, signals, and pin assignments (ON or OFF).

Line speed (configured)

Indicates the currently configured line speed for the SDLC interface.

Last port reset

Indicates how long ago the port was last reset.

Input frame errors

Indicates the input frame error type (CRC error, too short, aborted, alignment, too long, DMA/FIFO overrun) and the total number of errors that have occurred.

Output frame counters

Indicates the total number of DMA/FIFO overruns and output aborts sent for output frames.

Missed frame

When a frame arrives at the device and there is no buffer available, the hardware drops the frame and increments the missed frame counter.

L & F bits not set

On serial interfaces, the hardware sets input-descriptor information for arriving frames. If the buffer can accept the complete frame upon arrival, the hardware sets both the Last and First bits of the frame, indicating that the buffer accepted the complete frame. If either of the bits is not set, the packet is dropped, the L & F bits not set counter is incremented, and the buffer is cleared for reuse.

Note: It is unlikely that the L & F bits not set counter will be affected by traffic.

Configuring SDLC Interfaces

Chapter 46. Using the V.25bis Network Interface

The V.25bis interface allows routers to establish serial connections over switched telephone lines using V.25bis modems. This chapter describes how to use the V.25bis interface. It includes the following sections:

- “Before You Begin”
- “Configuration Procedures”

Notes:

1. You can assign a destination name to a **connection list** and assign a destination number to each line in the list. When that destination name is called, the numbers in the list are tried one by one until a connection is made or the list is exhausted.
2. V.25bis is supported only on the 8-port EIA 232 adapter.

Before You Begin

Before you configure V.25bis on the router, make sure you have the following:

- V.25bis modems that support synchronous V.25bis commands and the 1988 ITU/CCITT V.25bis specification.
- If your modem does not automatically detect answer originate, you must:
 - Configure the modem at one end of the link to originate calls.
 - Configure the modem at the other end of the link to answer calls.
 - Set up the modem on the answering end to auto-answer.

Configuration Procedures

This section describes how to configure your router for V.25bis. The tasks you need to perform are:

1. Adding V.25bis addresses
2. Configuring V.25bis parameters
3. Adding dial circuits
4. Configuring dial circuits

Note: You must restart the router for changes to the V.25bis configuration to take effect.

Adding V.25bis Addresses

You need to add a V.25bis address for each local V.25bis interface as well as for each destination. The V.25bis address includes:

- *Address Name*. The address name is a description of the address. You can use any string of up to 23 printable ASCII characters.
- *Network Dial Address*. Telephone number of the local or destination port. You can enter up to 30 characters that are in the valid format of the connected V.25bis modem. For additional information consult your modem manual.

Note: The valid character set for telephone numbers as defined by the CCITT and supported by the IBM 2216 includes:

Using V.25bis

- The decimal digits 0 through 9
- Colon (:) — "Wait Tone"
- Left-angled bracket (<) — "Pause", used for inserting a fixed delay (dependent on modem) between digit sequences. For example, when going through a PBX or PTN.
- Equal (=) — "Separator 3", which is "for national use." (Consult your modem manual.)
- The letter P — "Dialing to be continued in Pulse mode." (Not supported by some modems.)
- The letter T — "Dialing to be continued in DTMF mode." (Not supported by some modems.)

To add a V.25bis address, enter the **add v25-bis-address** command at the Config> prompt. For example:

```
Config>add v25-bis-address
Assign address name [1-23] chars []? remote-site-baltimore
Assign network dial address [1-30 digits] []? 19095551234
```

Configuring the V.25bis Interface

This section explains how to configure the V.25bis interface. To configure, do the following:

1. To set up a serial line interface for V.25bis, set the data-link protocol for the serial line interface. From the Config> prompt, use the **set data-link v25bis** command. For example:

```
Config>set data-link v25bis
Interface Number [0]? 2
```

2. Display the V.25bis Config> prompt by entering the **network** command followed by the number of the interface. For example:

```
Config>network 2
V.25bis Data Link Configuration
V25bis Config>
```

You can use the **list devices** command at the Config> prompt to display a list of interface numbers configured on the router.

3. Use the **set local-address** command to specify the network address name of the local port. You must enter one of the address names you defined using the **add v25bis-address** command. For example:

```
V25bis Config>set local-address
Local network address name []? remote-site-baltimore
```

Note: You must restart the router for configuration changes to take effect.

Optional V.25bis Parameters

The following are optional V.25bis parameters you can set. For a complete description of these commands, see "V.25bis Configuration Commands" on page 649 .

- You can limit the number of successive calls to an address that is inaccessible or that refuses those calls. To do so, use the **set retries-no-answer** and the **set timeout-no-answer** commands.
- The **set disconnect-timeout** command controls the amount of time the router waits to initiate a call after dropping a signal from the previous call.

- The **set command-delay-timeout** command specifies the amount of time the router waits to initiate or answer a call after it turns on DTR.
- The **set connect-timeout** command specifies the number of seconds allowed for a call to be established.
- The **set duplex** command specifies the duplexing mode for the call.
- The **set encoding** command sets the encoding for the call.
- When you have finished configuring the interface, you can use the **list** command to display your configuration.

Adding Dial Circuits

Dial circuits are mapped to V.25bis serial line interfaces. You can map multiple dial circuits to one serial line interface.

To add a dial circuit, use the **add device dial-circuit** command from the `Config>` prompt. The software assigns an interface number to each circuit. You will use this number to configure the dial circuit.

Example:

```
Config>add device dial-circuit
Adding device as interface 6
```

Note: Dial circuits default to the Point-to-Point protocol (PPP). You can also set the dial circuit to use Frame Relay (FR) or SDLC.

Configuring Dial Circuits

This section describes how to configure a dial circuit. For a complete description of the dial circuit commands, see “Chapter 50. Configuring and Monitoring Dial Circuits” on page 689.

Note: If the encapsulator type is SDLC, the only dial circuit parameter that you can set is the base net number.

To configure the dial circuit, do the following:

1. Display the `Circuit Config>` prompt by entering the **network** command followed by the interface number of the dial circuit. You can use the **list devices** command at the `Config>` prompt to display a list of the dial circuits that you added. For example:

```
Config>network 6
Circuit configuration
Circuit Config>
```

2. Map the dial circuit to a V.25bis interface. The Base net is the V.25bis interface number. For example:

```
Circuit Config>set net
Base net for this circuit [0]? 0
```

3. Specify the address name of the remote router to which the dial circuit will connect. You must use one of the names you defined using the **add v25-bis-address** command. For example:

```
Circuit Config>set destination
Assign destination address name []? newyork
```

4. Configure the dial circuit to initiate outbound calls only, accept inbound calls only, or both initiate and accept calls.

Use the **set calls** command. To avoid a conflict if both ends of the link attempt to establish a call at the same time, configure the dial circuit at one end of the

Using V.25bis

link to accept inbound calls only, and configure the dial circuit at the other end of the link to initiate outbound calls only. For example:

```
Circuit Config>set calls outbound  
Circuit Config>set calls inbound
```

Note: For WAN Restoral operations or another dial-on-demand application, you should set up the circuit for either inbound or outbound calls.

5. Specify the timeout period for the circuit.

Use the **set idle** command. If there is no traffic over the circuit for this specified time period, the dial circuit hangs up. To configure the circuit as a dedicated circuit, set the idle timer to zero. To configure the circuit to dial on demand, set the idle timer to a value other than zero. The range is 0 to 65535 and the default is 60 seconds. For example:

```
Circuit Config>set idle  
Idle timer (seconds, 0 means always active) [60]? 0
```

Note: For WAN Restoral or WAN Reroute operations you must set the idle time to 0.

6. Optionally, you can delay the time between when a call is established and the initial packet is sent.

Use the **set selftest-delay** command. Setting a selftest delay can prevent initial packets from being dropped. If your modems take extra time to synchronize, adjust this delay. For example:

```
Circuit Config>set selftest-delay  
Selftest delay(milli-seconds,0 means no delay) [150]?200
```

7. Set the inbound address name.

Use the **set inbound** command. You need to use this command only if you set up the circuit for both inbound and outbound calls and if the router's destination address is different from the destination address that the remote router dials. For example, the numbers would be different if one of the routers must go through a PBX, international, or inter-LATA exchange. For example:

```
Circuit Config>set inbound  
Assign destination inbound address name []? newyork
```

The inbound address name must match one of the names that you defined using the **add v25-bis-address** command.

8. Set the duplexing mode for the circuit using the **set duplex** command.
9. Set the encoding mode for the circuit using the **set encoding** command.
10. Optionally, you can enter the configuration process for the data-link layer protocol that is running on the dial circuit (PPP or Frame Relay). Use the **encapsulator** command. For example:

```
Circuit Config>encapsulator
```

Chapter 47. Configuring and Monitoring the V.25bis Network Interface

This chapter describes the V.25bis configuration and operational commands and GWCON commands. It includes the following sections:

- “Accessing the Interface Configuration Process”
- “V.25bis Configuration Commands”
- “Accessing the Interface Monitoring Process” on page 653
- “V.25bis Monitoring Commands” on page 653
- “V.25bis and the GWCON Commands” on page 658

Accessing the Interface Configuration Process

Use the following procedure to access the V.25bis configuration process.

1. At the OPCON prompt, enter the **talk** command and the PID for CONFIG. (For more detail on this command, refer to Chapter 4. The OPCON Process.) For example:

```
* talk 6
Config>
```

After you enter the **talk 6** command, the CONFIG prompt (Config>) displays on the console. If the prompt does not appear when you first enter **CONFIG**, press **Return** again.

2. At the CONFIG prompt, enter the **list devices** command to display the network interface numbers for which the router is currently configured.
3. Record the interface numbers.
4. Enter the CONFIG **network** command and the number of the interface you want to configure. For example:

```
Config> network 1
V.25bis Config>
```

The V.25bis configuration prompt now displays on the console.

V.25bis Configuration Commands

Table 92 summarizes and the rest of the section explains the V.25bis configuration commands. These commands allow you to display, create, or modify a V.25bis configuration. Enter the V.25bis configuration commands at the V.25bis Config> prompt.

Table 92. V.25bis Configuration Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
List	Displays the V.25bis configuration.
Set	Sets the local address, connect, disconnect, and no answer timeouts, number of retries after no answer, the duplexing mode, command delay timeout, and encoding.

V.25bis Configuration Commands

Table 92. V.25bis Configuration Commands Summary (continued)

Command	Function
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

List

Use the **list** command to display the current V.25bis configuration.

Syntax:

list

Example:

```
list
      V.25bis Configuration

Duplex                = Full
Encoding              = NRZ
Local Network Address Name = v403
Local Network Address  = 15088982403

Non-Responding addresses:
Retries               = 1
Timeout              = 0 seconds

Call timeouts:
Command Delay        = 0 ms
Connect              = 60 seconds
Disconnect           = 2 seconds

Cable type           = V.35 DTE
Speed                = 9600
```

Duplex

Displays the duplex mode for the interface once the dial connection has been established.

Encoding

Displays the transmission encoding scheme for the interface once the dial connection has been established. Encoding is either NRZ (non-return to zero) or NRZI (non-return to zero inverted).

Local Network Address Name:

Displays the network address name of the local port.

Local Network Address:

Displays the network dial address of the local port.

Non-responding addresses:

Retries

Maximum number of calls the router attempts to make to a non-responding address during the timeout period.

Timeout

If the router reaches the maximum number of retries to a non-responding address, it does not attempt to establish the call until this time has expired. This timeout period begins when the router attempts the first call.

Call timeouts:

Number of call timeouts.

V.25bis Configuration Commands

Command Delay

Amount of time, in milliseconds, that the router waits to initiate or answer a call after it turns on DTR (Data Terminal Ready). If you set this parameter to 0, the router waits for the modem to respond to DTR with the CTS (Clear to Send) signal before it issues commands.

Connect

Number of seconds allowed for a call to be established. If this parameter is set to 0, the modem controls the connection establishment timeout.

Disconnect

After the routers drops DTR it waits this amount of time before it initiates further calls. If you set this parameter to 0, the router waits for the modem to respond to the DTR drop by dropping CTS and DSR before it initiates the next call.

Set

Use the **set** command to configure local addresses, timeouts and delays for calls, retries and timeouts for non-responding addresses, and the HDLC cable type.

Syntax:

```
set                command-delay timeout . . .  
                   connect-timeout . . .  
                   disconnect-timeout . . .  
                   duplex  
                   hdlc cable . . .  
                   hdlc encoding . . .  
                   hdlc speed . . .  
                   local-address . . .  
                   retries-no-answer . . .  
                   timeout-no-answer . . .
```

command-delay-timeout # of milliseconds

After the router turns on DTR (Data Terminal Ready), it waits this amount of time before it initiates or answers a call. If you set this parameter to 0, the router waits for the modem to respond to DTR with the CTS (Clear to Send) signal before it issues commands. The range is 0 to 65535 milliseconds, and the default is 0.

connect-timeout # of seconds

Sets the number of seconds allowed for a call to be established. The range is 0 to 65535 seconds, and the default is 60. If you set this parameter to 0, the modem controls the connection timeout. You should initially set this parameter to 0 and then use ELS event V25B.027 to find out how long it takes to establish connections to various destinations. You can then set this parameter to a number slightly higher than the longest connect time.

V.25bis Configuration Commands

Note: Normally government regulation limits modem manufacturers to a maximum length for call setup. This value is merely an optimization, although inter-operation with some DSUs may require that you change this parameter.

disconnect-timeout # of seconds

Specifies the amount of time, in seconds, that the router waits after dropping DTR before it initiates further calls. The range is 0 to 65535 seconds, and the default is 2. If you set this parameter to 0, the router waits for the modem to respond to the DTR drop by dropping CTS and DSR before it initiates the next call.

duplex

Specifies the duplex type of the line.

When full-duplex is configured, the RTS modem signal remains asserted once the dial connection has been established.

When half-duplex is configured, the router raises RTS when it is time to transmit and waits for CTS to be asserted by the modem. After CTS is asserted, the router transmits data packets and then drops RTS when the router is through transmitting to let the peer device respond.

Only configure half-duplex when using the V.25bis interface to handle switched SDLC and the attached modem requires the half-duplex mode of operation.

Notes:

1. Duplex must be full for PPP or Frame Relay circuits.
2. If you configure half-duplex for a V.25bis interface on the 8-port EIA-232E adapter, you must configure the line speed using the **set hdlc speed** command.

Valid values: full or half

Default value: full

hdlc cable *rs232 dte*

Specifies the type of cable connected to this interface. Setting this parameter allows you to view the cable type when you enter the **interface** command at the GWCON (+) prompt and when you enter the **statistics** command at the V.25bis> monitoring prompt. This parameter does not affect operation of the router.

hdlc encoding

Sets the HDLC transmission encoding scheme as NRZ (non-return to zero) or NRZI (non-return to zero inverted). Most configurations use NRZ. The configured encoding is used for the end-to-end connection.

Note: Although you might configure NRZI, the exchange between the DTE and the modem (as described by CCITT recommendation, *V.25bis*) uses NRZ as the encoding scheme.

Valid values: NRZ or NRZI

Default value: NRZ

hdlc speed

Specifies the line speed for this interface. Setting this parameter allows you to view the line speed when you enter the interface command at the

V.25bis Configuration Commands

GWCON (+) prompt and when you enter the statistics command at the V.25bis> monitoring prompt. The range is 2400 to 64 000 bps. The default is 9600 bps.

Note: This command does not affect the actual line speed but it sets the speed some protocols, such as IPX, use when calculating routing cost parameters for dial circuits mapped to the V.25bis interface.

local-address *address name*

Specifies the network address name of the local port. This address name must match one of the names that you defined at the Config> using the **add v25-bis-address** command.

Example: `set local-address line-1-local`

retries-no-answer *value*

Some telephone service providers impose restrictions on automatic recalling devices to limit the number of successive calls to an address that is inaccessible or that refuses those calls. This parameter specifies the maximum number of calls the router attempts to make to a non-responding address during the timeout period. The range is 0 to 10, and the default is 1.

Note: Government regulation may also impose limits on the modem manufacturer that would supersede this parameter.

timeout-no-answer *# of seconds*

After the router reaches the maximum number of **retries-no-answer** to a non-responding address, it does not initiate further calls to that address until this time has expired. This timeout period begins when the router attempts the first call to an address. The range is 0 to 65535 seconds, and the default is 0. If you set this parameter to 0, the modem controls the timeout period.

Accessing the Interface Monitoring Process

To access the interface monitoring process for V.25bis, enter the following command at the GWCON (+) prompt:

```
+ network #
```

Where # is the number of the V.25bis serial line. You cannot directly access the V.25bis monitoring process for dial circuits, but you can monitor the dial circuits that are mapped to the serial line interface.

Note: V.25bis interfaces also have ELS troubleshooting messages that you can use to monitor V.25bis related activity. See the *IBM Nways Event Logging System Messages Guide* for further details.

V.25bis Monitoring Commands

This section summarizes and explains the V.25bis operating commands. These commands allow you to view the calls, circuits, parameters, and statistics of the V.25bis interfaces.

Enter the V.25bis monitoring commands at the V.25bis> prompt. Table 93 on page 654 shows the commands.

V.25bis Operating Commands

Table 93. V.25bis Monitoring Command Summary

Monitoring Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Calls	List the number of completed and attempted connections made for each dial circuit mapped to this interface since the last time statistics were reset on the router.
Circuits	Shows the status of all data circuits configured on the V.25bis interface.
Parameters	Displays the current parameters for the V.25bis interface. (This command is similar to the V.25bis Config> list command.)
Statistics	Displays the current statistics for the V.25bis interface.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Calls

Use the **calls** command to list the number of completed and attempted connections made for each dial circuit mapped to this interface since the last time statistics were reset on the router.

Syntax:

calls

Example:

```
calls
Net Interface Site Name      In   Out  Rfsd  Blckd
1   PPP/0     v403          2    0    0     0
```

Unmapped connection indications: 0

Net Number of the dial circuit mapped to this interface.

Interface

Type of interface and its instance number.

Site Name

Network address name of the dial circuit.

In Number of inbound connections accepted for this dial circuit.

Out Number of completed connections initiated by this dial circuit.

Rfsd Number of connections initiated by this dial circuit that were refused by the network or the remote destination port.

Blckd Number of connection attempts that the router blocked. The router blocks connection attempts if the local port is already in use, the maximum number of retries to a non-responding address is reached, or a modem is not responding.

Unmapped connection indications:

Number of connection attempts that were refused by the router because there were no enabled dial circuits that were configured to accept the incoming calls.

Circuits

The **circuits** command shows the status of all dial circuits configured on the V.25bis port.

Syntax:

circuits

Example:

```

circuit
Net Interface  MAC/Data-Link  State  Reason  Duration
2  PPP/0      Point to Point  Avail  Rmt Disc  1:02:25

```

Net Number of the dial circuit mapped to this interface

Interface

Type of interface and its instance number.

MAC/DataLink

Type of datalink protocol configured for this dial circuit.

State Current state of the dial circuit:

Up - currently connected

Available - not currently connected, but is available

Disabled - dial circuit was disabled

Down - failed to connect because of a busy dial circuit or because the link-layer protocol is down

Reason

Reason for the current state:

nnn_Data - (where nnn is the name of a protocol) the circuit is Up because a protocol had data to send.

Remote Disconnect - the circuit is either Down or Available because the remote destination disconnected the call.

Operator Request - the circuit is Available because the last call was disconnected by a monitoring command.

Inbound - the circuit is Up because the circuit answered an inbound call.

Restoral - the circuit is Up because of a WAN Restoral operation.

Self Test - the circuit was configured as static (idle time=0) and successfully connected once it was enabled.

Duration

Length of time that the circuit has been in the current state.

Parameters

Use the **parameters** command to display the current V.25bis serial line configuration. Note that this is the same information displayed in the V.25bis Config> list command.

Syntax:

parameters

Example:

V.25bis Operating Commands

parameters

V.25bis port Parameters

Local Network Address Name = v402
Local Network Address = 15088982402

Non-Responding addresses:

Retries = 1
Timeout = 0 seconds

Call timeouts:

Command Delay = 0 ms
Connect = 0 seconds
Disconnect = 0 seconds

Local Network Address Name:

Network address name of the local port.

Local Network Address:

Network dial address of the local port.

Non-responding addresses:

Retries

Maximum number of calls the router attempts to make to a non-responding address during the timeout period.

Timeout

If the router reaches the maximum number of retries to a non-responding address, it does not attempt to establish the call until this time has expired. This timeout period begins when the router attempts the first call to an address.

Call timeouts:

Command Delay

Amount of time, in milliseconds, that the router waits to initiate or answer a call after it turns on DTR (Data Terminal Ready). If you set this parameter to 0, the router waits for the modem to respond to DTR with the CTS (Clear to Send) signal before it issues commands.

Connect

Number of seconds allowed for a call to be established. If this parameter is set to 0, the modem controls the connection establishment timeout.

Disconnect

After the routers drops DTR it waits this amount of time before it initiates further calls. If you set this parameter to 0, the router waits for the modem to respond to the DTR drop by dropping CTS and DSR before it initiates the next call.

Statistics

Use the **statistics** command to display the current statistics for this V.25bis interface.

Syntax:

statistics
_

Example:

statistics

V.25bis port Statistics

Adapter cable: RS-232 DTE

Nicknames: RTS CTS DSR DTR DCD RI
 RS-232 CA CB CC CD CF CE
 State: OFF OFF OFF OFF OFF OFF

Line speed: 4800
 Last port reset: 24 seconds ago

Input frame errors:
 CRC error 0 alignment (byte length) 0
 missed frame 0 too long (> 2182 bytes) 0
 aborted frame 0 DMA/FIFO overrun 0
 L & F bits not set 0
 Output frame counters:
 DMA/FIFO underrun errors 0 Output aborts sent 0

Adapter cable:

Type of adapter cable being used.

Nicknames:

Common names for the circuits.

RS-232

EIA 232 (also known as RS-232) names for the circuits.

State: Current state of the circuits: ON, OFF, or "---," which means that the state is undefined for this type of interface.

Line speed:

The transmit clock speed (approximate).

Last port reset:

Length of time since the port was reset.

Input frame errors:

CRC error

Number of packets received that contained checksum errors and as a result were discarded.

Alignment (byte length)

Number of packets received that were not an even multiple of 8 bits in length and as a result were discarded.

Missed Frame

When a frame arrives at the device and there is no buffer available, the hardware drops the frame and increments the missed frame counter.

too long (> nnnn bytes)

Number of packets received that were greater than the configured frame size (nnnn) and as a result were discarded.

aborted frame

Number of packets received that were aborted by the sender or a line error.

V.25bis Operating Commands

DMA/FIFO overrun

The number of times the serial interface card could not send data fast enough to the system packet buffer memory to receive packets from the network.

L & F bits not set

On serial interfaces, the hardware sets input-descriptor information for arriving frames. If the buffer can accept the complete frame upon arrival, the hardware sets both the last and first bits of the frame, indicating that the buffer accepted the complete frame. If either of the bits is not set, the packet is dropped, the L & F bits not set counter is incremented, and the buffer is cleared for reuse.

Note: It is unlikely that the L & F bits not set counter will be affected by traffic.

Output frame counters:

DMA/FIFO underrun errors

Number of times the serial interface card could not retrieve data fast enough from the system packet buffer memory to transmit packets onto the network.

Output aborts sent

Number of transmissions that were aborted as requested by upper-level software.

V.25bis and the GWCON Commands

While V.25bis has its own monitoring process for monitoring purposes, the router also displays configuration information and complete statistics for devices and circuits when you use the interface, statistics, and error commands from the GWCON environment. You can also use the GWCON **test** command to test DCEs and circuits.

Note: Issuing the **test** command to the V.25bis serial interface causes the current call to be dropped and re-dialed.

For more information on the GWCON command, see "Chapter 10. The Operating/Monitoring Process (GWCON - Talk 5) and Commands" on page 105.

Statistics for V.25bis Interfaces and Dial Circuits

Use the **interface** command at the GWCON (+) prompt to display statistics for V.25bis serial line interfaces and dial circuits.

To display the following statistics for a V.25bis serial line interface, use the **interface** command followed by the *interface number* of the V.25bis serial line interface.

Example: interface 10

```

Nt Nt' Interface Slot-Port Self-Test Self-Test Maintenance
10 10 V.25/0 Slot: 4 Port: 0 Passed Failed Failed
V.25bis Base Net MAC/data-link on EIA 232E/V.24 interface

Adapter cable: RS-232 DTE

V.24 circuit: 105 106 107 108 109 125
Nicknames: RTS CTS DSR DTR DCD RI
```

V.25bis Operating Commands

```
RS-232:      CA CB CC CD CF CE
State:       OFF OFF OFF ON  OFF OFF

Line speed:      19.200 Kbps
Last port reset: 55 minutes, 1 second ago

Input frame errors:
CRC error                6 alignment (byte length)      0
missed frame             1 too long (> 2054 bytes)      0
aborted frame           34 DMA/FIFO overrun          0
Output frame counters:
DMA/FIFO underrun errors 0 Output aborts sent          0
```

To display the following statistics for a dial circuit, use the **interface** command followed by the *interface number* of the dial circuit.

Example:

```
interface 29
          Self-Test Self-Test Maintenance
Nt Nt' Interface Passed Failed Failed
29 10 PPP/20      2      1      0
Point to Point MAC/data-link on V.25bis Dial Circuit interface
```

The following list describes the output for both serial line interfaces and dial circuits.

Nt Serial line interface number or dial circuit interface number.

Nt' If "Nt" is a dial circuit, this is the interface number of the V.25bis serial line interface to which the dial circuit is mapped.

Interface

Interface type and its instance number.

Slot The slot number of the interface running V.25bis.

Port The port number of the interface that is running V.25bis.

Self-Test Passed

Number of self-tests that succeeded.

Self-Test Failed

Number of self-tests that failed.

Maintenance: Failed

Number of maintenance failures.

Adapter cable:

Type of adapter cable that is being used.

V.24 circuit:

Circuit numbers as identified by V.24 specifications.

RS-232

EIA 232 (also known as RS-232) names for the circuits.

State Current state of the circuits (ON or OFF).

Line speed

The transmit clock speed (approximate).

Last port reset

Length of time since the port was reset.

Input frame errors:

V.25bis Operating Commands

CRC error

Number of packets received that contained checksum errors and as a result were discarded.

Alignment (byte length)

Number of packets received that were not an even multiple of 8 bits in length and as a result were discarded.

Missed Frame

When a frame arrives at the device and there is no buffer available, the hardware drops the frame and increments the missed frame counter.

too long (> nnnn bytes)

Number of packets received that were greater than the configured frame size and as a result were discarded.

DMA/FIFO overrun

The number of times the serial interface card could not send data fast enough to the system packet buffer memory to receive packets from the network.

L & F bits not set

On serial interfaces, the hardware sets input-descriptor information for arriving frames. If the buffer can accept the complete frame upon arrival, the hardware sets both the last and first bits of the frame, indicating that the buffer accepted the complete frame. If either of the bits is not set, the packet is dropped, the L & F bits not set counter is incremented, and the buffer is cleared for reuse.

Note: It is unlikely that the L & F bits not set counter will be affected by traffic.

aborted frame

Number of packets received that were aborted by the sender or a line error.

Output frame counters:

DMA/FIFO underrun errors

Number of times the serial interface card could not retrieve data fast enough from the system packet buffer memory to transmit packets onto the network.

Output aborts sent

Number of transmissions that were aborted as requested by upper-level software.

Chapter 48. Using the ISDN Interface

Important

The original 2216 ISDN T1 and E1 Single Port LICs (IBM PN 11J7466 or 78H6147 and 11J7465 or 78H6148 respectively), do not support MAC address assignment for DIALs clients. This assignment is only necessary for customers who want to use the NetBIOS and/or SNA protocols natively in the DIALs Remote LAN Access environment. All other ISDN functions and DIALs functions (for example Dial-in IP and IPX) will work correctly without an upgrade. The newer ISDN T1 and E1 Single Port LICs support MAC address assignment for DIALs clients and all DIALs functions. Customers with the original ISDN LICs who want to use NetBIOS and/or SNA DIALs functions should contact their IBM service representative to upgrade to the newer LICs.

This chapter describes the Integrated Services Digital Network (ISDN) interfaces on the IBM 2216. It includes the following sections:

- “ISDN Overview”
- “ISDN Cause Codes” on page 664
- “Sample ISDN Configurations” on page 666
- “Channelized T1/E1” on page 667
- “Requirements and Restrictions for ISDN Interfaces” on page 668
- “Before You Begin” on page 668
- “Configuration Procedures” on page 668.
- “I.431 Switch Variant” on page 673

ISDN Overview

The ISDN interface software allows you to interconnect routers over ISDN. You can set up the interface to act as a dedicated link or to initiate and accept switched-circuit connections, either on demand, automatically from restart, or on command by the operator.

I.430, I.431, and Channelized T1/E1 are not switched. They are permanent leased-line type connections.

ISDN Adapters and Interfaces

The IBM 2216 supports the following ISDN-PRI adapters:

- 1-Port Channelized E1 ISDN-PRI
- 1-Port Channelized T1/J1 ISDN-PRI
- 4-Port Channelized E1 ISDN-PRI
- 4-Port Channelized T1/J1 ISDN-PRI

The PRI/Channelized adapters have an integrated CSU/DSU, so an external CSU/DSU is not required.

Using ISDN

Note: If you are upgrading from BRI to PRI from talk 6, you must clear the ISDN and dial configurations first, then bring up PRI and configure for PRI.

- The PRI adapter does not support multipoint.
- The PRI adapter provides T1/J1 and E1 support.
 - T1/J1 supports twenty-three 64-Kbps B-channels and one 64-Kbps D-channel.
 - E1 supports thirty 64-Kbps B-channels and one 64-Kbps D-channel.
- The PRI adapter provides enhanced line ID (LID) support.

Dial Circuits

There are four types of dial circuits:

- Static circuits (or link)

Notes:

1. I.430, I.431, and Channelized T1/E1 are leased line connections and therefore do not dial.
 2. ISDN considers X.25 traffic over the D-channel as a static circuit. However, you could configure the X.25 circuit as a PVC or SVC using the **encapsulator** command under the dial circuit configuration.
- Switched circuits that dial on demand and hang up after a specified idle time
 - WAN restoral circuits that are used only when an assigned primary leased line fails
 - Dial-in circuits are used to provide remote clients access to resources on the network.

When bridging over a dial on demand interface it is recommended that you disable spanning tree for that interface and create MAC filters to filter out all undesired traffic. (The MAC filters would drop all frames that are not destined specific MAC addresses.) This keeps the dial circuit from staying connected due to unwanted traffic.

Note: You don't need to add any MAC filters when running BAN traffic on a FR dial-on-demand interface. The BAN software always performs filtering such that the only bridging traffic that will keep a dial-on-demand circuit from hanging up is traffic whose destination MAC address matches the BAN DLCI MAC address.

Add a dial circuit for each potential destination. You can map multiple dial circuits to one ISDN interface. Each dial circuit is a normal serial line network, running Point-to-Point Protocol (PPP), Frame Relay or X.25 (for D-channels only). These protocols are configured to operate over the dial circuits.

Note: You can assign a destination name to a **connection list** (add ISDN address) and assign a destination number to each line in the list. When that destination name is called, the numbers in the list are tried one by one until a connection is made or the list is exhausted.

Routable protocols and bridging and routing features cannot communicate directly with an ISDN interface. You need to configure these protocols to run on the dial circuits. This implementation supports the following protocols and features for ISDN dial circuits:

- APPN
- Banyan VINES

- DECnet
- DLSw
- IP
- IPX
- AppleTalk 2
- Bridging (SRB, STP, SR-TB, and SRT)
- Bandwidth reservation
- WAN restoral
- DIALS

Addressing

To place an ISDN call, specify the telephone number of the destination. To identify yourself to the switch, you need to specify your own telephone number. For ISDN, telephone numbers are called network dial addresses and, for convenience, they are given names called network address names that represent the telephone number.

When you set up an ISDN interface, you add addresses for each potential destination as well as for your own telephone number, which is called the local network address. When you configure a dial circuit, the local network address is obtained from the physical interface configuration and you set a destination addresses for the circuit.

Oversubscribing and Circuit Contention

An ISDN PRI T1/J1 interface can support a maximum of 23 active calls, and an ISDN PRI E1 interface can support a maximum of 30 active calls. There can be more dial circuits configured on an ISDN interface than active calls supported. This is called oversubscribing. If a dial circuit attempts a call when the ISDN interface has all calls active, there are two possibilities: 1) If the dial circuit has a higher priority than a dial circuit with an active call, the active call will be terminated for the low priority dial circuit and a call will be attempted for the low priority dial circuit and a call will be attempted for the higher priority dial circuit. 2) If the dial circuit does not have a higher priority than any dial circuits with active calls, no call will be made. The router will drop packets sent by protocols on dial circuits that cannot connect to their ISDN destination.

Note: There is no circuit contention when you are running X.25 over the D-channel because the D-channel is always available for the X.25 connection.

See “Set” on page 692 for more information about priority.

Cost Control Over Demand Circuits

Dial-on-demand circuits always appear to be in the Up state to the protocols. Most protocols send out periodic routing information that could cause the router to dial out each time the routing information is sent over dial-on-demand circuits. To limit periodic routing updates, configure IP and OSI to use only static routes and disable the routing protocols (RIP, OSPF) over the dial circuits. If you are using IPX, configure static routes and services and disable the routing protocols (RIP, SAP) over the dial circuits. Another option is to configure low-frequency RIP and SAP update intervals, although this does not prevent RIP and SAP from broadcasting

Using ISDN

routing information changes as they occur. You should also enable IPX Keepalive filtering, which prevents keepalive and serialization packets from continually activating the dial-on-demand link.

Caller ID and LIDS

If the ISDN service provides the ANI or CallerID (CLID) service by providing the Calling Party Number (CPN) in the ISDN setup message, you can use it to match up dial circuits to the appropriate caller. Otherwise, you must either use a proprietary line identification protocol (LID) or provide circuits that are "ANY INBOUND".

The LID protocol uses the inbound destination in the dial circuit configuration and LID received to match the calling dial circuit to the receiving dial circuit. The LID protocol is a brief identification protocol initiated by the caller and answered by the receiver. If the caller does not provide the LID message, the receiver may reject the call, if any_inbound dial circuit is not configured. LID exchanges occur on the B-channel.

When connecting to routes that do not support logical ids (LIDS), you can suppress the LID exchange using the config option under the individual dial circuit.

```
config> set lid_used no
```

On the incoming side, if lid_used=no, the call is completed and the IBM 2216 does not wait for the LID to come on the B_channel. Instead, the IBM 2216 tries to use the callerID received. If there is no match on the callerID the IBM 2216 checks to see if an any_inbound dial circuit is available. If no any_inbound circuit is available the call is rejected.

On the outgoing side, PPP/FR selftest starts immediately, after B-Channel is allocated.

ISDN Cause Codes

This ISDN implementation specifies a cause code that will stop the router from attempting to establish a connection through an ISDN interface. If the application retries, the router again attempts to establish a connection through this interface and will succeed if the original problem has been corrected. If during the retry the router encounters the same cause code, the application will not attempt further connection processing through this interface.

Cause code interpretations:

1. If cause0 is not "0x5" ignore the cause code.
2. If cause0 is "0x5" look at cause1. If the high-order (most significant) bit of cause1 is 0N, set it to 0FF.
3. Convert the result to decimal and look up the meaning in the following table, which is taken from *ITU-T Recommendation Q.850*.

Table 94. ISDN Q.931 Cause Codes

Code	Cause
1	Unallocated (unassigned number)
2	No route to specified transit network
3	No route to destination

Table 94. ISDN Q.931 Cause Codes (continued)

Code	Cause
6	Channel unacceptable
7	Call awarded and is being delivered in an established channel
16	Normal call clearing
17	User busy
18	No user responding
19	No answer from user (user alerted)
21	Call rejected
22	Number changed
26	Non-selected user clearing
27	Destination out of order
28	Invalid number format (address incomplete)
29	Facility rejected
30	Response to STATUS ENQUIRY
31	Normal, unspecified
34	No circuit/channel available
38	Network out of order
41	Temporary Failure
42	Switching equipment congestion
43	Access information discarded
44	Requested circuit/channel not available
47	Resource unavailable, unspecified
49	Quality of Service not available
50	Requested facility not subscribed
57	Bearer capability not authorized
58	Bearer capability not presently available
63	Service or option not available, unspecified
65	Bearer capability not implemented
66	Channel type not implemented
69	Requested facility not implemented
70	Only restricted digital information bearer capability is available
79	Service or option not implemented, unspecified
81	Invalid call reference value
82	Identified channel does not exist
83	A suspended call exists, but this call identity does not
84	Call identity in use
85	No call suspended
86	Call having the requested call identity has been cleared
88	Incompatible destination
91	Invalid transit network selection
95	Invalid message, unspecified

Using ISDN

Table 94. ISDN Q.931 Cause Codes (continued)

Code	Cause
96	Mandatory information element is missing
97	Message type nonexistent or not implemented
98	Message not compatible with call state or message type nonexistent or not implemented
99	Information element nonexistent or not implemented
100	Invalid information element contents
101	Message not compatible with call state
102	Recovery on timer expiry
111	Protocol error, unspecified
127	Interworking, unspecified

Sample ISDN Configurations

The following topics show several typical ISDN configurations.

Frame Relay over ISDN Configuration

Figure 48 shows how you can connect to a Frame Relay network through an ISDN network. In this configuration, you set the data link on your dial circuits to Frame Relay.

Note: Dial circuits default to point-to-point (PPP) protocol. To change the protocol to Frame Relay, enter **set data-link fr** at the `Config>` prompt. A connection will only be usable if the data link on both ends matches (for example, either FR to FR, or PPP to PPP).

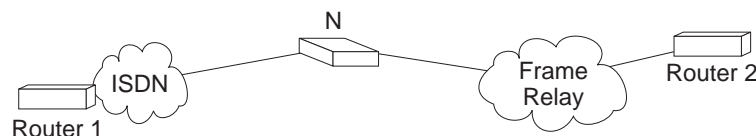


Figure 48. Frame Relay over ISDN Configuration

Note: N could be either an ISDN TA connected to the FR switch, or an ISDN card in a FR switch.

WAN Restoral Configuration

Figure 49 on page 667 shows how you can use an ISDN connection to back up a failed dedicated WAN link (WAN restoral). In this example, Router A normally uses the WAN link to communicate with Router B. If that connection fails, the ISDN dial-up link reconnects the two routers. When the WAN link recovers, the secondary link automatically disconnects. For more information on how to configure the router for WAN restoral, see Using WAN Restoral in *Using and Configuring Features*.

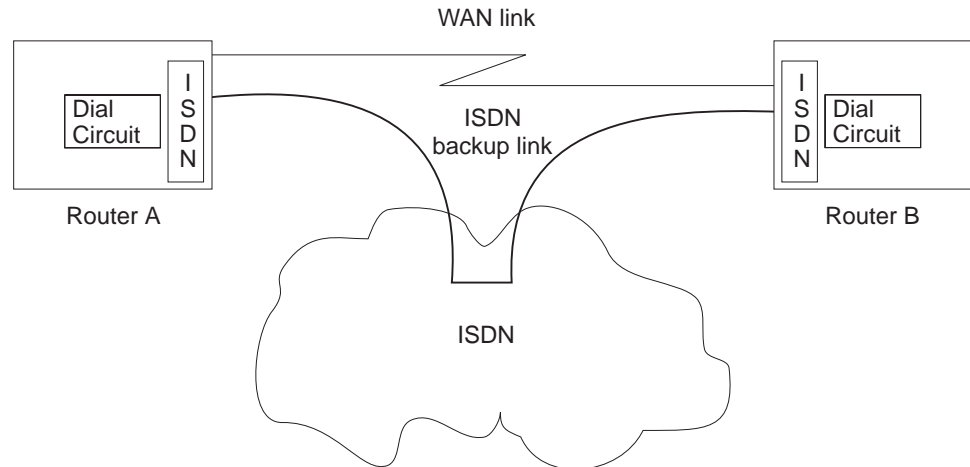


Figure 49. Using ISDN for WAN Restoration

For WAN Restoration, only dial circuits configured for PPP can be used as the secondary link. For WAN Reroute, either a PPP dial circuit or a FR dial circuit can be used as the alternate link.

Channelized T1/E1

When configured for channelized, the Channelized/PRI adapter allows you to get Fractional/Channelized T1/J1/E1 support. You can have channels of 56-Kbps or $N \times 64$ -Kbps. This will let you multiplex multiple leased lines connections (for example: using V.35 at 56-Kbps) into one physical connection.

To configure a T1 or E1 Primary adapter as channelized:

1. Select "Channelized" as the switch variant for the ISDN interface.
2. Configure the time slots to be used for this ISDN interface when you configure the dial circuit. See "Set" on page 692 for more information.

Example of configuring a Channelized T1 interface:

```
Config>n 6
ISDN Config>set switch chan
ISDN Config>list
```

ISDN Configuration

```
Maximum frame size in bytes      = 2048
Switch Variant/Service Type      = Channelized
Available Timeslots: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
```

```
Config>n 7
Circuit config: 7>set net 6
Circuit config: 7>set timeslot 2 3 4 24
Circuit config: 7>list
```

```
Base net          = 6
Idle character    = 7E
Bandwidth         = 64 Kbps
Timeslot         = 2 3 4 24
```

Note: If this were an E1 circuit, the available timeslots would be 1 to 31.

Requirements and Restrictions for ISDN Interfaces

Switches/Services Supported

The ISDN Primary Rate Interface (PRI) supports the following switches/services:

Switch names	Valid command
AT&T 5ESS (North America)	5ESS
AT&T 4ESS (North America)	4ESS
Australia (AUSTEL)	AUSPRI
INS-Net 1500 (Japan, NTT)	INSPRI
National ISDN 2 (North America)	USNI2
NET 5 (Euro-ISDN, ETSI)	NET5
Northern Telecom DMS (DMSPRI)	DMSPRI
Native I.431	I431 (See "I.431 Switch Variant" on page 673.)
Channelized T1/E1	CHANNELIZED

ISDN Interface Restrictions

- You cannot boot or dump the router over an ISDN interface.
- Except for BRI, which allows you to use the D-channel for X.25 packet data, you cannot use the D-channel for data traffic. Normally the D-channel is used only for setting up and taking down B-channel connections.

Dial Circuit Configuration Requirements

You need to consider the following when you configure PPP or Frame Relay with ISDN:

- The ISDN interface will not enforce transmit delay counters that you set in the PPP configurations.
- Do not enable psuedo-serial-ethernet on the dial circuit.

Before You Begin

Before you configure ISDN, you need the following information:

- Telephone number of the local ISDN port.
- Destination telephone numbers, including any telephone extensions.
- Type of switch to which the ISDN interface is connected. See "Switches/Services Supported" for the list of switches.

Note: Additional parameters, such as TEI and SPID may be required based on your Switch Type and your service provider.

Configuration Procedures

This section describes how to configure your ISDN interface and its associated dial circuits. Specifically, the tasks you need to perform are:

1. Adding ISDN addresses
2. Configuring ISDN parameters
3. Configuring the ISDN Interface

4. Adding dial circuits
5. Configuring dial circuits

Note: You must restart the router for configuration changes to take effect.

Adding ISDN Addresses

You need to add an ISDN address for each ISDN interface as well as for each destination. The ISDN address includes:

- *Address Name.* The address name is a description of the address. You can use any string of up to 23 printable ASCII characters.
- *Network Dial Address.* Telephone number of the local or destination port. You can enter up to 25 numbers as well as 6 characters, including punctuation. The router uses only the numbers.
- *Network Subdial Address.* Optional. This is an additional part of telephone number, such as an extension, that is interpreted once the interface connects to a PBX. You can enter up to 20 numbers, as well as 11 additional spaces and punctuation. The router uses only the numbers.

To add an ISDN address, enter the **add isdn-address** command at the Config> prompt. For example:

```
Config>add isdn-address
Assign address name [23] chars []? baltimore
Assign network dial address [1-15 digits] []? 1-555-0983
Assign network subdial address [1-20 digits] []? 23
```

To see a list of your ISDN addresses, enter **list isdn-address** at the Config> prompt.

To delete an ISDN address from your list, enter the **delete isdn-address** command at the Config> prompt.

Configuring ISDN Parameters

Access the ISDN Config> prompt. To access the ISDN Config> prompt, enter the **network** command followed by the interface number of the ISDN interface at the Config> prompt. For example:

```
Config>network 3
ISDN user configuration
ISDN Config>
```

You can use the **list devices** command at the Config> prompt to display a list of interface numbers configured on the router. See “ISDN Configuration Commands” on page 675 for more information about configuration commands.

1. Specify the type of switch/service to which this ISDN interface is connected. Use the **set switch-variant** command to specify the type of switch to which this ISDN interface is connected. See “Switches/Services Supported” on page 668 for the list of switches/services. For example:

```
ISDN Config>set switch net5
```

This is the software type running at the switch (for example, DMS100 means running DMS100 Custom software).

2. Specify the network address name of the local port.

Using ISDN

Use the **set local-address-name** command to specify the network address name of the local port. You must use one of the address names you defined using the **add isdn-address** command. For example:

```
ISDN Config> set local-address-name
Assign local address name []? baltimore
```

Note: This is what we will send in the Calling Party Number field of the ISDN Setup message.

3. Set the directory number of the local port.
4. To set the frame size, use the **set framesize** command. For example:

```
ISDN Config> set framesize
Framesize in bytes (1024/2048/4096/8192) [1024]? 2048
```

Note: If you choose a frame size of 1024, PPP will not work over the ISDN dial circuit, since the minimum frame size for PPP is 1500.

For more information about setting the ISDN framesize, see “Set” on page 676.

Optional ISDN Parameters

This section describes optional ISDN parameters you can set. For a complete description of these commands see “ISDN Configuration Commands” on page 675.

- For all ISDN switches except INSPRI, you can configure the limit for the number of calls to an address. Use the **set retries-call-address** command to set the number of calls to a non-responding destination. Use the **set timeout-call-address** command to set the time period to wait before trying the call again.

When you have finished configuring the ISDN interface, you can use the **list** command to display your configuration.

Configuring the ISDN Interface

For the ISDN PRI, you need to configure T1/J1 or E1 for each adapter, depending upon the adapter.

T1/J1 PRI Interface

Specify the following T1/J1 parameters:

1. For the T1/J1 PRI interface, line build out specifies the attenuation of the signal transmitted by the router’s T1 port. Specify the lbo (line build out) based on the information provided by the service provider.

```
a= -00.0 dB
b= -07.5 dB
c= -15.0 dB
d= -22.5 dB
```

For example:

```
set int lbo a
```

2. Specify the code, either B8ZS or AMI. B8ZS is default. The service provider provides this information.

For example:

```
set int code AMI
```

3. Specify ZBTISI- Zero Byte Time Slot Inversion, either ENABLED or DISABLED. The default is DISABLED. The service provider provides this information.

For example:

```
set int ZBTISI enabled
```

4. Specify the esf-data-link. Select one of the following based on the service subscription:

ANSI-T1.403 ANSI-IDLE AT&T-IDLE

Default is ANSI-T1.403

For example:

```
set int esf-data-link ansi-idle
```

E1 PRI Interface

For the E1 PRI interface, specify the following parameters:

1. Specify the code, either HDB3 or AMI. HDB3 is default. The service provider provides this information.

For example:

```
set int code HDB3
```

2. Specify the crc4, either ENABLED or DISABLED. Default is ENABLED. The service provider provides this information.

For example:

```
set int crc4 enabled
```

Adding Dial Circuits

Dial circuits are mapped to ISDN interfaces. You can map multiple dial circuits to one ISDN interface.

To add a dial circuit, enter the **add device dial-circuit** command at the Config> prompt. The software assigns an interface number to each circuit. You will use this number to configure the dial circuit. For example:

```
Config>add device dial-circuit
Enter the number of PPP Dial Circuit interfaces [1]?
Adding device as interface 6
Base net for the circuits(s) [0]?
```

The number of dial circuits that can be configured depends on the total number of parameters to be configured and the size of the resulting configuration file.

Note: Dial circuits default to point-to-point (PPP) protocol. To change the dial circuit protocol to Frame Relay, enter the **set data-link fr** command at the Config> prompt. . Other data-link types (X.25, SDLC, and SRLY) are not supported over ISDN.

Configuring Dial Circuits

This section describes how to configure a dial circuit.

1. Display the Circuit Config> prompt by entering the **network** command followed by the interface number of the dial circuit. You can enter the **list devices** command at the Config> prompt to display a list of the interface numbers configured on the router. For example:

Using ISDN

```
Config> network 6
Circuit configuration
Circuit Config>
```

2. Map the dial circuit to an ISDN interface. Use the **set net** command. The Base net is the ISDN interface number. (This is needed only if you are changing the base net.) For example:

```
Circuit Config> set net
Base net for this circuit [0]? 3
```

Note: If the dial circuit data link type is X.25 or the base net switch variant is 1.43x or channelized, the following steps (3-11 on page 673) do not apply.

3. Specify the address name of the remote router to which the dial circuit will connect. You must use one of the names you defined using the **add isdn-address** command. For example:

```
Circuit Config> set destination
Assign destination address name []? baltimore
```

4. Configure the dial circuit to initiate outbound calls only, accept inbound calls only, or to both initiate and accept calls.

Use the **set calls** command. For example:

```
Circuit Config> set calls outbound
Circuit Config> set calls inbound
Circuit Config> set calls both
```

Note: For WAN-Restoral operations or dial-on-demand applications, you should set up the circuit for either inbound or outbound calls.

5. Specify the timeout period for the circuit.
Use the **set idle** command. If there is no traffic over the circuit for this specified time period, the dial circuit hangs up. To configure the circuit as a dedicated circuit, set the idle timer to zero. To configure the circuit to dial on demand, set the idle timer to a value other than zero. The range is 0 to 65535 and the default is 60 seconds. For example:

```
Circuit Config> set idle
Idle timer (seconds, 0 means always active) [0]? 0
```

Note: WAN restoral/reroute must be fixed.

6. Optionally, you can provide a LID name to send (instead of the default LID, which is the destination name) by specifying a `lid_out_addr`.

When more than one circuit is configured between two routers (parallel circuits), there must be a way to know which dial circuit connects them. For this purpose, a `lid_out_addr` is sent from the router at one end (the caller). The receiving router must have an inbound destination address that matches the `lid_out_address` on the sending router in order for the dial circuits to connect. The `lid_out_addr` must be an address name that has been previously added using "ADD ISDN-ADDRESS" at the **config>** prompt.

```
Circuit Config> set lid_out_addr router2
```

7. Optionally, you can set the relative priority of dial circuits.

The priority field allows a circuit to preempt another when no channels are available. If an outbound call is made and all the channels are in use, then the priority of the requesting dial circuit is checked against all the active dial circuits. If there is one whose priority is lower than this, then that circuit is disconnected and a call is made for the higher priority dial circuit.

Note: Only outbound dial-on-demand circuits will be brought down.

See “Set” on page 692 for more information about priority.

```
Circuit Config> set priority 1
```

- Optionally, you can delay the time between when a call is established and the initial packet is sent. Use the **set selftest-delay** command. Some ISDN switches start to send data before receiving a signal indicating the complete establishment of the circuit at the destination. Setting a selftest delay can prevent initial packets from being dropped. For example:

```
Circuit Config> set selftest-delay
Selftest delay(milli-seconds,0 means no delay) [150]?200
```

- Set the inbound address name.

Use the **set inbound** command. This command is for inbound circuits only. For example:

```
Circuit Config> set inbound
Assign destination inbound address name [ ]? newyork
```

The inbound destination number is used to match the incoming LID or CallerID with the dial circuit. If there is a match that dial circuit gets the call.

- Optionally, you can enter the configuration process for the data-link layer protocol that is running on the dial circuit (PPP or Frame Relay).

Use the **encapsulator** command. For example:

```
Circuit Config> encapsulator
```

- Optionally, you can use the **set bandwidth** command to set the line speed at which to make the call (either 56-Kbps or 64-Kbps). This provides per-call control for ISDN interfaces. For example:

```
Circuit Config> set bandwidth 56Kbps
```

I.431 Switch Variant

Code the switch variant as I.431 when running a leased line over ISDN PRI (T1/J1 only).

Native I.431 Support

When configuring for Native I.431 support, only one dial circuit should be used. It should be attached to the base net. The I.431 only runs on the ISDN PRI T1 adapter. The speed is fixed at 1.5 Mbps.

Note: The multiport ISDN PRI adapters do not support the I.431 switch variant. To utilize a full PRI line, select the channelized variant and assign all the timeslots to one dial circuit.

Example: Base ISDN net

```
Config> n 5
ISDN Config> set sw i431
ISDN Config> list all
ISDN Configuration
Maximum frame size in bytes    = 2048
Switch Variant                  = I431 PRI
```

Example: Dial Circuit

Using ISDN

```
Config> n 6  
Circuit config: 6>set net 5  
Circuit config: 6>list all
```

```
Base net = 5
```

Chapter 49. Configuring and Monitoring the ISDN Interface

This chapter describes the ISDN commands and GWCON commands. It includes the following sections:

- “ISDN Configuration Commands”
- “Accessing the Interface Monitoring Process” on page 680
- “ISDN Monitoring Commands” on page 681
- “ISDN and the GWCON Commands” on page 686

Notes:

1. ISDN interfaces have both ELS messages and cause codes that you can use to monitor ISDN-related activity. See *Event Logging System Messages Guide*
2. The ISDN, Q931, CEME, LAPD, and DIAL ELS subsystems are available.

ISDN Configuration Commands

Table 95 describes the ISDN configuration commands, and the following sections explain the commands. Enter these commands at the ISDN Config> prompt.

Table 95. ISDN Configuration Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Block-calls	Blocks incoming calls from a specific caller.
Disable	Valid only for BRI. Disables Power Source 1 detection.
Enable	Valid only for BRI. Enables Power Source 1 detection.
List	Displays the ISDN configuration.
Remove	Removes DN0 entries from the ISDN configuration.
Set	Sets the frame size, local address, no-answer timeouts, number of retries after no answer, type of ISDN switch, directory numbers, SPIDS, and TEI.
Cause Code	Stops further processing attempts to establish a connection through an interface.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Block-Calls

Use the **block-calls** commands to block incoming calls. Caller numbers to be blocked must be added to the authentication list. The maximum number of caller blocked calls is 16 per interface.

Call block can be used for:

- An unsolicited call being constantly received.
- Network bringup/test where you need to ignore certain calls.

Syntax:

```
block-calls          _add  
                        _list  
                        _remove
```

ISDN Configuration Commands

- Add** Adds a caller's number to be blocked.
- List** Lists the callers' numbers to be blocked.
- Remove**
Removes a caller's number for the list to be blocked.

List

The **list** command displays the current ISDN configuration.

Syntax:

list

Example: list

```
ISDN Configuration
Local Network Address Name      = local2216
Local Network Address:Subaddress = 2542216:

Maximum frame size in bytes     = 2048
Outbound call address Timeout   = 180 Retries = 2
Switch Variant                  = NT DMS-250
DN0 (Directory Number 0)       = 2542216
No circuit address accounting information being kept.

T1/J1 Interface Parameters:

LBO                             = 00.0 dB
Code                             = B8ZS
ZBTSI                            = Disabled
ESF-Data-Link                    = ANSI-IDLE
```

Remove

The **remove** command lets you remove DN0 or DN1 entries that you set previously with the **set DN0** or **set DN1** command.

Syntax:

remove DN0-entry...

Example:

```
remove DN0
```

Set

The **set** command configures frame size, addresses, and timeouts. It also specifies the switch-variant and TEI number. For PRI, the terminal endpoint identifier (TEI) is always zero (0).

Syntax:

set framesize...
frame-type¹
interface
local-address-name...

ISDN Configuration Commands

RAI-type¹
retries-call-address...
switch-variant...
dn0...

framesize 1024 or 2048 or 4096 or 8192

Sets the size of the network layer portion of frames transmitted and received on the ISDN interface. Data link and MAC layer headers are not included. You must set the ISDN frame size so that it is greater than or equal to the frame size configured for the dial circuits using the ISDN interface.

For PPP dial circuit interfaces, you can change the PPP MRU using the **set lcp options** command. The ISDN frame size must include enough bytes for the PPP MRU and the PPP header.

Note: If you choose a frame size of 1024, PPP will not work over the ISDN dial circuit, since the minimum frame size for PPP is 1500.

For FR dial circuit interfaces, you can change the frame size using the **set framesize** command. The ISDN frame size must be greater than or equal to the FR frame size.

If a dial circuit's frame size is greater than the ISDN frame size, then the dial circuit's frame size is decreased at router initialization.

Example:

```
set framesize
Framesize in bytes (1024/2048/4096/8192) [1024]? 2048
```

frame-type

Choices are D4 or ESF. This specifies the T1 multiframe format. Only ESF is supported for non-channelized mode. Frame type is configured under the base ISDN net menu.

Example:

```
set frame-type
Circuit config: 10>set frame type
```

interface

For PRI only. Sets the following interface parameter values for T1 and E1 lines.

For T1 PRI:

lbo The attenuation of the signal transmitted by the router's T1 port. This information is provided by the service provider.

Valid Values:

a= -00.0 dB
b= -07.5 dB
c= -15.0 dB
d= -22.5 dB

Default Value: a

1. Channelized only

ISDN Configuration Commands

code This information is provided by the service provider.

Valid Values: B8ZS or AMI

Default Values: B8ZS

ZBTSI Zero Byte Time Slot Inversion. This information is provided by the service provider.

Valid Values: Enabled or Disabled

Default Value: Disabled

esf-data-link

The service subscription. This information is provided by the service provider.

Valid Values:

ANSI-T1.403

ANSI-IDLE

AT&T-IDLE

Default Value: ANSI-T1.403

For E1 PRI:

code This information is provided by the service provider.

Valid Values: HDB3 or AMI

Default Value: HDB3

crc4 Specifies whether the router's E1 port will transmit crc4 code words and check them in the received frames. This information is provided by the service provider.

Valid Values:Enabled or Disabled

Default Value:Disabled

local-address-name *address name*

This is the network address name of the local ISDN interface. This address name must match one of the names that you defined at the Config> prompt using the **add isdn-address** command.

Valid Values: Any valid address

Default Value: None

Example:

```
set local-address-name  
Assign local address name [ ]? line-1-local
```

RAI-type

Choices are ANSI or Japanese. This specifies the method of indicating RAI on the T1 line when using D4 framing. ANSI RAI is indicated by a value of 0 in bit 2 of all channels. Japanese RAI is indicated by a value of 1 in the S-bit position of frame 12. RAI type is configured under the base ISDN net menu.

retries-call-address *value*

Some telephone service providers impose restrictions on automatic recalling devices to limit the number of successive calls to an address that is inaccessible or that refuses those calls. **Retries-call-address** specifies the

ISDN Configuration Commands

maximum number of calls the router attempts to make at one time. Setting **retries-call-address** to 0 causes the router to bring up all circuits at once.

If you set the switch-variant to INS64, you cannot change the **retries-call-address** default. It is fixed at 2.

Valid Values: 0 to 30

Default Value: 23 (2 for BRI)

switch-variant *4ess or 5ess or auspri usni2 or ins1500 or dms250 or channel*
Specifies the model of the switch to which this ISDN interface is connected. You can choose switch-variants/service type for the ISDN Primary Rate interface from the following lists.

Valid Values ISDN Primary Rate Interface (PRI)/Channelized T1/E1:

- AT&T 5ESS (North America)
- AT&T 4ESS (North America)
- Australia (AUSTEL)
- INS-Pri (Japan, NTT)
- National ISDN 2 (North America)
- NET 5 (Euro-ISDN, ETSI)
- Northern Telecom 250 (DMSPRI)
- Native I.431
- Channelized T1/E1

Default Value: DMSPRI

dn0 *directory number 0*

To accept inbound calls **DN0** must match the network dial address (telephone number) you configured using the **set local-address-name** command. If DN0 is not configured no check is made and all calls will be accepted. If the switch does not provide the called party number in the incoming setup message, DN0 should not be configured. See on page 679 for additional information.

Example:

```
set dn0
Enter DN0 (Directory-Number-0) [ ]? 5088981234
```

Note: This applies to all Basic Rate ISDN switch variants:

- DN0, and DN1 are used to verify that the incoming call is being delivered to the correct ISDN destination.
- If the destination number (Called Party Number) in the ISDN call being delivered does not match either DN0 or DN1, then the call is rejected.
- If the user wishes to bypass the destination verification checking, then do not configure either DN0, or DN1. If the ISDN line provisioning has only one DN, and the user wishes to use the destination verification then you must configure DN0. Do not configure DN1 unless the ISDN line is provisioned for two DNs.
- When configuring the SPIDs and TEIs, always be sure to configure the first SPID (SPID[0]) and TEI (TEI[0]). It will cause errors if you have a SPID[1] or TEI[1] configured without SPID[0] or TEI[0] configured.

ISDN Configuration Commands

Cause Code

Use the **Cause Code** command to prevent the router from retrying to establish a connection through the ISDN interface when it receives a “specified” (valid value) response. Enter these commands at the Cause Config> prompt.

Syntax:

```
cause code                ? (Help)
                             add
                             list
                             remove
                             exit
```

Table 96. ISDN Cause Codes Command Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Add	Adds cause code entries to the ISDN configuration.
List	Displays the cause code lists for the ISDN configuration.
Remove	Removes cause code entries from the ISDN configuration.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Add Use the **add** command to add a cause code to an ISDN configuration.

Valid Values: Any hexadecimal value between 01 and FF

Default Value: None

Syntax: cause code add *value*

Example: add FF

List Use the **list** command to show the cause code list of an ISDN configuration.

Syntax: cause code list

Remove

Use the **remove** command to remove a cause code from an ISDN configuration.

Valid Values: Any hexadecimal value between 01 and FF

Default Value: None

Syntax: cause code remove *value*

Example: remove FF

Accessing the Interface Monitoring Process

To access the interface monitoring process for ISDN, enter the following command at the GWCON (+) prompt:

```
+ network #
```

Where # is the number of the ISDN interface. You cannot directly access the monitoring process for dial circuits, but you can monitor the dial circuits that are mapped to the ISDN interface.

ISDN Monitoring Commands

The following sections explain the ISDN operating commands which allow you to view the accounting entries, calls, circuits, parameters, and statistics of the ISDN interfaces. Enter these commands at the ISDN> prompt.

Table 97. ISDN Monitoring Command Summary

Monitoring Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Block-calls	Blocks incoming calls from a specific caller.
Calls	Displays the number of completed and attempted connections made for each dial circuit mapped to this interface since the last time statistics were reset on the router.
Channels	Displays the statistics for the channels on the ISDN Primary Rate Interface.
Circuits	Displays the status of all data circuits configured on the ISDN interface.
Dial-dump	Displays the operation characteristics of the specified dial circuit.
L2_counters	Lists the L2/L1 states along with some L2 counters.
L3_counters	Lists counters of set ups sent/received/accepted.
TEI	Lists status of TEI's (BRI only)
Parameters	Displays the current parameters for the ISDN interface.
Signaling-L3	This command is to be used only by product support personell.
Statistics	Displays the current statistics for the ISDN interface.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Block-Calls

Use the **block-calls** commands to block incoming calls. Caller numbers to be blocked must be added to the authentication list. The maximum number of caller blocked calls is 16 per interface.

Syntax:

```
block-calls          add
                       list
                       remove
```

Add Adds a caller's number to be blocked.

List Lists the callers' numbers to be blocked.

Remove

Removes a caller's number for the list to be blocked.

ISDN Monitoring Commands

Calls

Use the **calls** command to list the number of completed and attempted connections made for each dial circuit mapped to this interface since the last time statistics were reset on the router.

Syntax:

calls

Example:

```
calls
Net Interface Site Name      In   Out  Rfsd  Blckd
  4   PPP/1  v403                2    0    0     0
```

Unmapped connection indications: 0

Net Number of the dial circuit mapped to this interface.

Interface

Type of interface and its instance number.

Site Name

Network address name of the dial circuit.

In Inbound connections accepted for this dial circuit.

Out Completed connections initiated by this dial circuit.

Rfsd Connections initiated by this dial circuit that were refused by the network or the remote destination port.

Blckd Connection attempts that the router blocked. The router blocks connection attempts if all available channels are in use, if the maximum retries are used up and the router is waiting for the timer to count down, or if layer 1 is up, but layer 2 is down.

Unmapped connection indications:

Connection attempts that were refused by the router because there were no enabled dial circuits that were configured to accept the incoming calls.

Channels

The **channels** command lists the statistics for a channel on the ISDN Primary Rate Interface.

Syntax:

channels

Circuits

The **circuits** command shows the status of the dial circuits configured on the ISDN interface that are in the state of "Up" or "Available".

Syntax:

circuits

Example:

ISDN Monitoring Commands

circuit

Net	Interface	MAC/Data-Link	State	Reason	Duration
4	PPP/1	Point to Point	Up B1	SelfTest	91:24:03
5	PPP/2	Point to Point	Up B2	Inbound	91:24:00

Net Number of the dial circuit mapped to this interface

Interface

Type of interface and its instance number.

MAC/Data-Link

Type of data-link protocol configured for this dial circuit.

State Current state of the dial circuit:

Up Currently connected.

Available

Not currently connected, but available.

Disabled

Dial circuit disabled.

Down Failed to connect because of a busy dial circuit or because the link-layer protocol is down.

Reason

Reason for the current state:

nnn_Data

(Where nnn is the name of a protocol.) The circuit is up because a protocol had data to send.

Rmt Disc

Remote Disconnect. The circuit is either down or available because the remote destination disconnected the call.

Opr Req

Operator Request. The circuit is available because the last call was disconnected by a monitoring command.

Inbound

The circuit is up because the circuit answered an inbound call.

Restoral

The circuit is up because of a WAN-Restoral operation.

Self Test

The circuit was configured as static (idle time=0) and successfully connected once it was enabled.

Duration

Length of time that the circuit has been in the current state.

Dial-dump

Use the **dial-dump** command to display the operation characteristics of the specified dial circuit.

Syntax:

dial-dump *circuitname*

ISDN Monitoring Commands

L2_Counters

Use the **L2_counters** command to list the L2/L1 states along with some L2 counters.

Syntax:

L2_counters

L3_Counters

Use the **L3_Counters** command to list counters of set ups sent/received/accepted.**Syntax:**

L3_counters

TEI

Use the **TEI** command to list the status of TEIs. For BRI only.

Syntax:

parameters

Example:

parameters

ISDN Port parameters:

```
Local Address Name:      v1233
Local Network Address:   20
Local Network Subaddress:
Frame Size:              2048
TEI 0:                   Automatic
TEI 1:                   Automatic
```

```
Switch Variant:         AT&T 5ESS (United States)
Multipoint Selection:   Multipoint
Directory Number 0:     20
Outbound call address Timeout: 180      Retries: 0
```

Parameters

Use the **parameters** command to display the current ISDN configuration.

Syntax:

parameters

Example:

parameters

ISDN Port parameters:

```
Local Address Name:      v1233
Local Network Address:   20
Local Network Subaddress:
Frame Size:              2048
TEI 0:                   Automatic
TEI 1:                   Automatic
```

```
Switch Variant:         AT&T 5ESS (United States)
```



```

Multipoint Selection: Multipoint
Directory Number 0: 20
Outbound call address Timeout: 180 Retries: 0
  
```

Statistics

Use the **statistics** command to display the current statistics for this ISDN interface.

Syntax:

statistics

Example for PRI with E1:

```

statistics
Link: Active ISDN Firmware: 1.0 Handler State: Running

Transmit D Channel Receive D Channel
Packets 68422 Packets 68419
Bytes 411656 Bytes 413592
Overflow 23 Overflow 3
Underrun 0 Too Long 6
Abort 4
CRC error 8
Misaligned 3

Transmit B Channels Receive B Channels
Packets 1499094 Packets 1499228
Bytes 59955660 Bytes 59951780
Overflow 0 Overflow 90
Underrun 0 Too Long 171
Abort 139
CRC error 232
Misaligned 72

E1 Status Register E1 Error Count Registers
Receive AIS : Off CRC6 Errors: 4
Receive RAI : Off LCV Errors: 38
Receive Carrier Loss: Off FEB Errors: 11
Receive Loss of Sync: Off FAS Errors: 24
  
```

Example for PRI with T1 using I.431:

```

statistics
Transmit Receive
Packets 0 Packets 0
Bytes 0 Bytes 0
Overflow 68480 Overflow 0
Underrun 0 Too Long 0
Abort 0
CRC error 0
Misaligned 0

T1 Status Register T1 Error Count Registers
Receive AIS : Off LCV Errors: 0
Receive RAI : Off CRC6 Errors: 0
Receive Carrier Loss: Off Sync Errors: 47937328
Receive Loss of Sync: On

T1 PRM Events Local Remote
CRC Error 0 0
Controlled Slip 0 0
Line Code Violation 0 0
Frame Sync Bit Error 0 0
Severely Errored Frame 0 0
Payload Loopback Active 0 0
PRMs Processed (1/sec) 0 0
  
```

ISDN and the GWCON Commands

While ISDN has its own monitoring process for monitoring purposes, the router also displays configuration information and complete statistics for devices and circuits when you use the **interface**, **statistics**, and **error** commands from the GWCON environment. You can also use the GWCON **test** command to test DCEs and circuits.

Note: Issuing the **test** command to the ISDN interface causes the current calls to be dropped and re-dialed.

Interface — Statistics for ISDN Interfaces and Dial Circuits

Use the **interface** command at the GWCON prompt (+) to display statistics for ISDN interfaces and dial circuits.

To display statistics for a dial circuit, enter the **interface** command followed by the interface number of the dial circuit. For ISDN interfaces, information is displayed on a D and B channel basis. (This is the same information that is displayed by the ISDN **statistics** command.)

Example:

interface 2

Nt Nt'	Interface	Slot-Port	Self-Test	Self-Test	Maintenance
2 2	ISDN/0	Slot: 8 Port: 1	Passed	Failed	Failed
			1	0	0

ISDN Base Net MAC/data-link on ISDN Primary Rate interface
 Link: Active ISDN Firmware: 1.0 Handler State: Running

Transmit	D Channel	Receive	D Channel
Packets	36	Packets	36
Bytes	214	Bytes	214
Overflow	0	Overflow	0
Underrun	0	Too Long	0
		Abort	0
		CRC error	0
		Misaligned	0

Transmit	B Channels	Receive	B Channels
Packets	0	Packets	0
Bytes	0	Bytes	0
Overflow	0	Overflow	0
Underrun	0	Too Long	0
		Abort	0
		CRC error	0
		Misaligned	0

T1 Status Register	T1 Error Count Registers
Receive AIS : Off	LCV Errors: 0
Receive RAI : Off	CRC6 Errors: 0
Receive Carrier Loss: Off	Sync Errors: 0
Receive Loss of Sync: Off	

T1 PRM Events	Local	Remote
CRC Error	0	0
Controlled Slip	0	0
Line Code Violation	0	0
Frame Sync Bit Error	0	0
Severely Errored Frame	0	0
Payload Looback Active	0	0
PRMs Processed (1/sec)	365	367

ISDN and the GWCON Commands

To display the following statistics for a dial circuit, use the **interface** command followed by the interface number of the dial circuit.

Example:

```
interface 3
Nt Nt' Interface           Self-Test Passed Self-Test Failed Maintenance Failed
3 2  PPP/1                 1             0             0
Point to Point MAC/data-link on ISDN Primary Rate interface
```

The following list describes the output for both ISDN and dial circuits.

Nt Serial line interface number or dial circuit interface number.

Nt' If *Nt* is a dial circuit, this is the interface number of the ISDN interface to which the dial circuit is mapped.

Interface

Interface type and its instance number.

Slot The slot that contains the ISDN adapter

Port The port number on the ISDN adapter.

Self-Test Passed

Number of self-tests that succeeded.

Self-Test Failed

Number of self-tests that failed.

Maintenance: Failed

Number of maintenance failures.

Configuration - Information on Router Hardware and Software

Enter the **configuration** command at the GWCON (+) prompt to display information about the router hardware and software. It includes a section that displays the interfaces configured on the router along with the state of the interface.

If a dial circuit is configured to dial-on-demand, the state of the dial circuit is always displayed as Up whether or not it is connected. In this case Up means that the dial circuit is either connected or available.

If a dial circuit is configured as a static circuit, the state indicates Up only if the dial circuit is connected. (Refer to "Configuration" on page 108 for a sample output from the **configuration** command.)

ISDN and the GWCON Commands

Chapter 50. Configuring and Monitoring Dial Circuits

This chapter describes how to configure dial circuits on a dial circuit interface mapped to a V.25bis or ISDN interface. It contains the following sections:

- “Dial Circuit Configuration Commands”
- “Dial Circuit Monitoring Commands” on page 695

Notes:

1. PPP dial circuit interfaces can use an ISDN or V.25bis network as the base-network interface.
2. FR dial circuit interfaces can use an ISDN or a V.25bis network as the base network interface.
3. Switched SDLC Call-In dial circuit interfaces use a V.25bis network as the base-network interface.
4. X.25 circuits can be used over ISDN D-channels for BRI.

For information on how to configure dial circuits for use with:

- ISDN interfaces, see “Chapter 48. Using the ISDN Interface” on page 661.
- V.25bis interfaces, see “Chapter 46. Using the V.25bis Network Interface” on page 645 .

Dial Circuit Configuration Commands

Table 98 describes the dial circuit configuration commands. Enter the dial circuit configuration commands at the `Circuit Config>` prompt. You must restart the router for configuration changes to take effect.

To access the `Circuit Config>` prompt, enter the **network** command followed by the interface number of the “dial circuit”. (The dial circuit number was assigned when you entered the **add device dial-circuit** command.) You can enter the **list devices** command at the `Config>` prompt to display a list of the dial circuits that you added.

Table 98. Dial Circuit Configuration Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See “Getting Help” on page 10.
Delete	Deletes the inbound call settings from the dial circuit configuration.
Encapsulator	Allows you to change the data-link protocol configuration.
List	Displays the dial circuit configuration parameters.
Set	Configures the dial circuit for inbound or outbound calls, maps the dial circuit to a serial line interface, and sets addresses, idle timeout, priority, lid_out address, inbound destination, and self-test delay.
Exit	Returns you to the previous command level. See “Exiting a Lower Level Environment” on page 11.

Configuring Dial Circuits

Delete

Use the **delete** command to remove the inbound call settings from the dial circuit configuration.

Syntax:

delete *inbound destination*

inbound destination

Removes both the INBOUND destination and the ANY_INBOUND settings from the dial circuit configuration. This causes the dial circuit to accept calls only from callers that have a phone number that matches the *destination* parameter.

Encapsulator

Use the encapsulator command to enter the configuration process for the link-layer protocol (for example, PPP, Frame Relay, X.25, SDLC) that is running on the dial circuit interface.

Note: The default for a dial circuit interface created via the **add device dial-circuit** command is PPP. To change the link layer type, at the Config> prompt:

- For Frame Relay, enter **set data-link frame-relay**.
- For SDLC, enter **set data-link sdlc**.

Syntax:

encapsulator

The following example shows that the PPP configuration process is entered when the encapsulator command is used for a PPP dial circuit interface.

Example:

```
encapsulator
Point-to-Point user configuration
PPP Config>
```

Be aware of the following when you configure a dial circuit that uses a V.25bis interface as the base network:

- The V.25bis interface pre-defines clocking as external. The modem (DCE) controls the clock speed. You cannot configure clocking, encoding, and other HDLC parameters as part of the dial circuit configuration.

Be aware that you cannot configure HDLC parameters of the dial circuit configuration when you configure PPP or Frame Relay for ISDN. Physical layer parameters are configured on the ISDN interface.

For information on configuring the PPP protocol, refer to “Chapter 32. Configuring Serial Line Interfaces” on page 399 or refer to “Chapter 39. Using Point-to-Point Protocol Interfaces” on page 531.

For information on configuring the Frame Relay protocol, see “Chapter 37. Using Frame Relay Interfaces” on page 469 or “Chapter 38. Configuring and Monitoring Frame Relay Interfaces” on page 487.

Configuring Dial Circuits

For information on configuring or monitoring SDLC interfaces, see “Chapter 44. Using SDLC Interfaces” on page 621 or “Chapter 45. Configuring and Monitoring SDLC Interfaces” on page 623.

For information on configuring or monitoring X.25 interface, see “Chapter 34. Configuring and Monitoring the X.25 Network Interface” on page 409.

To return to the `Circuit Config>` prompt, use the **exit** command.

List

Use the **list** command to display the current dial circuit configuration.

For more information about I.430 and I.431, see “I.431 Switch Variant” on page 673.

Syntax:

list

Example:

Note: Options listed depend upon the type of interface used. All options may not be shown for all interface types.

```
list
Any inbound          set
Bandwidth:           64
Base net:             1
Callback:            yes
Calls:               inbound
Destination name:    remote-site-sanfrancisco
Idle char:           7E
Idle timer:          = 60 sec
Inbound calls        allowed
Inbound dst name:    local-1
LID out address:     1234
LID used:            enabled
Net #:               2
Outbound calls       allowed
Priority:             8
SelfTest Delay Timer: = 0 ms
Time slot:           1 4 5 8
```

Any inbound

Displays this setting when inbound calls that do not match any other dial circuit are mapped to this circuit and accepted as inbound calls.

Bandwidth

Displays the bandwidth value in Kbps.

Base net

Displays the name of the serial line interface to which this dial circuit is mapped.

Callback

Displays the setting of this option.

Calls Displays the setting of this option.

Destination name

Displays the network address name to be called for outbound circuits, and the default comparison address used by the LID mechanism for inbound calls.

Configuring Dial Circuits

Idle char

Displays the idle character used for I.43x or channelized circuits.

Idle timer

Displays the idle timer setting in seconds. The range is 0 to 65535; 0 indicates that this is a dedicated circuit (leased line).

Inbound calls allowed

Displays this parameter when the circuit is configured to accept inbound calls.

Inbound dst name

Displays this parameter if the circuit is configured to accept inbound calls that do not match any other addresses. This is an alternate comparison address name used by the LID mechanism for inbound calls.

LID out address

Displays the name of the dial circuit connecting the routers.

LID used

Displays the setting of this option.

Net # Displays the base circuit number.

Outbound calls allowed

Displays this parameter when the circuit is configured to initiate outbound calls.

Priority

Displays the setting of this parameter.

SelfTest Delay Timer

Displays the self-test delay timer setting in milliseconds. The range is 0 to 65535; 0 indicates no delay.

Time slot

Displays the list of slots to use for this dial circuit.

Set

Use the **set** command to map the dial circuit to an interface (for example: ISDN or V.25bis), configure the dial circuit for inbound and/or outbound calls, and set destination addresses, inbound addresses, idle timeout, and self-test delay.

Note:

Notes:

1. If you are running SDLC, I.430, I.431, Channelized, or X.25 on a dial circuit, you will be unable to use the **set** command to change the following parameters as the software will use specific defaults:
 - Any_inbound - any_inbound is set
 - Calls - inbound
 - Destination - default address
 - Inbound destination - no destination inbound address
 - Idle - 0
 - Lid_out_addr - no LID name
 - Lid_used - disabled
 - Priority - 8

- Self_test_delay

Syntax:

```

set          any_inbound
             bandwidth...
             callback...
             calls...
             destination...
             idle...
             idle-char...
             inbound destination...
             lid_out_addr...
             lid_used...
             net...
             priority...
             selftest-delay...
             timeslot...
  
```

any_inbound

Specifies that inbound calls that do not match any other dial circuit will be mapped to this circuit and accepted as inbound calls.

bandwidth *kbps*

Sets the bandwidth, in Kbps, for I.430 and Channelized T1/E1 circuits.

Valid values:

For I.430: 64 or 128

For Channelized: 56 or 64

Default value: 64

callback [*Yes or No*]

The callback feature uses the callers telephone number to verify the call against an authentication table and then disconnects the incoming call. Callback then makes an outgoing call to the same caller. Callback should always be disabled. The default is no.

calls [*outbound or inbound or both*]

Restricts this dial circuit to initiating outbound calls only, accepting inbound calls only, or both initiating and accepting calls. The default is both.

destination *address_name*

This parameter is required for the dial circuit to operate. It specifies the network dial address of the remote router to which this dial circuit will connect. The LID protocol uses this parameter as the default comparison address for incoming calls. This parameter must match an address name that you assigned using the Config> prompt with either the **add isdn address** command or the **add v25-bis address** command.

Example: set destination remote-site-sanfrancisco

Configuring Dial Circuits

idle # of seconds

Specifies a timeout period for the circuit. If there is no protocol traffic over the circuit for this specified time period, the dial circuit hangs up. The range is 0 to 65535, and the default is 60 seconds. A setting of zero specifies that there is no timeout period and that this is a dedicated circuit.

Notes:

1. For WAN Restoral operations, you must set the idle timeout to 0.
2. On a I.43x, X.25 or Channelized circuit, you cannot set this parameter.

idle-char

Specifies the idle character used for I.43x or channelized circuits.

Note: You cannot configure this parameter for regular ISDN circuits.

Valid values: 7E or FF

Default value: 7E

Example: set idle-char 7E

inbound-destination address_name

Set this parameter if the dial circuit is set up for both inbound and outbound calls and if this router's local dial address is different from the destination dial address that the remote router dials. For example, the numbers would be different if one of the routers must go through a PBX, international, or inter-LATA exchange. This parameter must match an address name that you assigned at the Config> prompt with either the **add isdn address** command or the **add v25-bis address** command. The inbound destination number is used to match the incoming LID or CallerID with the dial circuit. If there is a match that dial circuit gets the call.

Example: set inbound remote-site-1

lid_out_addr address_name

The lid_out_addr is the name of a dial circuit between two routers. When more than one circuit is configured between two routers (parallel circuits), then there needs to be a way to unambiguously know which dial circuit connects between them. For this purpose, a lid_out_addr is sent from the router at one end (the caller). At the receiving end the other router configures the same string as the inbound destination name. The lid_out_addr must be an address name that has previously been added using **ADD ISDN-ADDRESS** from the config> prompt.

lid_used [enabled or disabled]

Suppresses the exchange of logical ids for circuits to devices that do not support logical ids.

Valid values: Enabled or disabled

Default value: Disabled

net

Sets the base network number of the interface to the # of the serial line interface to which you want to map this circuit.

Example:

```
Circuit Config> set net
Base net for this circuit [ ]? 2
```

priority

The priority field allows an outbound dial-on-demand circuit to preempt another when no channels are available. If a call request is made and all the channels are in use, then the priority of the requesting dial-on-demand circuit is checked against all the active dial-on-demand circuits. If there is an outbound dial-on-demand circuit with lower priority, then that circuit is disconnected and a call is made for the higher priority dial-on-demand circuit. Only the priority on the outbound end of a connection is considered. An inbound dial-on-demand call will not be taken down in favor of a higher priority outbound call. An inbound dial-on-demand call cannot cause a lower priority call to be taken down.

selftest-delay # of milliseconds

Use this parameter to delay the time between when the call is established and the time when the initial packet is sent. Setting a selftest-delay can prevent initial packets from being dropped. The range is 0 to 65535, and the default is 150.

For V.25bis dial circuits, adjust this setting if your modems take extra time to synchronize.

For ISDN dial circuits, you may need to adjust this setting for dial-on-demand links because some ISDN switches start to deliver data before signalling the complete establishment of the circuit at the destination end.

timeslot list of slots

Specifies a slot or list of slots to use for this dial circuit. Your service provider will issue the number of the slots you can use for the circuit. Specify the list as slot numbers separated by blanks.

Note: You can only use this parameter for Channelized T1/E1 circuits.

Valid values:

For Channelized T1: 1 to 24

For Channelized E1: 1 to 31

Default value: None

Example: `set timeslot 1 4 5 8`

Dial Circuit Monitoring Commands

Table 99 describes the dial circuit monitoring commands. Enter the dial circuit monitoring commands at the `Circuit Config>` prompt. You must restart the router for monitoring changes to take effect.

Table 99. Dial Circuit Configuration Commands Summary

Command	Function
? (Help)	Displays all the commands available for this command level or lists the options for specific commands (if available). See "Getting Help" on page 10.
Callback	Adds, deletes, or lists the information in the authentication cache.
Exit	Returns you to the previous command level. See "Exiting a Lower Level Environment" on page 11.

Configuring Dial Circuits

Callback

Use the **callback** command to add, delete or list the information in the authentication cache.

Syntax:

```
callback                add  
                          delete  
                          list
```

add Adds a callback number to the authentication lists.

delete Deletes a callback number from the authentication lists

list Lists the callback numbers and other information in the authentication list.

Appendix A. Quick Configuration Reference

Important

If you are attempting to configure or monitor your IBM 2216 and your service terminal is unreadable, see "Service Terminal Display Unreadable" in 2216 Nways Multiaccess Connector Service and Maintenance Manual.

Quick Configuration Tips

Before starting the Quick Configuration process, read these notes:

1. Attach an ASCII terminal to the service port to run the Quick Configuration program. See the *Installation and Initial Configuration Guide*.
2. Any existing configuration for a particular item will be removed if that item is configured through Quick Configuration.
3. Configuration is done at the level of the *interface*, which corresponds to a single *port* on an adapter. Because different types of adapters have differing numbers of ports, you may have to configure up to eight ports to activate all of the interfaces on the adapter (for example, the X.21 adapter, FC 2291).

Note: The ESCON adapter or PCA can have up to 16 virtual interfaces configured on one physical interface. All of the virtual interfaces are associated with a single port.

4. Using the **add device** command, you must "add" all desired network interfaces or virtual interfaces for the adapters installed in your IBM 2216. This must be done prior to running Quick Configuration. To add an interface, see "Add" on page 68 .
5. Using the **network** command, you must enter the network interface configuration information. See "Network" on page 91.

Making Selections

On the panels that you view when using the Quick Configuration program, the information shown in brackets, [], is the default. For example:

Configure Bridging? (Yes, No, Quit): [Yes]

- To use the default Yes, press **Enter**.
- To use a value other than the default, such as No or Quit, choose from the values in the parentheses.
- If no value appears in the brackets, there is no default and you must type a value.

Exiting and Restarting

- To restart the current Quick Configuration section at any time, type **r**. For example, if you are in the Interface Configuration section, type **r** and press **Enter** to return to the beginning of that section.
- To exit Quick Configuration, type **q** and press **Enter**. The Config> prompt will appear.
- To restart Quick Configuration from the Config> prompt, type **qc** and press **Enter**.

When You're Done

- Once you have completed your configuration, you must restart the IBM 2216 for the configuration to take effect. At the end of the Quick Configuration program, you are given this option.

Starting the Quick Configuration Program

The following sections describe sample configurations using the Quick Configuration program (**qconfig**).

To start the quick configuration program, enter **qc** at the Config> prompt.

The program displays the following panel after starting.

```
Router Quick Configuration for the following:
o Bridging
  Spanning Tree Bridge (STB)
  Source Routing Bridge (SRB)
  Source Routing Transparent Bridge (SRT)
o Protocols
  IP (including OSPF, RIP, and SNMP)
  IPX
  DNA (DECnet)

Event Logging will be enabled for all configured subsystems
with logging level 'Standard'

Note: Please be warned that any existing configuration for a particular item
will be removed if that item is configured through Quick Configuration
```

Event logging records system activity, status changes, data transmission and reception, data and internal errors, and service requests. The logging level is set to standard (the default). For more information about error logging, refer to the *Event Logging System Messages Guide*.

During Quick Configuration you can:

1. Configure bridging
2. Configure protocols
3. Restart the router

Configuring LAN Emulation

If you added an ATM device, you will see the following prompts:

```
*****
LAN Emulation Configuration
*****

Type 'Yes' to Configure LAN Emulation
Type 'No' to skip LAN Emulation Configuration
Type 'Quit' to exit Quick Config

Configure LAN Emulation? (Yes, No, Quit): [Yes]
```

You can configure either Token-Ring or Ethernet LAN Emulation clients from this question.

Configuring Bridging

```
*****  
Bridging Configuration  
*****  
  
Type 'Yes' to Configure Bridging  
Type 'No' to skip Bridging Configuration  
Type 'Quit' to exit Quick Config  
  
Configure Bridging? (Yes, No, Quit): [Yes]
```

1. In response to Configure Bridging, take one of the following actions:
 - Enter **y** to display the bridging configuration prompts. The prompts that appear depend on your network configuration.
 - Enter **n** to skip the bridging configuration and continue with quick configuration.
 - Enter **q** to exit quick configuration. This displays the Config> prompt. To reenter quick configuration, enter **qc** after this prompt.
2. If you choose to configure bridging, Spanning Tree Bridging (STB) will be enabled on all LAN interfaces. You will see the following panels:

```
Type 'r' any time at this level to restart Bridging Configuration  
  
STB will be enabled on all LAN interfaces
```

Enter **y** to configure SRT bridging. Otherwise, enter **n**. For each Token-Ring interface in the configuration, you will be prompted to enable Source Routing on the interface.

```
Configure SRT Bridging? (Yes, No): [Yes]  
You are now configuring the Source Routing part of SRT Bridging  
Bridge Number (hex) of this Router (1-F): [A]
```

3. Enter a bridge number, which is a hexadecimal value from 1 to F that is unique between two parallel segments.

```
Interface 0 (Port 1) is of type Token Ring  
Configure Source Routing on this interface (Yes, No): [Yes]
```

4. Enter **y** to configure source routing on the interface. The console displays the next two lines.

```
Configuring Interface 0 (Port 1)  
Segment Number (hex) of this Interface (1-FFF): [A1]
```

Note: The port number increases by one because source routing bridging does not allow a port number of zero.

A unique hexadecimal value from 1 to FFF is assigned to each interface. The interfaces on each ring (segment) have the same segment number, but the segment number is unique to each ring.

These prompts appear for each Token Ring interface.

```
Interface 1 (Port 2) is of type Token Ring
Configure Source Routing on this interface? (Yes, No): [Yes]
Configuring Interface 1 (Port 2)
Segment Number (hex) of this Interface (1-FFF): [A2]
```

If more than two interfaces are configured for source routing, enter a unique hexadecimal value from 1 to FFF unique for the internal virtual segment.

```
Virtual Segment Number (hex) of this Router (1-FFF): [A4]
```

5. A panel similar to the following is displayed:

```
This is all configured bridging information:

Interfaces configured for STB:

Interface #   Port #   Interface Type
-----
0             1       Token Ring
1             2       Token Ring

The Source Routing part of SRT Bridging has been enabled

Bridge Number of this Router: A

Interfaces configured for Source Routing:

Interface #   Port#   Segment #   Interface Type
-----
0             1       A1          Token Ring
1             2       A2          Token Ring

Virtual Segment Number of this Router: A4

Save this Configuration? (Yes, No): [Yes]
```

6. Enter **y** to save the bridging configuration and continue with quick configuration. Enter **n** to re-display the bridging configuration prompts.

If you enter **y**, the following message appears:

```
Bridging configuration saved
```

Configuring Protocols

After you save the bridging configuration, you will see the following panel:

```
*****
Protocol Configuration
*****

Type 'Yes' to Configure Protocols
Type 'No' to skip Protocol Configuration
Type 'Quit' to exit Quick Config

Configure Protocols? (Yes, No, Quit): [Yes]
```

Take one of the following actions:

- Enter **y** to configure the protocols.
- Enter **n** to skip protocol configuration and continue with quick configuration.
- Enter **q** to exit quick configuration.

You will first configure IP, then IPX, and then DECnet.

Configuring IP

When you answer **y** to the Configure Protocol panel, quick configuration displays the following messages:

```
Type 'r' any time at this level to restart Protocol configuration
Configure IP? (Yes, No): [Yes]
```

1. Take one of the following actions:
 - Enter **y** to configure IP.
 - Enter **n** to skip IP configuration and continue with quick configuration.

The following lines appear for each interface.

```
Configuring Per-Interface IP Information
Configuring Interface 0 (Token Ring)
Configure IP on this interface? (Yes, No): [Yes]
IP Address: [ ] 128.185.141.1
Address Mask: [255.255.0.0]
```

2. Enter the IP address in decimal notation for example, 128.185.142.20. The console displays one of the following error messages if you enter an invalid IP address:

```
Bad address, please try again.
```

```
This address has already been assigned. Enter a different address
```

Address mask is a decimal value that reflects the IP network or subnetwork to which this interface is attached.

For more information about IP addressing or address masks, refer to the *Protocol Configuration and Monitoring Reference*, or consult your network administrator.

```
Per-Interface IP Configuration complete
Configuring IP Routing Information
Enable Dynamic Routing (Yes, No): [Yes]
```

3. Enter **y** if you want the routing protocols (RIP or OSPF) to build the routing tables. Enter **n** to manually add IP address destinations to the routing tables (static routes).

```
Enable OSPF? (Yes, No): [Yes]
```

4. Enter **y** to enable the OSPF routing protocol as the primary dynamic IP routing protocol. RIP will be enabled only to send advertisements, not to receive them. Enter **n** if you do not want to use OSPF. RIP will be enabled to send and receive advertisements.

```
OSPF Enabled with Max routes = 1000 and Max routers = 50
```

Max routes is the maximum number of autonomous system (AS) external routes imported into the OSPF routing domain. Max routers is the maximum number of OSPF routers in the routing domain.

```

Routing Configuration Complete

SNMP will be configured with the following parameters:

Community: public
Access:   READONLY

If you plan to use the graphical configuration tool
to download a configuration, it requires the definition
of a community name with read_write_trap access.

Define community with read_write_trap access ? (Yes, No): [Yes]

This is the information you have entered:

      Interface #      IP Address      Address Mask
      -----
      0                128.185.141.1  255.255.255.0
      1                128.185.142.1  255.255.255.0
      2                128.185.143.1  255.255.255.0

OSPF is configured, and RIP is configured only for 'sending'

SNMP has been configured with the following parameters:

Community: public
Access:   read_trap

Community: dana
Access:   read_write_trap

Save this configuration? (Yes, No): [Yes]

```

5. Enter **y** to save the IP configuration and continue with quick configuration. Enter **n** to re-display the protocol configuration prompts.

Configuring IPX

After you save the IP configuration, you will see the following messages:

```
Configure IPX? (Yes, No): [Yes]
```

1. Enter **y** to configure IPX. Enter **n** to skip IPX configuration and continue with quick configuration.

You will see messages similar to the following:

```
Type 'r' any time at this level to restart IPX Configuration
IPX Configuration is already present
Configure IPX anyway? (Yes, No): [No] yes
```

2. Enter **y** to replace the existing configuration. Enter **n** to keep the current configuration and continue.

```
Configuring Per-Interface IPX Information

Configuring Interface 0 (Token Ring)
Configure IPX on this interface? (Yes, No): [Yes]
```

3. The next messages and your responses depend on whether you are configuring Token-Ring, FDDI, or Ethernet.

Configuring IPX for Token-Ring:

- a. The following prompt is displayed:

Token Ring encapsulation (frame) type? (TOKEN-RING MSB, TOKEN-RING LSB, TOKEN-RING_SNAP MSB, TOKEN-RING_SNAP LSB): [TOKEN-RING MSB]

- b. Enter the encapsulation type used by the IPX protocol on your Token-Ring end stations.

Token-Ring MSB:	Most common encapsulation type and the default. The IBM 2216 builds outgoing packets with a 3-byte 802.2 header, (0xE0, 0xE0, 0x03). It sends the source and destination addresses in MSB (most significant bit), or noncanonical, format, which is the native address format for Token-Ring.
Token-Ring LSB	Same as Token-Ring MSB except the IBM 2216 sends the addresses in LSB (least significant bit), or canonical, format.
Token-Ring SNAP MSB	The IBM 2216 builds outgoing packets with an 8-byte 802.2/SNAP header (0xAA, 0xAA, 0x03, 0x00, 0x00, 0x00, 0x81, 0x37). It sends the source and destination addresses in most significant bit (MSB), or noncanonical, format.
Token-Ring SNAP LSB	Same as Token-Ring SNAP MSB except the IBM 2216 sends the addresses in LSB, or canonical, format.

Configuring IPX for Ethernet:

- a. The following prompts are displayed:

Ethernet encapsulation type? (ETHERNET_8022, ETHERNET_8023, ETHERNET_ii, ETHERNET_SNAP): [ETHERNET_8023]

- b. Enter the encapsulation type used by the IPX protocol on your Ethernet end stations.

Ethernet_8022	Packet includes an 802.2 header.
Ethernet_8023	Uses an IEEE 802.3 packet format without the 802.2 header. This is the default and the default for NetWare versions prior to 4.0. Ethernet 802.3 does not conform to the IEEE 802 standards because it does not include an 802.2 header. It may cause problems with other nodes on the network.
Ethernet_II	Uses Ethernet type 8137 as the packet format. This format is required if you are using NetWare VMS on the Ethernet. This is the default for NetWare Versions 4.0 and higher.
Ethernet_SNAP	Uses the 802.2 format with a SNAP header. This encapsulation type is meant to be compatible with token-ring SNAP encapsulation. However, it violates IEEE standards and is not interoperable across conformal bridges.

Configuring IPX for FDDI:

- a. The following prompts are displayed:

FDDI encapsulation (frame) type? (FDDI, FDDI_SNAP): [FDDI_SNAP]

- b. Enter the encapsulation type used by the IPX Protocol for your FDDI end stations.

fddi	Sets the encapsulation type to FDDI IEEE 802.2.
fddi_snap	Sets the encapsulation type to FDDI SNAP.

```
Network Number (hex) (1-FFFFFFFD):[1] 1
```

4. Assign an IPX network number to the associated directly connected network. Every IPX interface must have a unique network number.

```
Configuring Interface 1 (WAN PPP)
Configure IPX on this interface? (Yes, No): [Yes]
Network Number (hex) (1-FFFFFFFD): [1] 2

Enable IPXWAN? (Yes, No): [No] yes

Configuring Interface 2 (WAN PPP)
Configure IPX on this interface? (Yes, No): [Yes]
Network Number (hex) (1-FFFFFFFD):[1] 3

Enable IPXWAN? (Yes, No): [No] yes

Host Number for Serial Lines: (000000000000) 1

Configure IPXWAN NodeID? (Yes, No): [Yes]
NodeID (hex) (1 - FFFFFFFD): [1] 4
```

If enabled, the IPXWAN protocol negotiates routing parameters to be used on the PPP serial interface before IPX packet forwarding begins. IPXWAN is not required to forward IPX packets on PPP serial interfaces. The IPXWAN Node ID is a unique IPX network number that identifies the router, and is required if IPXWAN is enabled on any network interfaces.

5. Host number is a unique 12-digit hexadecimal value assigned to an IPX router. It is required because serial lines do not have hardware node addresses from which to build a host number.

```
This is the information you have entered:

                Per-Interface Configuration Information

Cir  Ifc  IPX Net(hex)  Encapsulation  IPXWAN
---  ---  ---          ---          ---
1    1    10           ETHERNET_8023  Not Configured
2    3    300          ---          Not Configured
3    5    400          ---          Not Configured
4    6    600          ---          Enabled

Host Number for Serial Lines: 0002210A0000
IPXWAN Node ID = 2210A
IPX Router Name = ipxwan_router-2210A

Save this configuration? (Yes, No): [Yes]
```

6. Enter **y** to save the IPX configuration and continue with quick configuration. Enter **n** to re-display the IPX configuration prompts.

If you enter **y**, the following message appears:

```
IPX configuration saved
```

Configuring DECnet (DNA)

After you save the IPX configuration, you will see the following messages.

```
IPX Configuration saved
Configure DNA? (Yes, No): [Yes]
```

1. Enter **y** to configure DNA. Enter **n** to skip DNA configuration and continue with quick configuration.

```
Type 'r' any time at this level to restart DNA Configuration
Configuring Global DNA information
Highest Node Number (decimal) (1-1023): [32]
Router Level (Level1, Level2, DEC Level1, DEC Level2):
[ Level2]
Highest Area (decimal) (1-63): [63]
Node Address (area.node): (63.32)
```

The above configuration fields are configured with the following considerations:

Highest Node Number

Is the highest node address in the router's area. Setting it excessively high will affect the routers efficiency and require excess storage.

Router Level

Identifies whether the router is a Level 1 or Level 2 router. A Level 1 router keeps track of all nodes in its area and does not care about nodes outside its area. A Level 2 router routes traffic between areas.

Normally you should select Level1 or Level2 with the following exception: select DEC Level1 or DEC Level2 only when this router must communicate over X.25 networks with routers conforming to the DEC X.25 standard.

Highest Area

This number should be at least as high as the highest area number in the overall network.

Node Address

Is the node ID of this router and must be unique in the network.

When you press Enter, the following is displayed:

```
Configuring Per-Interface DNA Information
Configuring Max Routers on each interface
Configuring Interface 0 (Ethernet)
Configure DNA on this interface? (Yes, No) [YES]
Max Routers (decimal) (1-33): [16]
Configuring Interface 1 (WAN PPP)
Configure DNA on this interface? (Yes, No) [Yes]
Configuring Interface 2 (Token Ring)
Configure DNA on this interface? (Yes, No) [Yes]
Max Routers (decimal) (1-33): [16]
```

2. Enter **y** for every interface that will be connected to the DECnet network. For LANs, Max Routers specifies how many other routers may be on this circuit. For router efficiency and memory requirements set this argument to a few more than the total number of adjacent routers on this circuit.

The following panel is displayed:

This is the information you have entered:

Global Configuration Information

Highest Node Number:	32
Router Level:	Level2
Highest Area:	63
Node Address:	63.32

Pre-Interface Configuration Information

Interface Number	Max Routers
0	16
1	1
2	16

Save this configuration? (Yes, No): [Yes]

3. Enter **y** to save the DECnet configuration and continue with the quick configuration. Enter **n** to re-display the DECnet configuration prompts. If you enter **y**, the following message appears:

DNA Configuration Saved

Restarting the IBM 2216

After configuring the protocols, you will receive the following message:

Quick Config Done
Do you want to write this configuration? (Yes, No): [Yes]

Enter **y** to save your changes and display the following information:

Default config file written successfully.
Configuration was written.
The system must be restarted for this configuration to take effect.

Enter **reload** at the OPCON prompt (*) to restart the IBM 2216 with the new configuration. To change or view the current configuration, enter **qc**.

Appendix B. X.25 National Personalities

This appendix lists the default settings for GTE-Telenet and DDN.

GTE-Telenet

The following parameters are the default settings for GTE-Telenet:

- Callreq: 20
- Clearreq:
 - Retries: 1
 - Timer: 18
- Disconnect: Passive
- DP-timer: 500 milliseconds
- Frame window size: 7
- Network Type: CCITT
- N2 timeouts: 20
- Packet:
 - Default size: 128
 - Maximum size: 256
 - Window size: 2
- Reset
 - Retries: 1
 - Timer: 18
- Restart
 - Retries: 1
 - Timer: 18
- Standard: 1984
- T1-timer: 4
- T2-timer: 2

DDN

The following parameters are the default settings for DDN:

- Callreq: 20
- Clearreq:
 - Retries: 1
 - Timer: 18
- Disconnect: Passive
- DP-timer: 500 milliseconds
- Frame window size: 7
- Network Type: CCITT
- N2 timeouts: 20
- Packet:
 - Default size: 128
 - Maximum size: 256

- Window size: 2
- Reset
 - Retries: 1
 - Timer: 18
- Restart
 - Retries: 1
 - Timer: 18
- Standard: 1984
- T1-timer: 4
- T2-timer: 2

Appendix C. Making a Router Load File from Multiple Disks

If a software load arrives on multiple disks, use the procedure in the following sections to combine the loads into one load file that the router can use at the time of booting.

The first disk contains the following four files that you need if you want to fragment an existing load for transport on multiple diskettes.

cutup.c

(UNIX C source file that can be compiled using a standard C compiler)

cutup.exe

(DOS)

Use the following files for reassembling the load fragments onto a DOS or UNIX server.

kopy.bat

(DOS)

kopy (UNIX shell script)

Assembling a Load File Under DOS

To assemble a load from the two diskettes, use the DOS batch file provided on diskette 1 (KOPY.BAT) using the following syntax:

```
kopy <installation_drive><destination_directory>
```

Before assembling the load make sure that you have created a destination directory, and that you have inserted the first diskette in the drive specified by the installation_diskette_drive parameter. The following example illustrates this procedure.

```
B:\>kopy b: c:\source\cutup\tmp
B:\>copy c:\gw0/B c:\source\cutup\tmp\gw.tmp
1 file(s) copied
.
Please mount the second diskette
Press any key to continue . . .
Copying the second load file fragment
B:\>
B:\>copy c:\source\cutup\tmp\gw.tmp/B + b:\gw1
c:\source\cutup\tmp\gw.tmp c:\SOURCE\CUTUP\TMP\GW.TMP
B:\GW1
1 file(s) copied
B:\>rename c:\source\cutup\tmp\gw.tmp gw.ldc
Load file reassembly was successful
B:>
```

Assembling a Load File Under UNIX

To assemble a load from two UNIX diskettes, you can use the UNIX Bourne shell script (kopy) provided on diskette 1 using the following syntax:

```
kopy<installation_drive><diskette_directory><destination_directory>
```

Before assembling the load make sure that you have created the mount and destination directories, and that you have inserted the first diskette in the drive specified by the installation_diskette_drive parameter. The following example illustrates this procedure.

```
kopy /dev/fd0 /kew /pcfs
```

Please insert the first diskette

Copying the first load file fragment

Please mount the second diskette

Copying the second load file fragment

Load file reassembly was successful

```
# ls /kew
```

```
gw0  gw1  gw.ldc
```

If you can't use the UNIX Bourne shell script, you can assemble the load manually using the following procedure:

1. Copy the load fragments on the two diskettes (gw0 and gw1) into a directory on the UNIX file system.
2. Type the following UNIX command:

```
cat gw0 gw1 > gw.ldc
```

The resulting file (gw.ldc) is the assembled router load.

Disassembling a Load File Under DOS

To disassemble a load under DOS, use the CUTUP.EXE file as follows:

```
cutup<file_extension><file_name><cut_length>
```

The file_extension is attached to the front of each slice needed to cut. The file_name is the DOS file name of the file to be disassembled. The cut_length is the length that CUTUP.EXE makes each fragment as it disassembles the file. The following example illustrates this procedure.

```
C: \source\cutup>dir
Volume in drive C has no label
Volume Serial Number is XXXXXXXX
Directory of C: \SOURCE\CUTUP
.0730934:46p
..0730934:46p
GW      LDC 10225660728931:22p
CUTUP  EXE 105410902939:38a
2 file(s) 1033107 bytes
14811136 bytes free
C: \source\cutup>cutup gw.ldc gw 1000000
.....
.....
c: \SOURCE\CUTUP>dir
Volume in drive C has no label
Volume Serial Number is XXXXXXXX
Directory of C: \SOURCE\CUTUP
.0730934:46p
..0730934:46p
GW      0 10000000801931:22p
GW      LDC 10225660728931:22p
CUTUP  EXE 105410902939:38a
GW      1 225660801931:22p
4 file(s) 2055673 bytes
14811136 bytes free
```

Disassembling a Load File Under UNIX

To disassemble a load under use cutup.c. Begin by compiling the program using your UNIX compiler to make a cutup executable file. Then use the following syntax:

```
cutup<file_extension><file_name><cut_length>
```

The file_extension is attached to the front of each slice needed to cut. The file_name is the DOS file name of the file to be disassembled. The cut_length is the length CUTUP.EXE that is used to disassemble the file. The following example illustrates this procedure.

```
# ls -la
total 658
drwxrwxr-x 2 root 512 Aug 114:41 .
drwxrwxr-x 26 root 1024 Aug 114:41 ..
drwxrwxr-x 2 root 24576 Aug 114:41 cutup
drwxrwxr-r 2 root1022566 Aug 114:41 gw.ldc
```

```
# cutup gw.ldc gw 100000
```

```
# ls -la
total 658
drwxrwxr-x 2 root 512 Aug 114:41 .
drwxrwxr-x 26 root 1024 Aug 114:41 ..
drwxrwxr-x 2 root 24576 Aug 114:41 cutup
drwxrwxr-r 2 root1022566 Aug 114:41 gw.ldc
drwxrwxr-r 2 root1000000 Aug 114:41 gw0
drwxrwxr-r 2 root 22566 Aug 114:41 gw1
```

Appendix D. Remote AAA Attributes

This section contains the remote AAA Attributes use by Radius, TACACS and TACACS+ servers.

Radius

IBM Vendor ID: 211

Authorization Attributes

Standard Drafted

TUNNEL_TYPE	64
TUNNEL_MEDIUM_TYPE	65
TUNNEL_CLIEN_TYPE	66
TUNNEL_SERVER_EP	67
TUNNEL_CONN_ID	68
TUNNEL_PASSWORD	69

values

TUNNEL_TYPE	integer
3	L2TP
TUNNEL_MEDIUM_TYPE	integer
1	IP
TUNNEL_SERVER_EP	string
	ip address

IBM Vendor Specific

NAS_TUNNEL_PASSWORD	101
CALLBACK_FLAGS	210
ENCRYPTION	211
HOSTNAME	213
SUBNETMASK	215
PRIVILEGE	216

Keywords

Keywords are used for Radius servers that allow the entry of vendor specific fields <keyword>=<value>.

KWD_CALLBACK_FLAGS	CBF
KWD_ENCRYPTION	ENC
KWD_HOSTNAME	HSN
KWD_SUBNETMASK	SNM
KWD_PRIVELGE	PRV

Values

PRIVILEGE:

ADMIN
OPER
MONITOR

CALLBACKFLAGS

REQ required callback
ROAM roaming callback

TACACS+

Authentication

Authorization

PPP service=ppp protocol=ip
LOGIN service=shell cmd=null pri_lvl*0

Standard TACACS+ Attributes

service
protocol
cmd
addr
timeout
priv_lvl
callback-dialstring

IBM Specific Attributes

encryption_key 16 hex characters
dial_out TRUE FALSE ONLY

Accounting

task_id
start_time
stop_time
elapsed_time
timezone
event
reason
bytes
bytes_in
bytes_out
paks
paks_in
paks_out
status
err_msg

List of Abbreviations

AARP	AppleTalk Address Resolution Protocol
ABR	area border router
ack	acknowledgment
AIX	Advanced Interactive Executive
AMA	arbitrary MAC addressing
AMP	active monitor present
ANSI	American National Standards Institute
AP2	AppleTalk Phase 2
APPN	Advanced Peer-to-Peer Networking
ARE	all-routes explorer
ARI	ATM real interface
ARI/FCI	address recognized indicator/frame copied indicator
ARP	Address Resolution Protocol
AS	autonomous system
ASBR	autonomous system boundary router
ASCII	American National Standard Code for Information Interchange
ASN.1	abstract syntax notation 1
ASRT	adaptive source routing transparent
ASYNC	asynchronous
ATCP	AppleTalk Control Protocol
ATP	AppleTalk Transaction Protocol
AUI	attachment unit interface
AVI	ATM virtual interface
ayt	are you there
BAN	Boundary Access Node
BBCM	Bridging Broadcast Manager
BECN	backward explicit congestion notification
BGP	Border Gateway Protocol
BNC	bayonet Niell-Concelman
BNCP	Bridging Network Control Protocol
BOOTP	BOOT protocol
BPDU	bridge protocol data unit
bps	bits per second
BR	bridging/routing

BRS bandwidth reservation
BSD Berkeley software distribution
BTP BOOTP relay agent
BTU basic transmission unit
CAM content-addressable memory
CCITT Consultative Committee on International Telegraph and Telephone
CD collision detection
CGWCON
 Gateway Console
CIDR Classless Inter-Domain Routing
CIP Classical IP
CIR committed information rate
CLNP Connectionless-Mode Network Protocol
CPU central processing unit
CRC cyclic redundancy check
CRS configuration report server
CTS clear to send
CUD call user data
DAF destination address filtering
DB database
DBsum
 database summary
DCD data channel received line signal detector
DCE data circuit-terminating equipment
DCS Directly connected server
DDLC dual data-link controller
DDN Defense Data Network
DDP Datagram Delivery Protocol
DDT Dynamic Debugging Tool
DHCP Dynamic Host Configuration Protocol
dir directly connected
DL data link
DLC data link control
DLCI data link connection identifier
DLS data link switching
DLSw data link switching
DMA direct memory access
DNA Digital Network Architecture

DNCP	DECnet Protocol Control Protocol
DNIC	Data Network Identifier Code
DoD	Department of Defense
DOS	Disk Operating System
DR	designated router
DRAM	Dynamic Random Access Memory
DSAP	destination service access point
DSE	data switching equipment
DSE	data switching exchange
DSR	data set ready
DSU	data service unit
DTE	data terminal equipment
DTR	data terminal ready
Dtype	destination type
DVMRP	Distance Vector Multicast Routing Protocol
E1	2.048 Mbps transmission rate
EDEL	end delimiter
EDI	error detected indicator
EGP	Exterior Gateway Protocol
EIA	Electronics Industries Association
ELAN	Emulated LAN
ELAP	EtherTalk Link Access Protocol
ELS	Event Logging System
ELSCon	Secondary ELS Console
ESI	End system identifier
EST	Eastern Standard Time
Eth	Ethernet
fa-ga	functional address-group address
FCS	frame check sequence
FECN	forward explicit congestion notification
FIFO	first in, first out
FLT	filter library
FR	Frame Relay
FRL	Frame Relay
FTP	File Transfer Protocol
GMT	Greenwich Mean Time

GOSIP	Government Open Systems Interconnection Profile
GTE	General Telephone Company
GWCON	Gateway Console
HDLC	high-level data link control
HEX	hexadecimal
HPR	high-performance routing
HST	TCP/IP host services
HTF	host table format
IBD	Integrated Boot Device
ICMP	Internet Control Message Protocol
ICP	Internet Control Protocol
ID	identification
IDP	Initial Domain Part
IDP	Internet Datagram Protocol
IEEE	Institute of Electrical and Electronics Engineers
lfc#	interface number
IGP	interior gateway protocol
InARP	Inverse Address Resolution Protocol
IP	Internet Protocol
IPCP	IP Control Protocol
IPPN	IP Protocol Network
IPX	Internetwork Packet Exchange
IPXCP	IPX Control Protocol
ISDN	integrated services digital network
ISO	International Organization for Standardization
Kbps	kilobits per second
LAC	L2TP Network Access Concentrator
LAN	local area network
LAPB	link access protocol-balanced
LAT	local area transport
LCS	LAN Channel Station
LCP	Link Control Protocol
LED	light-emitting diode
LF	largest frame; line feed
LIS	Logical IP subnet
LLC	logical link control

LLC2 logical link control 2
LMI local management interface
LNS L2TP Network Server
LRM LAN reporting mechanism
LS link state
LSA link state advertisement
LSA Link Services Architecture
LSB least significant bit
LSI LAN shortcuts interface
LSreq link state request
LSrxl link state retransmission list
LU logical unit
MAC medium access control
Mb megabit
MB megabyte
Mbps megabits per second
MBps megabytes per second
MC multicast
MCF MAC filtering
MIB Management Information Base
MIB II Management Information Base II
MILNET
 military network
MOS Micro Operating System
MOSDBG
 Micro Operating System Debugging Tool
MOSPF
 Open Shortest Path First with multicast extensions
MPC Multi-Path Channel
MPC+ High performance data transfer (HPDT) Multi-Path Channel
MSB most significant bit
MSDU MAC service data unit
MRU maximum receive unit
MTU maximum transmission unit
nak not acknowledged
NAS Nways Switch Administration station
NBMA Non-Broadcast Multiple Access
NBP Name Binding Protocol

NBR neighbor
NCP Network Control Protocol
NCP Network Core Protocol
NDPS non-disruptive path switching
NetBIOS
 Network Basic Input/Output System
NHRP Next Hop Resolution Protocol
NIST National Institute of Standards and Technology
NPDU Network Protocol Data Unit
NRZ non-return-to-zero
NRZI non-return-to-zero inverted
NSAP Network Service Access Point
NSF National Science Foundation
NSFNET
 National Science Foundation NETwork
NVCNFG
 nonvolatile configuration
OPCON
 Operator Console
OSI open systems interconnection
OSICP
 OSI Control Protocol
OSPF Open Shortest Path First
OUI organization unique identifier
PC personal computer
PCA parallel channel adapter
PCR peak cell rate
PDN public data network
PING Packet internet groper
PDU protocol data unit
PID process identification
P-P Point-to-Point
PPP Point-to-Point Protocol
PROM programmable read-only memory
PU physical unit
PVC permanent virtual circuit
RAM random access memory
RD route descriptor
REM ring error monitor

REV receive
RFC Request for Comments
RI ring indicator; routing information
RIF routing information field
RII routing information indicator
RIP Routing Information Protocol
RISC reduced instruction-set computer
RNR receive not ready
ROM read-only memory
ROpcon Remote Operator Console
RPS ring parameter server
RTMP Routing Table Maintenance Protocol
RTP RouTing update Protocol
RTS request to send
Rtype route type
rxmits retransmissions
rxmt retransmit
s second
SAF source address filtering
SAP service access point
SAP Service Advertising Protocol
SCR Sustained cell rate
SCSP Server Cache Synchronization Protocol
sdel start delimiter
SDLC SDLC relay, synchronous data link control
seqno sequence number
SGID sever group id
SGMP Simple Gateway Monitoring Protocol
SL serial line
SMP standby monitor present
SMTP Simple Mail Transfer Protocol
SNA Systems Network Architecture
SNAP Subnetwork Access Protocol
SNMP Simple Network Management Protocol
SNPA subnetwork point of attachment
SPF OSPF intra-area route
SPE1 OSPF external route type 1

SPE2	OSPF external route type 2
SPIA	OSPF inter-area route type
SPID	service profile ID
SPX	Sequenced Packet Exchange
SQE	signal quality error
SRAM	static random access memory
SRB	source routing bridge
SRF	specifically routed frame
SRLY	SDLC relay
SRT	source routing transparent
SR-TB	source routing-transparent bridge
STA	static
STB	spanning tree bridge
STE	spanning tree explorer
STP	shielded twisted pair; spanning tree protocol
SVC	switched virtual circuit
TB	transparent bridge
TCN	topology change notification
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TEI	terminal point identifier
TFTP	Trivial File Transfer Protocol
TKR	token ring
TMO	timeout
TOS	type of service
TSF	transparent spanning frames
TTL	time to live
TTY	teletypewriter
TX	transmit
UA	unnumbered acknowledgment
UDP	User Datagram Protocol
UI	unnumbered information
UTP	unshielded twisted pair
VCC	Virtual Channel Connection
VINES	Virtual NEtworking System
VIR	variable information rate

VL	virtual link
VNI	Virtual Network Interface
VR	virtual route
WAN	wide area network
WRS	WAN restoral/reroute
X.25	packet-switched networks
X.251	X.25 physical layer
X.252	X.25 frame layer
X.253	X.25 packet layer
XID	exchange identification
XNS	Xerox Network Systems
XSUM	checksum
ZIP	AppleTalk Zone Information Protocol
ZIP2	AppleTalk Zone Information Protocol 2
ZIT	Zone Information Table

Glossary

This glossary includes terms and definitions from:

- The *American National Standard Dictionary for Information Systems*, ANSI X3.172-1990, copyright 1990 by the American National Standards Institute (ANSI). Copies may be purchased from the American National Standards Institute, 11 West 42nd Street, New York, New York 10036. Definitions are identified by the symbol (A) after the definition.
- The ANSI/EIA Standard—440-A, *Fiber Optic Terminology* Copies may be purchased from the Electronic Industries Association, 2001 Pennsylvania Avenue, N.W., Washington, DC 20006. Definitions are identified by the symbol (E) after the definition.
- The *Information Technology Vocabulary* developed by Subcommittee 1, Joint Technical Committee 1, of the International Organization for Standardization and the International Electrotechnical Commission (ISO/IEC JTC1/SC1). Definitions of published parts of this vocabulary are identified by the symbol (I) after the definition; definitions taken from draft international standards, committee drafts, and working papers being developed by ISO/IEC JTC1/SC1 are identified by the symbol (T) after the definition, indicating that final agreement has not yet been reached among the participating National Bodies of SC1.
- The *IBM Dictionary of Computing*, New York: McGraw-Hill, 1994.
- Internet Request for Comments: 1208, *Glossary of Networking Terms*
- Internet Request for Comments: 1392, *Internet Users' Glossary*
- The *Object-Oriented Interface Design: IBM Common User Access Guidelines*, Carmel, Indiana: Que, 1992.

The following cross-references are used in this glossary:

Contrast with:

This refers to a term that has an opposed or substantively different meaning.

Synonym for:

This indicates that the term has the same meaning as a preferred term, which is defined in its proper place in the glossary.

Synonymous with:

This is a backward reference from a defined term to all other terms that have the same meaning.

See: This refers the reader to multiple-word terms that have the same last word.

See also:

This refers the reader to terms that have a related, but not synonymous, meaning.

A

AAL. ATM Adaptation Layer, the layer that adapts user data to/from the ATM network by adding/removing headers and segmenting/reassembling the data into/from cells.

AAL-5. ATM Adaptation Layer 5, one of several standard AALs. AAL-5 was designed for data communications, and is used by LAN Emulation and Classical IP.

abstract syntax. A data specification that includes all distinctions that are needed in data transmissions, but that omits (abstracts) other details such as those that depend on specific computer architectures. See also *abstract syntax notation 1 (ASN.1)* and *basic encoding rules (BER)*.

abstract syntax notation 1 (ASN.1). The Open Systems Interconnection (OSI) method for abstract syntax specified in the following standards:

- ITU-T Recommendation X.208 (1988) | ISO/IEC 8824: 1990
- ITU-T Recommendation X.680 (1994) | ISO/IEC 8824-1: 1994

See also *basic encoding rules (BER)*.

ACCESS. In the Simple Network Management Protocol (SNMP), the clause in a Management Information Base (MIB) module that defines the minimum level of support that a managed node provides for an object.

acknowledgment. (1) The transmission, by a receiver, of acknowledge characters as an affirmative response to a sender. (T) (2) An indication that an item sent was received.

active. (1) Operational. (2) Pertaining to a node or device that is connected or is available for connection to another node or device.

active monitor. In a token-ring network, a function performed at any one time by one ring station that

initiates the transmission of tokens and provides token error recovery facilities. Any active adapter on the ring has the ability to provide the active monitor function if the current active monitor fails.

address. In data communication, the unique code assigned to each device, workstation, or user connected to a network.

address mapping table (AMT). A table, maintained within the AppleTalk router, that provides a current mapping of node addresses to hardware addresses.

address mask. For internet subnetworking, a 32-bit mask used to identify the subnetwork address bits in the host portion of an IP address. Synonymous with *subnet mask* and *subnetwork mask*.

address resolution. (1) A method for mapping network-layer addresses to media-specific addresses. (2) See also *Address Resolution Protocol (ARP)* and *AppleTalk Address Resolution Protocol (AARP)*.

Address Resolution Protocol (ARP). (1) In the Internet suite of protocols, the protocol that dynamically maps an IP address to an address used by a supporting metropolitan or local area network such as Ethernet or token-ring. (2) See also *Reverse Address Resolution Protocol (RARP)*.

addressing. In data communication, the way in which a station selects the station to which it is to send data.

adjacent nodes. Two nodes connected together by at least one path that connects no other node. (T)

Administrative Domain. A collection of hosts and routers, and the interconnecting networks, managed by a single administrative authority.

Advanced Peer-to-Peer Networking (APPN). An extension to SNA featuring (a) greater distributed network control that avoids critical hierarchical dependencies, thereby isolating the effects of single points of failure; (b) dynamic exchange of network topology information to foster ease of connection, reconfiguration, and adaptive route selection; (c) dynamic definition of network resources; and (d) automated resource registration and directory lookup. APPN extends the LU 6.2 peer orientation for end-user services to network control and supports multiple LU types, including LU 2, LU 3, and LU 6.2.

Advanced Peer-to-Peer Networking (APPN) end node. A node that provides a broad range of end-user services and supports sessions between its local control point (CP) and the CP in an adjacent network node. It uses these sessions to dynamically register its resources with the adjacent CP (its network node server), to send and receive directory search requests, and to obtain management services. An APPN end node can also attach to a subarea network as a peripheral node or to other end nodes.

Advanced Peer-to-Peer Networking (APPN) network. A collection of interconnected network nodes and their client end nodes.

Advanced Peer-to-Peer Networking (APPN) network node. A node that offers a broad range of end-user services and that can provide the following:

- Distributed directory services, including registration of its domain resources to a central directory server
- Topology database exchanges with other APPN network nodes, enabling network nodes throughout the network to select optimal routes for LU-LU sessions based on requested classes of service
- Session services for its local LUs and client end nodes
- Intermediate routing services within an APPN network

Advanced Peer-to-Peer Networking (APPN) node. An APPN network node or an APPN end node.

agent. A system that assumes an agent role.

alert. A message sent to a management services focal point in a network to identify a problem or an impending problem.

all-stations address. In communications, synonym for *broadcast address*.

American National Standards Institute (ANSI). An organization consisting of producers, consumers, and general interest groups, that establishes the procedures by which accredited organizations create and maintain voluntary industry standards in the United States. (A)

analog. (1) Pertaining to data consisting of continuously variable physical quantities. (A) (2) Contrast with *digital*.

AppleTalk. A network protocol developed by Apple Computer, Inc. This protocol is used to interconnect network devices, which can be a mixture of Apple and non-Apple products.

AppleTalk Address Resolution Protocol (AARP). In AppleTalk networks, a protocol that (a) translates AppleTalk node addresses into hardware addresses and (b) reconciles addressing discrepancies in networks that support more than one set of protocols.

AppleTalk Transaction Protocol (ATP). In AppleTalk networks, a protocol that provides client/server request and response functions for hosts accessing the Zone Information Protocol (ZIP) for zone information.

APPN network. See *Advanced Peer-to-Peer Networking (APPN) network*.

APPN network node. See *Advanced Peer-to-Peer Networking (APPN) network node*.

arbitrary MAC addressing (AMA). In DECnet architecture, an addressing scheme used by DECnet Phase IV-Prime that supports universally administered addresses and locally administered addresses.

area. In Internet and DECnet routing protocols, a subset of a network or gateway grouped together by definition of the network administrator. Each area is self-contained; knowledge of an area's topology remains hidden from other areas.

asynchronous (ASYNC). Pertaining to two or more processes that do not depend upon the occurrence of specific events such as common timing signals. (T)

ATM. Asynchronous Transfer Mode, a connection-oriented, high-speed networking technology based on cell switching.

ATMARP. ARP in Classical IP.

attachment unit interface (AUI). In a local area network, the interface between the medium attachment unit and the data terminal equipment within a data station. (I) (A)

Attribute Value Pair (AVP). A uniform method of encoding message types and bodies. This method maximizes the extensibility while permitting interoperability of L2TP.

authentication failure. In the Simple Network Management Protocol (SNMP), a trap that may be generated by an authentication entity when a requesting client is not a member of the SNMP community.

autonomous system. In TCP/IP, a group of networks and routers under one administrative authority. These networks and routers cooperate closely to propagate network reachability (and routing) information among themselves using an interior gateway protocol of their choice.

autonomous system number. In TCP/IP, a number assigned to an autonomous system by the same central authority that also assigns IP addresses. The autonomous system number makes it possible for automated routing algorithms to distinguish autonomous systems.

B

backbone. (1) In a local area network multiple-bridge ring configuration, a high-speed link to which the rings are connected by means of bridges or routers. A backbone may be configured as a bus or as a ring. (2) In a wide area network, a high-speed link to which nodes or data switching exchanges (DSEs) are connected.

backbone network. A central network to which smaller networks, normally of lower speed, connect. The

backbone network usually has a much higher capacity than the networks it helps interconnect or is a wide-area network (WAN) such as a public packet-switched datagram network.

backbone router. (1) A router used to transmit data between areas. (2) One in a series of routers that is used to interconnect networks into a larger internet.

Bandwidth. The bandwidth of an optical link designates the information-carrying capacity of the link and is related to the maximum bit rate that a fiber link can support.

basic transmission unit (BTU). In SNA, the unit of data and control information passed between path control components. A BTU can consist of one or more path information units (PIUs).

baud. In asynchronous transmission, the unit of modulation rate corresponding to one unit interval per second; that is, if the duration of the unit interval is 20 milliseconds, the modulation rate is 50 baud. (A)

bootstrap. (1) A sequence of instructions whose execution causes additional instructions to be loaded and executed until the complete computer program is in storage. (T) (2) A technique or device designed to bring itself into a desired state by means of its own action, for example, a machine routine whose first few instructions are sufficient to bring the rest of itself into the computer from an input device. (A)

Border Gateway Protocol (BGP). An Internet Protocol (IP) routing protocol used between domains and autonomous systems.

border router. In Internet communications, a router, positioned at the edge of an autonomous system, that communicates with a router that is positioned at the edge of a different autonomous system.

bridge. A functional unit that interconnects multiple LANs (locally or remotely) that use the same logical link control protocol but that can use different medium access control protocols. A bridge forwards a frame to another bridge based on the medium access control (MAC) address.

bridge identifier. An 8-byte field, used in a spanning tree protocol, composed of the MAC address of the port with the lowest port identifier and a user-defined value.

bridging. In LANs, the forwarding of a frame from one LAN segment to another. The destination is specified by the medium access control (MAC) sublayer address encoded in the destination address field of the frame header.

broadcast. (1) Transmission of the same data to all destinations. (T) (2) Simultaneous transmission of data to more than one destination. (3) Contrast with *multicast*.

broadcast address. In communications, a station address (eight 1's) reserved as an address common to all stations on a link. Synonymous with *all-stations address*.

C

cache. (1) A special-purpose buffer storage, smaller and faster than main storage, used to hold a copy of instructions and data obtained from main storage and likely to be needed next by the processor. (T) (2) A buffer storage that contains frequently accessed instructions and data; it is used to reduce access time. (3) An optional part of the directory database in network nodes where frequently used directory information may be stored to speed directory searches. (4) To place, hide, or store in a cache.

call request packet. (1) A call supervision packet that a data terminal equipment (DTE) transmits to ask that a connection for a call be established throughout the network. (2) In X.25 communications, a call supervision packet transmitted by a DTE to ask for a call establishment through the network.

canonical address. In LANs, the IEEE 802.1 format for the transmission of medium access control (MAC) addresses for token-ring and Ethernet adapters. In canonical format, the least significant (rightmost) bit of each address byte is transmitted first. Contrast with *noncanonical address*.

carrier. An electric or electromagnetic wave or pulse train that may be varied by a signal bearing information to be transmitted over a communication system. (T)

carrier detect. Synonym for *received line signal detector (RLSD)*.

carrier sense. In a local area network, an ongoing activity of a data station to detect whether another station is transmitting. (T)

carrier sense multiple access with collision detection (CSMA/CD). A protocol that requires carrier sense and in which a transmitting data station that detects another signal while transmitting, stops sending, sends a jam signal, and then waits for a variable time before trying again. (T) (A)

CCITT. International Telegraph and Telephone Consultative Committee. This was an organization of the International Telecommunication Union (ITU). On 1 March 1993 the ITU was reorganized, and responsibilities for standardization were placed in a subordinate organization named the Telecommunication Standardization Sector of the Telecommunication Union (ITU-TS). "CCITT" continues to be used for recommendations that were approved before the reorganization.

channel. (1) A path along which signals can be sent, for example, data channel, output channel. (A) (2) A functional unit, controlled by the processor, that handles the transfer of data between processor storage and local peripheral equipment.

channel service unit (CSU). A unit that provides the interface to a digital network. The CSU provides line conditioning (or equalization) functions, which keep the signal's performance consistent across the channel bandwidth; signal reshaping, which constitutes the binary pulse stream; and loopback testing, which includes the transmission of test signals between the CSU and the network carrier's office channel unit. See also *data service unit (DSU)*.

channelization. The process of breaking the bandwidth on a communication line into a number of channels, possibly of different size. Also called **time division multiplexing (TDM)**.

checksum. (1) The sum of a group of data associated with the group and used for checking purposes. (T) (2) In error detection, a function of all bits in a block. If the written and calculated sums do not agree, an error is indicated. (3) On a diskette, data written in a sector for error detection purposes; a calculated checksum that does not match the checksum of data written in the sector indicates a bad sector. The data are either numeric or other character strings regarded as numeric for the purpose of calculating the checksum.

circuit switching. (1) A process that, on demand, connects two or more data terminal equipment (DTEs) and permits the exclusive use of a data circuit between them until the connection is released. (I) (A) (2) Synonymous with *line switching*.

class A network. In Internet communications, a network in which the high-order (most significant) bit of the IP address is set to 0 and the host ID occupies the three low-order octets.

class B network. In Internet communications, a network in which the two high-order (most significant and next-to-most significant) bits of the IP address are set to 1 and 0, respectively, and the host ID occupies the two low-order octets.

class of service (COS). A set of characteristics (such as route security, transmission priority, and bandwidth) used to construct a route between session partners. The class of service is derived from a mode name specified by the initiator of a session.

client. (1) A functional unit that receives shared services from a server. (T) (2) A user.

client/server. In communications, the model of interaction in distributed data processing in which a program at one site sends a request to a program at

another site and awaits a response. The requesting program is called a client; the answering program is called a server.

clocking. (1) In binary synchronous communication, the use of clock pulses to control synchronization of data and control characters. (2) A method of controlling the number of data bits sent on a telecommunication line in a given time.

collision. An unwanted condition that results from concurrent transmissions on a channel. (T)

collision detection. In carrier sense multiple access with collision detection (CSMA/CD), a signal indicating that two or more stations are transmitting simultaneously.

Committed information rate. The maximum amount of data in bits that the network agrees to deliver.

community. In the Simple Network Management Protocol (SNMP), an administrative relationship between entities.

community name. In the Simple Network Management Protocol (SNMP), a string of octets identifying a community.

compression. (1) The process of eliminating gaps, empty fields, redundancies, and unnecessary data to shorten the length of records or blocks. (2) Any encoding to reduce the number of bits used to represent a given message or record.

configuration. (1) The manner in which the hardware and software of an information processing system are organized and interconnected. (T) (2) The devices and programs that make up a system, subsystem, or network.

configuration database (CDB). A database that stores the configuration parameters of one or several devices. It is prepared and updated using the configuration program.

configuration file. A file that specifies the characteristics of a system device or network.

configuration parameter. A variable in a configuration definition, the values of which can characterize the relationship of a product to other products in the same network or can define characteristics of the product itself.

configuration report server (CRS). In the IBM Token-Ring Network Bridge Program, the server that accepts commands from the LAN Network Manager (LNM) to get station information, set station parameters, and remove stations on its ring. This server also collects and forwards configuration reports generated by stations

on its ring. The configuration reports include the new active monitor reports and the nearest active upstream neighbor (NAUN) reports.

congestion. See *network congestion*.

connection. In data communication, an association established between functional units for conveying information. (I) (A)

control point (CP). (1) A component of an APPN or LEN node that manages the resources of that node. In an APPN node, the CP is capable of engaging in CP-CP sessions with other APPN nodes. In an APPN network node, the CP also provides services to adjacent end nodes in the APPN network. (2) A component of a node that manages resources of that node and optionally provides services to other nodes in the network. Examples are a system services control point (SSCP) in a type 5 subarea node, a network node control point (NNCP) in an APPN network node, and an end node control point (ENCP) in an APPN or LEN end node. An SSCP and an NNCP can provide services to other nodes.

control point management services (CPMS). A component of a control point, consisting of management services function sets, that provides facilities to assist in performing problem management, performance and accounting management, change management, and configuration management. Capabilities provided by the CPMS include sending requests to physical unit management services (PUMS) to test system resources, collecting statistical information (for example, error and performance data) from PUMS about the system resources, and analyzing and presenting test results and statistical information collected about the system resources. Analysis and presentation responsibilities for problem determination and performance monitoring can be distributed among multiple CPMSs.

control point management services unit (CP-MSU). The message unit that contains management services data and flows between management services function sets. This message unit is in general data stream (GDS) format. See also *management services unit (MSU)* and *network management vector transport (NMVT)*.

CU Logical Address. The Control Unit address defined in the host for the 2216. This value is defined in the host Input/Output Configuration Program (IOCP) by the CUADD statement on the CNTLUNIT macro instruction. The Control Unit Address must be unique for each logical partition defined on the same host.

D

D-bit. Delivery-confirmation bit. In X.25 communications, the bit in a data packet or call-request packet that is set to 1 if end-to-end acknowledgment (delivery confirmation) is required from the recipient.

daemon. A program that runs unattended to perform a standard service. Some daemons are triggered automatically to perform their task; others operate periodically.

data carrier detect (DCD). Synonym for *received line signal detector (RLSD)*.

data circuit. (1) A pair of associated transmit and receive channels that provide a means of two-way data communication. (l) (2) In SNA, synonym for *link connection*. (3) See also *physical circuit* and *virtual circuit*.

Notes:

1. Between data switching exchanges, the data circuit may include data circuit-terminating equipment (DCE), depending on the type of interface used at the data switching exchange.
2. Between a data station and a data switching exchange or data concentrator, the data circuit includes the data circuit-terminating equipment at the data station end, and may include equipment similar to a DCE at the data switching exchange or data concentrator location.

data circuit-terminating equipment (DCE). In a data station, the equipment that provides the signal conversion and coding between the data terminal equipment (DTE) and the line. (l)

Notes:

1. The DCE may be separate equipment or an integral part of the DTE or of the intermediate equipment.
2. A DCE may perform other functions that are usually performed at the network end of the line.

data link connection identifier (DLCI). The numeric identifier of a frame-relay subport or PVC segment in a frame-relay network. Each subport in a single frame-relay port has a unique DLCI. The following table, excerpted from the American National Standards Institute (ANSI) Standard T1.618 and the International Telegraph and Telephone Consultative Committee (ITU-T/CCITT) Standard Q.922, indicates the functions associated with certain DLCI values:

DLCI Values	Function
0	in-channel signaling
1–15	reserved
16–991	assigned using frame-relay connection procedures
992–1007	layer 2 management of frame-relay bearer service
1008–1022	reserved
1023	in-channel layer management

data link control (DLC). A set of rules used by nodes on a data link (such as an SDLC link or a token ring) to accomplish an orderly exchange of information.

data link control (DLC) layer. In SNA, the layer that consists of the link stations that schedule data transfer over a link between two nodes and perform error control for the link. Examples of data link control are SDLC for serial-by-bit link connection and data link control for the System/370 channel.

Note: The DLC layer is usually independent of the physical transport mechanism and ensures the integrity of data that reaches the higher layers.

data link layer. In the Open Systems Interconnection reference model, the layer that provides services to transfer data between entities in the network layer over a communication link. The data link layer detects and possibly corrects errors that may occur in the physical layer. (T)

data link level. (1) In the hierarchical structure of a data station, the conceptual level of control or processing logic between high level logic and the data link that maintains control of the data link. The data link level performs such functions as inserting transmit bits and deleting receive bits; interpreting address and control fields; generating, transmitting, and interpreting commands and responses; and computing and interpreting frame check sequences. See also *packet level* and *physical level*. (2) In X.25 communications, synonym for *frame level*.

data link switching (DLSw). A method of transporting network protocols that use IEEE 802.2 logical link control (LLC) type 2. SNA and NetBIOS are examples of protocols that use LLC type 2. See also *encapsulation* and *spoofing*.

data packet. In X.25 communications, a packet used for the transmission of user data on a virtual circuit at the DTE/DCE interface.

data service unit (DSU). A device that provides a digital data service interface directly to the data terminal equipment. The DSU provides loop equalization, remote and local testing capabilities, and a standard EIA/CCITT interface.

data set ready (DSR). Synonym for *DCE ready*.

data switching exchange (DSE). The equipment installed at a single location to provide switching functions, such as circuit switching, message switching, and packet switching. (l)

data terminal equipment (DTE). That part of a data station that serves as a data source, data sink, or both. (l) (A)

data terminal ready (DTR). A signal to the modem used with the EIA 232 protocol.

data transfer rate. The average number of bits, characters, or blocks per unit time passing between corresponding equipment in a data transmission system. (I)

Notes:

1. The rate is expressed in bits, characters, or blocks per second, minute, or hour.
2. Corresponding equipment should be indicated; for example, modems, intermediate equipment, or source and sink.

datagram. (1) In packet switching, a self-contained packet, independent of other packets, that carries information sufficient for routing from the originating data terminal equipment (DTE) to the destination DTE without relying on earlier exchanges between the DTEs and the network. (I) (2) In TCP/IP, the basic unit of information passed across the Internet environment. A datagram contains a source and destination address along with the data. An Internet Protocol (IP) datagram consists of an IP header followed by the transport layer data. (3) See also *packet* and *segment*.

Datagram Delivery Protocol (DDP). In AppleTalk networks, a protocol that provides network connectivity by means of connectionless socket-to-socket delivery service on the internet layer.

DCE ready. In the EIA 232 standard, a signal that indicates to the data terminal equipment (DTE) that the local data circuit-terminating equipment (DCE) is connected to the communication channel and is ready to send data. Synonymous with *data set ready (DSR)*.

DECnet. A network architecture that defines the operation of a family of software modules, databases, and hardware components typically used to tie Digital Equipment Corporation systems together for resource sharing, distributed computation, or remote system configuration. DECnet network implementations follow the Digital Network Architecture (DNA) model.

default. Pertaining to an attribute, condition, value, or option that is assumed when none is explicitly specified. (I)

dependent LU requester (DLUR). An APPN end node or an APPN network node that owns dependent LUs, but requests that a dependent LU server provide the SSCP services for those dependent LUs.

designated router. A router that informs end nodes of the existence and identity of other routers. The selection of the designated router is based upon the router with the highest priority. When several routers share the highest priority, the router with the highest station address is selected.

destination node. The node to which a request or data is sent.

destination port. The 8-port asynchronous adapter that serves as a connection point with a serial service.

destination service access point (DSAP). In SNA and TCP/IP, a logical address that allows a system to route data from a remote device to the appropriate communications support. Contrast with *source service access point (SSAP)*.

device. A mechanical, electrical, or electronic contrivance with a specific purpose.

device address. The unit address transmitted on the channel path to select a 2216 device. It is also referred to as subchannel number in S/370 I/O architecture. This value is defined in the host IOCP by the UNITADD statement on the CNTLUNIT macro instruction for the real device.

digital. (1) Pertaining to data that consist of digits. (T) (2) Pertaining to data in the form of digits. (A) (3) Contrast with *analog*.

Digital Network Architecture (DNA). The model for all DECnet hardware and software implementations.

direct memory access (DMA). The system facility that allows a device on the Micro Channel bus to get direct access to the system or bus memory without the intervention of the system processor.

directory. A table of identifiers and references to the corresponding items of data. (I) (A)

directory service (DS). An application service element that translates the symbolic names used by application processes into the complete network addresses used in an OSI environment. (T)

directory services (DS). A control point component of an APPN node that maintains knowledge of the location of network resources.

disable. To make nonfunctional.

disabled. (1) Pertaining to a state of a processing unit that prevents the occurrence of certain types of interruptions. (2) Pertaining to the state in which a transmission control unit or audio response unit cannot accept incoming calls on a line.

domain. (1) That part of a computer network in which the data processing resources are under common control. (T) (2) In Open Systems Interconnection (OSI), a part of a distributed system or a set of managed objects to which a common policy applies. (3) See *Administrative Domain* and *domain name*.

domain name. In the Internet suite of protocols, a name of a host system. A domain name consists of a sequence of subnames separated by a delimiter character. For example, if the fully qualified domain

name (FQDN) of a host system is `ralvm7.vnet.ibm.com`, each of the following is a domain name:

- `ralvm7.vnet.ibm.com`
- `vnet.ibm.com`
- `ibm.com`

domain name server. In the Internet suite of protocols, a server program that supplies name-to-address translation by mapping domain names to IP addresses. Synonymous with *name server*.

Domain Name System (DNS). In the Internet suite of protocols, the distributed database system used to map domain names to IP addresses.

dotted decimal notation. The syntactical representation for a 32-bit integer that consists of four 8-bit numbers written in base 10 with periods (dots) separating them. It is used to represent IP addresses.

dump. (1) Data that has been dumped. (T) (2) To copy the contents of all or part of virtual storage for the purpose of collecting error information.

dynamic reconfiguration (DR). The process of changing the network configuration (peripheral PUs and LUs) without regenerating complete configuration tables or deactivating the affected major node.

Dynamic Routing. Routing using learned routes rather than routes statically configured at initialization.

E

echo. In data communication, a reflected signal on a communications channel. For example, on a communications terminal, each signal is displayed twice, once when entered at the local terminal and again when returned over the communications link. This allows the signals to be checked for accuracy.

EIA 232. In data communication, a specification of the Electronic Industries Association (EIA) that defines the interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE), using serial binary data interchange.

Electronic Industries Association (EIA). An organization of electronics manufacturers that advances the technological growth of the industry, represents the views of its members, and develops industry standards.

EIA unit. A unit of measure, established by the Electronic Industries Association, equal to 44.45 millimeters (1.75 inches).

encapsulation. (1) In communications, a technique used by layered protocols by which a layer adds control information to the protocol data unit (PDU) from the layer it supports. In this respect, the layer encapsulates the data from the supported layer. In the Internet suite of protocols, for example, a packet would contain

control information from the physical layer, followed by control information from the network layer, followed by the application protocol data. (2) See also *data link switching*.

encode. To convert data by the use of a code in such a manner that reconversion to the original form is possible. (T)

end node (EN). (1) See *Advanced Peer-to-Peer Networking (APPN) end node* and *low-entry networking (LEN) end node*. (2) In communications, a node that is frequently attached to a single data link and cannot perform intermediate routing functions.

entry point (EP). In SNA, a type 2.0, type 2.1, type 4, or type 5 node that provides distributed network management support. It sends network management data about itself and the resources it controls to a focal point for centralized processing, and it receives and executes focal-point initiated commands to manage and control its resources.

Ethernet. A 10-Mbps baseband local area network that allows multiple stations to access the transmission medium at will without prior coordination, avoids contention by using carrier sense and deference, and resolves contention by using collision detection and delayed retransmission. Ethernet uses carrier sense multiple access with collision detection (CSMA/CD).

exception. An abnormal condition such as an I/O error encountered in processing a data set or a file.

exception response (ER). In SNA, a protocol requested in the form-of-response-requested field of a request header that directs the receiver to return a response only if the request is unacceptable as received or cannot be processed; that is, a negative response, but not a positive response, can be returned. Contrast with *definite response* and *no response*.

exchange identification (XID). A specific type of basic link unit that is used to convey node and link characteristics between adjacent nodes. XIDs are exchanged between link stations before and during link activation to establish and negotiate link and node characteristics, and after link activation to communicate changes in these characteristics.

explicit route (ER). In SNA, a series of one or more transmission groups that connect two subarea nodes. An explicit route is identified by an origin subarea address, a destination subarea address, an explicit route number, and a reverse explicit route number. Contrast with *virtual route (VR)*.

explorer frame. See *explorer packet*.

explorer packet. In LANs, a packet that is generated by the source host and that traverses the entire source routing part of a LAN, gathering information on the possible paths available to the host.

exterior gateway. In Internet communications, a gateway on one autonomous system that communicates with another autonomous system. Contrast with *interior gateway*.

Exterior Gateway Protocol (EGP). In the Internet suite of protocols, a protocol, used between domains and autonomous systems, that enables network reachability information to be advertised and exchanged. IP network addresses in one autonomous system are advertised to another autonomous system by means of EGP-participating routers. An example of an EGP is the Border Gateway Protocol (BGP). Contrast with Interior Gateway Protocol (IGP).

F

fax. Hardcopy received from a facsimile machine. Synonymous with *telecopy*.

File Transfer Protocol (FTP). In the Internet suite of protocols, an application layer protocol that uses TCP and Telnet services to transfer bulk-data files between machines or hosts.

flash memory. A data storage device that is programmable, erasable, and does not require continuous power. The chief advantage of flash memory over other programmable and erasable data storage devices is that it can be reprogrammed without being removed from the circuit board.

flow control. (1) In SNA, the process of managing the rate at which data traffic passes between components of the network. The purpose of flow control is to optimize the rate of flow of message units with minimum congestion in the network; that is, to neither overflow the buffers at the receiver or at intermediate routing nodes, nor leave the receiver waiting for more message units. (2) See also *padding*.

fragment. See *fragmentation*.

fragmentation. (1) The process of dividing a datagram into smaller parts, or fragments, to match the capabilities of the physical medium over which it is to be transmitted. (2) See also *segmenting*.

frame. (1) In Open Systems Interconnection architecture, a data structure pertaining to a particular area of knowledge and consisting of slots that can accept the values of specific attributes and from which inferences can be drawn by appropriate procedural attachments. (T) (2) The unit of transmission in some local area networks, including the IBM Token-Ring Network. It includes delimiters, control characters, information, and checking characters. (3) In SDLC, the vehicle for every command, every response, and all information that is transmitted using SDLC procedures.

frame level. Synonymous with *data link level*. See *link level*.

frame relay. (1) An interface standard describing the boundary between a user's equipment and a fast-packet network. In frame-relay systems, flawed frames are discarded; recovery comes end-to-end rather than hop-by-hop. (2) A technique derived from the integrated services digital network (ISDN) D channel standard. It assumes that connections are reliable and dispenses with the overhead of error detection and control within the network.

front-end processor. A processor such as the IBM 3745 or 3174, that relieves a main frame from the communication control tasks.

G

gateway. (1) A functional unit that interconnects two computer networks with different network architectures. A gateway connects networks or systems of different architectures. A bridge interconnects networks or systems with the same or similar architectures. (T) (2) In the IBM Token-Ring Network, a device and its associated software that connect a local area network to another local area network or a host that uses different logical link protocols. (3) In TCP/IP, synonym for *router*.

general data stream (GDS). The data stream used for conversations in LU 6.2 sessions.

general data stream (GDS) variable. A type of RU substructure that is preceded by an identifier and a length field and includes either application data, user control data, or SNA-defined control data.

H

header. (1) System-defined control information that precedes user data. (2) The portion of a message that contains control information for the message such as one or more destination fields, name of the originating station, input sequence number, character string indicating the type of message, and priority level for the message.

heap memory. The amount of RAM used to dynamically allocate data structures.

Hello. A protocol used by a group of cooperating, trusting routers to allow them to discover minimal delay routes.

hello message. (1) A message sent periodically to establish and test reachability between routers or between routers and hosts. (2) In the Internet suite of protocols, a message defined by the Hello protocol as an Interior Gateway Protocol (IGP).

heuristic. Pertaining to exploratory methods of problem solving in which solutions are discovered by evaluation of the progress made toward the final result.

high-level data link control (HDLC). In data communication, the use of a specified series of bits to control data links in accordance with the International Standards for HDLC: ISO 3309 Frame Structure and ISO 4335 Elements of Procedures.

high-performance routing (HPR). An addition to the Advanced Peer-to-Peer Networking (APPN) architecture that enhances data routing performance and reliability, especially when using high-speed links.

hop. (1) In APPN, a portion of a route that has no intermediate nodes. It consists of only a single transmission group connecting adjacent nodes. (2) To the routing layer, the logical distance between two nodes in a network.

hop count. (1) A metric or measure of distance between two points. (2) In Internet communications, the number of routers that a datagram passes through on its way to its destination. (3) In SNA, a measure of the number of links to be traversed in a path to a destination.

host. In the Internet suite of protocols, an end system. The end system can be any workstation; it does not have to be a mainframe.

hot pluggable. Refers to a hardware component that can be installed or removed without disturbing the operation of any other resource that is not connected to, or dependant on, this component.

hub (intelligent). A wiring concentrator, such as the IBM 8260, that provides bridging and routing functions for LANs with different cables and protocols.

hysteresis. The amount the temperature must change past the set alert threshold before the alert condition is cleared.

I

I-frame. Information frame.

information (I) frame. A frame in I format used for numbered information transfer.

input/output channel. In a data processing system, a functional unit that handles transfer of data between internal and peripheral equipment. (I) (A)

Integrated Digital Network Exchange (IDNX). A processor integrating voice, data, and image applications. It also manages the transmission resources, and connects to multiplexers and network management support systems. It allows integration of equipment from different vendors.

integrated services digital network (ISDN). A digital end-to-end telecommunication network that supports multiple services including, but not limited to, voice and data.

Note: ISDNs are used in public and private network architectures.

interface. (1) A shared boundary between two functional units, defined by functional characteristics, signal characteristics, or other characteristics, as appropriate. The concept includes the specification of the connection of two devices having different functions. (T) (2) Hardware, software, or both, that links systems, programs, or devices.

interior gateway. In Internet communications, a gateway that communicates only with its own autonomous system. Contrast with *exterior gateway*.

Interior Gateway Protocol (IGP). In the Internet suite of protocols, a protocol used to propagate network reachability and routing information within an autonomous system. Examples of IGPs are Routing Information Protocol (RIP) and Open Shortest Path First (OSPF).

intermediate node. A node that is at the end of more than one branch. (T)

intermediate session routing (ISR). A type of routing function within an APPN network node that provides session-level flow control and outage reporting for all sessions that pass through the node but whose end points are elsewhere.

International Organization for Standardization (ISO). An organization of national standards bodies from various countries established to promote development of standards to facilitate international exchange of goods and services, and develop cooperation in intellectual, scientific, technological, and economic activity.

International Telecommunication Union (ITU). The specialized telecommunication agency of the United Nations, established to provide standardized communication procedures and practices, including frequency allocation and radio regulations worldwide.

internet. A collection of networks interconnected by a set of routers that allow them to function as a single, large network. See also *Internet*.

Internet. The internet administered by the Internet Architecture Board (IAB), consisting of large national backbone networks and many regional and campus networks all over the world. The Internet uses the Internet suite of protocols.

Internet address. See *IP address*.

Internet Architecture Board (IAB). The technical body that oversees the development of the Internet suite of protocols that are known as TCP/IP.

Internet Control Message Protocol (ICMP). The protocol used to handle errors and control messages in

the Internet Protocol (IP) layer. Reports of problems and incorrect datagram destinations are returned to the original datagram source. ICMP is part of the Internet Protocol.

Internet Control Protocol (ICP). The Virtual NEtworking System (VINES) protocol that provides exception notifications, metric notifications, and PING support. See also *RouTing update Protocol (RTP)*.

Internet Engineering Task Force (IETF). The task force of the Internet Architecture Board (IAB) that is responsible for solving the short-term engineering needs of the Internet.

Internetwork Packet Exchange (IPX). (1) The network protocol used to connect Novell's servers, or any workstation or router that implements IPX, with other workstations. Although similar to the Internet Protocol (IP), IPX uses different packet formats and terminology. (2) See also *Xerox Network Systems (XNS)*.

Internet Protocol (IP). A connectionless protocol that routes data through a network or interconnected networks. IP acts as an intermediary between the higher protocol layers and the physical network. However, this protocol does not provide error recovery and flow control and does not guarantee the reliability of the physical network.

interoperability. The capability to communicate, execute programs, or transfer data among various functional units in a way that requires the user to have little or no knowledge of the unique characteristics of those units. (T)

intra-area routing. In Internet communications, the routing of data within an area.

Inverse Address Resolution Protocol (InARP). In the Internet suite of protocols, the protocol used for locating a protocol address through the known hardware address. In a frame-relay context, the data link connection identifier (DLCI) is synonymous with the known hardware address.

IPPN. The interface that other protocols can use to transport data over IP.

IP address. The 32-bit address defined by the Internet Protocol, standard 5, Request for Comments (RFC) 791. It is usually represented in dotted decimal notation.

IP datagram. In the Internet suite of protocols, the fundamental unit of information transmitted through an internet. It contains source and destination addresses, user data, and control information such as the length of the datagram, the header checksum, and flags indicating whether the datagram can be or has been fragmented.

IP router. A device in an IP internet that is responsible for making decisions about the paths over which network traffic will flow. Routing protocols are used to gain information about the network and to determine the best route over which the datagram should be forwarded toward the final destination. The datagrams are routed based on IP destination addresses.

IPXWAN. A Novell protocol that is used to exchange router-to-router information before exchanging standard Internetwork Packet Exchange (IPX) routing information and traffic over wide area networks (WANs).

J

jitter. (1) Short-term non-cumulative variations of the significant instants of a digital signal from their ideal positions in time. (2) Undesirable variations of a transmitted digital signal. (3) Variations in the network delay.

L

L2TP Access Concentrator (LAC). A device attached to one or more public service telephone network (PSTN) or ISDN lines capable of handling both PPP operation and of the L2TP protocol. The LAC implements the media over which L2TP operates. L2TP passes the traffic to one or more L2TP Network Servers (LNS). L2TP can tunnel any protocol carried by the PPP network.

L2TP Network Server (LNS). An LNS operates on any platform capable that can be a PPP end station. The LNS handles the server side of the L2TP protocol. Since L2TP relies only on the single media over which L2TP tunnels arrive, the LNS has only a single LAN or WAN interface, yet is still able to terminate calls arriving from any the full range of PPP interfaces supported by a LAC. These include asynchronous ISDN, synchronous ISDN, V.120, and other types of connections.

LAN bridge server (LBS). In the IBM Token-Ring Network Bridge Program, the server that keeps statistical information about frames forwarded between two or more rings (through a bridge). The LBS sends these statistics to the appropriate LAN managers through the LAN reporting mechanism (LRM).

LAN Emulation (LE). An ATM Forum standard that supports legacy LAN applications over ATM networks.

LAN Emulation Client (LEC). A LAN Emulation component that represents users of the Emulated LAN.

LAN Emulation Configuration Server (LECS). A LAN Emulation Service component that centralizes and disseminates configuration data.

LAN Emulation Server (LES). A LAN Emulation Service component that resolves LAN Destinations to ATM Addresses.

LAN Network Manager (LNM). An IBM licensed program that enables a user to manage and monitor LAN resources from a central workstation.

LAN segment. (1) Any portion of a LAN (for example, a bus or ring) that can operate independently, but that is connected to other parts of the network by means of bridges. (2) A ring or bus network without bridges.

layer. (1) In network architecture, a group of services that is complete from a conceptual point of view, that is one out of a set of hierarchically arranged groups, and that extends across all systems that conform to the network architecture. (T) (2) In the Open Systems Interconnection reference model, one of seven conceptually complete, hierarchically arranged groups of services, functions, and protocols, that extend across all open systems. (T) (3) In SNA, a grouping of related functions that are logically separate from the functions in other groups. Implementation of the functions in one layer can be changed without affecting functions in other layers.

LE. LAN Emulation. An ATM Forum standard that supports legacy LAN applications over ATM networks.

LEC. LAN Emulation Client. A LAN Emulation component that represents users of the Emulated LAN.

LECS. LAN Emulation Configuration Server. A LAN Emulation Service component that centralizes and disseminates configuration data.

LES. LAN Emulation Server. A LAN Emulation Service component that resolves LAN Destinations to ATM Addresses.

line switching. Synonym for *circuit switching*.

link. The combination of the link connection (the transmission medium) and two link stations, one at each end of the link connection. A link connection can be shared among multiple links in a multipoint or token-ring configuration.

link access protocol balanced (LAPB). A protocol used for accessing an X.25 network at the link level. LAPB is a duplex, asynchronous, symmetric protocol, used in point-to-point communication.

Link Address. For the 2216 with an ESCON Channel Adapter, a port number determined as follows: If one ESCD is in the communication path, it is the ESCON Director (ESCD) port number that is attached to the host. If two ESCDs are in the path, it is the host-side port number of the ESCD defined with the dynamic connection. When no ESCD is in the communication path, this value must be set to X'01'.

link-attached. (1) Pertaining to devices that are connected to a controlling unit by a data link. (2) Contrast with *channel-attached*. (3) Synonymous with *remote*.

link connection. (1) The physical equipment providing two-way communication between one link station and one or more other link stations; for example, a telecommunication line and data circuit-terminating equipment (DCE). (2) In SNA, synonymous with *data circuit*.

link level. (1) A part of Recommendation X.25 that defines the link protocol used to get data into and out of the network across the full-duplex link connecting the subscriber's machine to the network node. LAP and LAPB are the link access protocols recommended by the CCITT. (2) See *data link level*.

link-state. In routing protocols, the advertised information about the usable interfaces and reachable neighbors of a router or network. The protocol's topological database is formed from the collected link-state advertisements.

link station. (1) The hardware and software components within a node representing a connection to an adjacent node over a specific link. For example, if node A is the primary end of a multipoint line that connects to three adjacent nodes, node A will have three link stations representing the connections to the adjacent nodes. (2) See also *adjacent link station (ALS)*.

local. (1) Pertaining to a device accessed directly without use of a telecommunication line. (2) Contrast with *remote*. (3) Synonym for *channel-attached*.

local area network (LAN). (1) A computer network located on a user's premises within a limited geographical area. Communication within a local area network is not subject to external regulations; however, communication across the LAN boundary may be subject to some form of regulation. (T) (2) A network in which a set of devices are connected to one another for communication and that can be connected to a larger network. (3) See also *Ethernet* and *token ring*. (4) Contrast with *metropolitan area network (MAN)* and *wide area network (WAN)*.

local bridging. A function of a bridge program that allows a single bridge to connect multiple LAN segments without using a telecommunication link. Contrast with *remote bridging*.

local management interface (LMI). See *local management interface (LMI) protocol*.

local management interface (LMI) protocol. In NCP, a set of frame-relay network management procedures and messages used by adjacent frame-relay nodes to exchange line status information over DLCI X'00'. NCP supports both the American National Standards Institute (ANSI) and International Telegraph and Telephone

Consultative Committee (ITU-T/CCITT) versions of LMI protocol. These standards refer to LMI protocol as *link integrity verification tests (LIVT)*.

locally administered address. In a local area network, an adapter address that the user can assign to override the universally administered address. Contrast with *universally administered address*.

logical channel. In packet mode operation, a sending channel and a receiving channel that together are used to send and receive data over a data link at the same time. Several logical channels can be established on the same data link by interleaving the transmission of packets.

logical link. A pair of link stations, one in each of two adjacent nodes, and their underlying link connection, providing a single link-layer connection between the two nodes. Multiple logical links can be distinguished while they share the use of the same physical media connecting two nodes. Examples are 802.2 logical links used on local area network (LAN) facilities and LAP E logical links on the same point-to-point physical link between two nodes. The term logical link also includes the multiple X.25 logical channels that share the use of the access link from a DTE to an X.25 network.

logical link control (LLC). The data link control (DLC) LAN sublayer that provides two types of DLC operation for the orderly exchange of information. The first type is connectionless service, which allows information to be sent and received without establishing a link. The LLC sublayer does not perform error recovery or flow control for connectionless service. The second type is connection-oriented service, which requires establishing a link prior to the exchange of information. Connection-oriented service provides sequenced information transfer, flow control, and error recovery.

logical link control (LLC) protocol. In a local area network, the protocol that governs the exchange of transmission frames between data stations independently of how the transmission medium is shared. (T) The LLC protocol was developed by the IEEE 802 committee and is common to all LAN standards.

logical link control (LLC) protocol data unit. A unit of information exchanged between link stations in different nodes. The LLC protocol data unit contains a destination service access point (DSAP), a source service access point (SSAP), a control field, and user data.

logical partition. A number assigned to a partition in a host that can operate in logically partitioned (LPAR) mode. In LPAR mode, the ESCON adapter can share a physical fiber connection with multiple host partitions.

Logically Partitioned (LPAR) mode. A function of some host processors in which processing is divided into logical partitions (LPs) to provide the appearance of

multiple processors. In LPAR mode, the ESCON adapter can share a physical fiber connection with multiple host partitions.

LP. logical partition

LP number. Logical partition number. This allows multiple logical host partitions, LPs, to share one ESCON fiber. This value is defined in the host Input/Output Configuration Program (IOCP) by the RESOURCE macro instruction. If the host is not using EMIF, use the default of 0 for the LP number.

LPAR. logically partitioned

LPAR mode. Logically Partitioned (LPAR) mode.

logical unit (LU). A type of network accessible unit that enables users to gain access to network resources and communicate with each other.

loopback test. A test in which signals from a tester are looped at a modem or other network element back to the tester for measurements that determine or verify the quality of the communications path.

low-entry networking (LEN). A capability of nodes to attach directly to one another using basic peer-to-peer protocols to support multiple and parallel sessions between logical units.

low-entry networking (LEN) end node. A LEN node receiving network services from an adjacent APPN network node.

low-entry networking (LEN) node. A node that provides a range of end-user services, attaches directly to other nodes using peer protocols, and derives network services implicitly from an adjacent APPN network node, that is, without the direct use of CP-CP sessions.

M

Management Information Base (MIB). (1) A collection of objects that can be accessed by means of a network management protocol. (2) A definition for management information that specifies the information available from a host or gateway and the operations allowed. (3) In OSI, the conceptual repository of management information within an open system.

management station. In Internet communications, the system responsible for managing all, or a portion of, a network. The management station communicates with network management agents that reside in the managed node by means of a network management protocol, such as the Simple Network Management Protocol (SNMP).

mapping. The process of converting data that is transmitted in one format by the sender into the data format that can be accepted by the receiver.

mask. (1) A pattern of characters used to control retention or elimination of portions of another pattern of characters. (I) (A) (2) To use a pattern of characters to control retention or elimination of portions of another pattern of characters. (I) (A)

maximum transmission unit (MTU). In LANs, the largest possible unit of data that can be sent on a given physical medium in a single frame. For example, the MTU for Ethernet is 1500 bytes.

medium access control (MAC). In LANs, the sublayer of the data link control layer that supports medium-dependent functions and uses the services of the physical layer to provide services to the logical link control (LLC) sublayer. The MAC sublayer includes the method of determining when a device has access to the transmission medium.

medium access control (MAC) protocol. In a local area network, the protocol that governs access to the transmission medium, taking into account the topological aspects of the network, in order to enable the exchange of data between data stations. (T)

medium access control (MAC) sublayer. In a local area network, the part of the data link layer that applies a medium access method. The MAC sublayer supports topology-dependent functions and uses the services of the physical layer to provide services to the logical link control sublayer. (T)

metric. In Internet communications, a value, associated with a route, which is used to discriminate between multiple exit or entry points to the same autonomous system. The route with the lowest metric is preferred.

metropolitan area network (MAN). A network formed by the interconnection of two or more networks which may operate at higher speed than those networks, may cross administrative boundaries, and may use multiple access methods. (T) Contrast with *local area network (LAN)* and *wide area network (WAN)*.

MIB. (1) MIB module. (2) Management Information Base.

MIB object. Synonym for *MIB variable*.

MIB variable. In the Simple Network Management Protocol (SNMP), a specific instance of data defined in a MIB module. Synonymous with *MIB object*.

MIB view. In the Simple Network Management Protocol (SNMP), the collection of managed objects, known to the agent, that is visible to a particular community.

MILNET. The military network that was originally part of ARPANET. It was partitioned from ARPANET in 1984. MILNET provides a reliable network service for military installations.

modem (modulator/demodulator). (1) A functional unit that modulates and demodulates signals. One of the functions of a modem is to enable digital data to be transmitted over analog transmission facilities. (T) (A) (2) A device that converts digital data from a computer to an analog signal that can be transmitted on a telecommunication line, and converts the analog signal received to data for the computer.

module. In the Nways Switch, a packaged functional hardware unit containing logic cards, connectors, and lights. The modules are used to package adapters, line interface couplers, voice server extensions, and other components. All modules are *hot pluggable* in the logic subracks.

modulo. (1) Pertaining to a modulus; for example, 9 is equivalent to 4 modulo 5. (2) See also *modulus*.

modulus. A number, such as a positive integer, in a relationship that divides the difference between two related numbers without leaving a remainder; for example, 9 and 4 have a modulus of 5 ($9 - 4 = 5$; $4 - 9 = -5$; and 5 divides both 5 and -5 without leaving a remainder).

monitor. (1) A device that observes and records selected activities within a data processing system for analysis. Possible uses are to indicate significant departure from the norm, or to determine levels of utilization of particular functional units. (T) (2) Software or hardware that observes, supervises, controls, or verifies operations of a system. (A) (3) The function required to initiate the transmission of a token on the ring and to provide soft-error recovery in case of lost tokens, circulating frames, or other difficulties. The capability is present in all ring stations.

multicast. (1) Transmission of the same data to a selected group of destinations. (T) (2) A special form of broadcast in which copies of a packet are delivered to only a subset of all possible destinations.

multipath channel (MPC). A channel protocol that uses multiple unidirectional subchannels for VTAM-to-VTAM bidirectional communication.

multiple-domain support (MDS). A technique for transporting management services data between management services function sets over LU-LU and CP-CP sessions. See also *multiple-domain support message unit (MDS-MU)*.

multiple-domain support message unit (MDS-MU). The message unit that contains management services data and flows between management services function sets over the LU-LU and CP-CP sessions used by multiple-domain support. This message unit, as well as the actual management services data that it contains, is in general data stream (GDS) format. See also *control point management services unit (CP-MSU)*, *management services unit (MSU)*, and *network management vector transport (NMVT)*.

N

Name Binding Protocol (NBP). In AppleTalk networks, a protocol that provides name translation function from the AppleTalk entity (resource) name (character string) into an AppleTalk IP address (16-bit number) on the transport layer.

name resolution. In Internet communications, the process of mapping a machine name to the corresponding Internet Protocol (IP) address. See also *Domain Name System (DNS)*.

name server. In the Internet suite of protocols, synonym for *domain name server*.

nearest active upstream neighbor (NAUN). In the IBM Token-Ring Network, the station sending data directly to a given station on the ring.

neighbor. A router on a common subnetwork that has been designated by a network administrator to receive routing information.

NetBIOS. Network Basic Input/Output System. A standard interface to networks, IBM personal computers (PCs), and compatible PCs, that is used on LANs to provide message, print-server, and file-server functions. Application programs that use NetBIOS do not need to handle the details of LAN data link control (DLC) protocols.

network. (1) A configuration of data processing devices and software connected for information interchange. (2) A group of nodes and the links interconnecting them.

Network Access Server (NAS). A device providing temporary, on-demand network access to users. This access is point-to-point using PSTN or ISDN lines.

network accessible unit (NAU). A logical unit (LU), physical unit (PU), control point (CP), or system services control point (SSCP). It is the origin or the destination of information transmitted by the path control network. Synonymous with *network addressable unit*.

network address. According to ISO 7498-3, a name, unambiguous within the OSI environment, that identifies a set of network service access points.

network addressable unit (NAU). Synonym for *network accessible unit*.

network architecture. The logical structure and operating principles of a computer network. (T)

Note: The operating principles of a network include those of services, functions, and protocols.

network congestion. An undesirable overload condition caused by traffic in excess of what a network can handle.

network identifier. (1) In TCP/IP, that part of the IP address that defines a network. The length of the network ID depends on the type of network class (A, B, or C). (2) A 1- to 8-byte customer-selected name or an 8-byte IBM-registered name that uniquely identifies a specific subnetwork.

Network Information Center (NIC). In Internet communications, local, regional, and national groups throughout the world who provide assistance, documentation, training, and other services to users.

network layer. In Open Systems Interconnection (OSI) architecture, the layer that is responsible for routing, switching, and link-layer access across the OSI environment.

network management. The process of planning, organizing, and controlling a communication-oriented data processing or information system.

network management station. In the Simple Network Management Protocol (SNMP), a station that executes management application programs that monitor and control network elements.

network management vector transport (NMVT). A management services request/response unit (RU) that flows over an active session between physical unit management services and control point management services (SSCP-PU session).

network manager. A program or group of programs that is used to monitor, manage, and diagnose the problems of a network.

network node (NN). See *Advanced Peer-to-Peer Networking (APPN) network node*.

network support station. The processor used to locally operate and service the Nways Switch. It is used by the Nways Switch administrator or service personnel.

network user address (NUA). In X.25 communications, the X.121 address containing up to 15 binary code digits.

node. (1) In a network, a point at which one or more functional units connect channels or data circuits. (I) (2) Any device, attached to a network, that transmits and receives data.

noncanonical address. In LANs, a format for the transmission of medium access control (MAC) addresses for token-ring adapters. In noncanonical format, the most significant (leftmost) bit of each address byte is transmitted first. Contrast with *canonical address*.

Non-Return-to-Zero Changes-on-Ones Recording (NRZ-1). A recording method in which the ones are represented by a change in the condition of magnetization, and zeros are represented by the

absence of change. Only the one signals are explicitly recorded. (Previously called *non-return-to-zero inverted*, NRZI, recording.)

nonseed router. In AppleTalk networks, a router that acquires network number range and zone list information from a seed router attached to the same network.

Nways Switch. Synonymous with IBM 2220 Nways BroadBand Switch.

Nways Switch configuration station. A dedicated OS/2 station running a stand-alone version of the Nways Switch Configuration Tool (NCT). It is used to generate a network configuration database and should be installed as a remote console.

O

Open Shortest Path First (OSPF). In the Internet suite of protocols, a function that provides intradomain information transfer. An alternative to the Routing Information Protocol (RIP), OSPF allows the lowest-cost routing and handles routing in large regional or corporate networks.

Open Systems Interconnection (OSI). (1) The interconnection of open systems in accordance with standards of the International Organization for Standardization (ISO) for the exchange of information. (T) (A) (2) The use of standardized procedures to enable the interconnection of data processing systems.

Note: OSI architecture establishes a framework for coordinating the development of current and future standards for the interconnection of computer systems. Network functions are divided into seven layers. Each layer represents a group of related data processing and communication functions that can be carried out in a standard way to support different applications.

Open Systems Interconnection (OSI) architecture. Network architecture that adheres to that particular set of ISO standards that relates to Open Systems Interconnection. (T)

Open Systems Interconnection (OSI) reference model. A model that describes the general principles of the Open Systems Interconnection, as well as the purpose and the hierarchical arrangement of its seven layers. (T)

origin. An external logical unit (LU) or application program from which a message or other data originates. See also *destination*.

orphan circuit. A non-configured circuit whose availability is learned dynamically.

P

padding. (1) A technique by which a receiving component controls the rate of transmission of a sending component to prevent overrun or congestion. (2) See also *flow control*, *receive pacing*, *send pacing*, *session-level pacing*, and *virtual route (VR) pacing*.

packet. In data communication, a sequence of binary digits, including data and control signals, that is transmitted and switched as a composite whole. The data, control signals, and, possibly, error control information are arranged in a specific format. (I)

packet internet groper (PING). (1) In Internet communications, a program used in TCP/IP networks to test the ability to reach destinations by sending the destinations an Internet Control Message Protocol (ICMP) echo request and waiting for a reply. (2) In communications, a test of reachability.

packet loss ratio. The probability that a packet will not reach its destination or not reach it within a specified time.

packet mode operation. Synonym for *packet switching*.

packet switching. (1) The process of routing and transferring data by means of addressed packets so that a channel is occupied only during transmission of a packet. On completion of the transmission, the channel is made available for transfer of other packets. (I) (2) Synonymous with *packet mode operation*. See also *circuit switching*.

parallel bridges. A pair of bridges connected to the same LAN segment, creating redundant paths to the segment.

parallel transmission groups. Multiple transmission groups between adjacent nodes, with each group having a distinct transmission group number.

path. (1) In a network, any route between any two nodes. A path may include more than one branch. (T) (2) The series of transport network components (path control and data link control) that are traversed by the information exchanged between two network accessible units. See also *explicit route (ER)*, *route extension*, and *virtual route (VR)*.

path control (PC). The function that routes message units between network accessible units in the network and provides the paths between them. It converts the basic information units (BIUs) from transmission control (possibly segmenting them) into path information units (PIUs) and exchanges basic transmission units containing one or more PIUs with data link control. Path control differs by node type: some nodes (APPN nodes,

for example) use locally generated session identifiers for routing, and others (subarea nodes) use network addresses for routing.

path cost. In link-state routing protocols, the sum of the link costs along the path between two nodes or networks.

path information unit (PIU). A message unit consisting of a transmission header (TH) alone, or a TH followed by a basic information unit (BIU) or a BIU segment.

pattern-matching character. A special character such as an asterisk (*) or a question mark (?) that can be used to represent one or more characters. Any character or set of characters can replace a pattern-matching character. Synonymous with *global character* and *wildcard character*.

permanent virtual circuit (PVC). In X.25 and frame-relay communications, a virtual circuit that has a logical channel permanently assigned to it at each data terminal equipment (DTE). Call-establishment protocols are not required. Contrast with *switched virtual circuit (SVC)*.

physical circuit. A circuit established without multiplexing. See also *data circuit*. Contrast with *virtual circuit*.

physical layer. In the Open Systems Interconnection reference model, the layer that provides the mechanical, electrical, functional, and procedural means to establish, maintain, and release physical connections over the transmission medium. (T)

physical unit (PU). (1) The component that manages and monitors the resources (such as attached links and adjacent link stations) associated with a node, as requested by an SSCP via an SSCP-PU session. An SSCP activates a session with the physical unit in order to indirectly manage, through the PU, resources of the node such as attached links. This term applies to type 2.0, type 4, and type 5 nodes only. (2) See also *peripheral PU* and *subarea PU*.

ping command. The command that sends an Internet Control Message Protocol (ICMP) echo-request packet to a gateway, router, or host with the expectation of receiving a reply.

Point-to-Point Protocol (PPP). A protocol that provides a method for encapsulating and transmitting packets over serial point-to-point links.

polling. (1) On a multipoint connection or a point-to-point connection, the process whereby data stations are invited, one at a time, to transmit. (I) (2) Interrogation of devices for such purposes as to avoid contention, to determine operational status, or to determine readiness to send or receive data. (A)

port. (1) An access point for data entry or exit. (2) A connector on a device to which cables for other devices such as display stations and printers are attached. (3) The representation of a physical connection to the link hardware. A port is sometimes referred to as an adapter; however, there can be more than one port on an adapter. There may be one or more ports controlled by a single DLC process. (4) In the Internet suite of protocols, a 16-bit number used to communicate between TCP or the User Datagram Protocol (UDP) and a higher-level protocol or application. Some protocols, such as File Transfer Protocol (FTP) and Simple Mail Transfer Protocol (SMTP), use the same well-known port number in all TCP/IP implementations. (5) An abstraction used by transport protocols to distinguish among multiple destinations within a host machine. (6) Synonymous with *socket*.

port number. In Internet communications, the identification of an application entity to the transport service.

private branch exchange (PBX). A private telephone exchange for transmission of calls to and from the public telephone network.

problem determination. The process of determining the source of a problem; for example, a program component, machine failure, telecommunication facilities, user or contractor-installed programs or equipment, environmental failure such as a power loss, or user error.

program temporary fix (PTF). A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of the program.

protocol. (1) A set of semantic and syntactic rules that determine the behavior of functional units in achieving communication. (I) (2) In Open Systems Interconnection architecture, a set of semantic and syntactic rules that determine the behavior of entities in the same layer in performing communication functions. (T) (3) In SNA, the meanings of, and the sequencing rules for, requests and responses used for managing the network, transferring data, and synchronizing the states of network components. Synonymous with *line control discipline* and *line discipline*. See *bracket protocol* and *link protocol*.

protocol data unit (PDU). A unit of data specified in a protocol of a given layer and consisting of protocol control information of this layer, and possibly user data of this layer. (T)

pulse code modulation (PCM). A standard adopted for the digitalization of an analog voice signal. In PCM, the voice is sampled at a rate of eight kHz and each sample is coded in an 8-bit frame.

R

Rapid Transport Protocol (RTP) connection. In high-performance routing (HPR), the connection established between the endpoints of the route to transport session traffic.

reachability. The ability of a node or a resource to communicate with another node or resource.

read-only memory (ROM). Memory in which stored data cannot be modified by the user except under special conditions.

real-time processing. The manipulation of data that are required, or generated, by some process while the process is in operation. Usually the results are used to influence the process, and perhaps related processes, while it is occurring.

reassembly. In communications, the process of putting segmented packets back together after they have been received.

receive not ready (RNR). In communications, a data link command or response that indicates a temporary condition of being unable to accept incoming frames.

receive not ready (RNR) packet. See *RNR packet*.

received line signal detector (RLSD). In the EIA 232 standard, a signal that indicates to the data terminal equipment (DTE) that it is receiving a signal from the remote data circuit-terminating equipment (DCE). Synonymous with *carrier detect* and *data carrier detect (DCD)*.

Recognized Private Operating Agency (RPOA). Any individual, company, or corporation, other than a government department or service, that operates a telecommunication service and is subject to the obligations undertaken in the Convention of the International Telecommunication Union and in the Regulations; for example, a communication common carrier.

reduced instruction-set computer (RISC). A computer that uses a small, simplified set of frequently used instructions for rapid execution.

remote. (1) Pertaining to a system, program, or device that is accessed through a telecommunication line. (2) Synonym for *link-attached*. (3) Contrast with *local*.

remote bridging. The function of a bridge that allows two bridges to connect multiple LANs using a telecommunication link. Contrast with *local bridging*.

remote console. A station running OS/2, TCP/IP, and the remote Nways Switch Resource Control program. It can be connected to any network support station to operate and service the Nways Switch remotely. The connection may be through:

- A switched line using a modem

Any network support station can be used as a remote console of another network support station.

Remote Execution Protocol (REXEC). A protocol that allows the execution of a command or program on any host in the network. The local host receives the results of the command execution.

Request for Comments (RFC). In Internet communications, the document series that describes a part of the Internet suite of protocols and related experiments. All Internet standards are documented as RFCs.

reset. On a virtual circuit, reinitialization of data flow control. At reset, all data in transit are eliminated.

reset request packet. In X.25 communications, a packet transmitted by the data terminal equipment (DTE) to the data circuit-terminating equipment (DCE) to request that a virtual call or a permanent virtual circuit be reset. The reason for the request can also be specified in the packet.

resource. In the Nways Switch, an hardware element or a logical entity created by the Control Program. For example, the adapters, LICs, and lines are physical resources. The control points and connections are logical resources.

ring. See *ring network*.

ring network. (1) A network in which every node has exactly two branches connected to it and in which there are exactly two paths between any two nodes. (T) (2) A network configuration in which devices are connected by unidirectional transmission links to form a closed path.

ring segment. A section of a ring that can be isolated (by unplugging connectors) from the rest of the ring. See *LAN segment*.

rlogin (remote login). A service, offered by Berkeley UNIX-based systems, that allows authorized users of one machine to connect to other UNIX systems across an internet and interact as if their terminals were connected directly. The rlogin software passes information about the user's environment (for example, terminal type) to the remote machine.

RNR packet. A packet used by a data terminal equipment (DTE) or by a data circuit-terminating equipment (DCE) to indicate a temporary inability to accept additional packets for a virtual call or permanent virtual circuit.

root bridge. The bridge that is the root of a spanning tree formed between other active bridges in the bridging network. The root bridge originates and transmits bridge protocol data units (BPDUs) to other active bridges to

maintain the spanning tree topology. It is the bridge with the highest priority in the network.

route. (1) An ordered sequence of nodes and transmission groups (TGs) that represent a path from an origin node to a destination node traversed by the traffic exchanged between them. (2) The path that network traffic uses to get from source to destination.

route bridge. A function of an IBM bridge program that allows two bridge computers to use a telecommunication link to connect two LANs. Each bridge computer is connected directly to one of the LANs, and the telecommunication link connects the two bridge computers.

route extension (REX). In SNA, the path control network components, including a peripheral link, that make up the portion of a path between a subarea node and a network addressable unit (NAU) in an adjacent peripheral node. See also *explicit route (ER)*, *path*, and *virtual route (VR)*.

Route Selection control vector (RSCV). A control vector that describes a route within an APPN network. The RSCV consists of an ordered sequence of control vectors that identify the TGs and nodes that make up the path from an origin node to a destination node.

router. (1) A computer that determines the path of network traffic flow. The path selection is made from several paths based on information obtained from specific protocols, algorithms that attempt to identify the shortest or best path, and other criteria such as metrics or protocol-specific destination addresses. (2) An attaching device that connects two LAN segments, which use similar or different architectures, at the reference model network layer. (3) In OSI terminology, a function that determines a path by which an entity can be reached. (4) In TCP/IP, synonymous with *gateway*. (5) Contrast with *bridge*.

routing. (1) The assignment of the path by which a message is to reach its destination. (2) In SNA, the forwarding of a message unit along a particular path through a network, as determined by parameters carried in the message unit, such as the destination network address in a transmission header.

routing domain. In Internet communications, a group of intermediate systems that use a routing protocol so that the representation of the overall network is the same within each intermediate system. Routing domains are connected to each other by exterior links.

Routing Information Protocol (RIP). In the Internet suite of protocols, an interior gateway protocol used to exchange intradomain routing information and to determine optimum routes between internet hosts. RIP determines optimum routes on the basis of route metrics, not link transmission speed.

routing loop. A situation that occurs when routers circulate information among themselves until convergence occurs or until the networks involved are considered unreachable.

routing protocol. A technique used by a router to find other routers and to remain up to date about the best way to get to reachable networks.

routing table. A collection of routes used to direct datagram forwarding or to establish a connection. The information is passed among routers to identify network topology and destination feasibility.

Routing Table Maintenance Protocol (RTMP). In AppleTalk networks, a protocol that provides routing information generation and maintenance on the transport layer by means of the AppleTalk routing table. The AppleTalk routing table directs packet transmission through the internet from source socket to destination socket.

RouTing update Protocol (RTP). The Virtual NEtworking System (VINES) protocol that maintains the routing database and allows the exchange of routing information between VINES nodes. See also *Internet Control Protocol (ICP)*.

rsh. A variant of the rlogin command that invokes a command interpreter on a remote UNIX machine and passes the command-line arguments to the command interpreter, skipping the login step completely.

S

SAP. See service access point.

seed router. In AppleTalk networks, a router that maintains configuration data (network range numbers and zone lists, for example) for the network. Each network must have at least one seed router. The seed router must be initially set up using the configurator tool. Contrast with *nonseed router*.

segment. (1) A section of cable between components or devices. A segment may consist of a single patch cable, several patch cables that are connected, or a combination of building cable and patch cables that are connected. (2) In Internet communications, the unit of transfer between TCP functions in different machines. Each segment contains control and data fields; the current byte-stream position and actual data bytes are identified along with a checksum to validate received data.

segmenting. In OSI, a function performed by a layer to map one protocol data unit (PDU) from the layer it supports into multiple PDUs.

sequence number. In communications, a number assigned to a particular frame or packet to control the transmission flow and receipt of data.

Serial Line Internet Protocol (SLIP). A protocol used over a point-to-point connection between two IP hosts over a serial line, for example, a serial cable or an RS232 connection into a modem, over a telephone line.

server. A functional unit that provides shared services to workstations over a network; for example, a file server, a print server, a mail server. (T)

service access point (SAP). (1) In Open Systems Interconnection (OSI) architecture, the point at which the services of a layer are provided by an entity of that layer to an entity of the next higher layer. (T) (2) A logical point made available by an adapter where information can be received and transmitted. A single service access point can have many links terminating in it.

Service Advertising Protocol (SAP). In Internetwork Packet Exchange (IPX), a protocol that provides the following:

- A mechanism that allows IPX servers on an internet to advertise their services by name and type. Servers using this protocol have their name, service type, and address recorded in all file servers running NetWare.
- A mechanism that allows a workstation to broadcast a query to discover the identities of all servers of all types, all servers of a specific type, or the nearest server of a specific type.
- A mechanism that allows a workstation to query any file server running NetWare to discover the names and addresses of all servers of a specific type.

session. (1) In network architecture, for the purpose of data communication between functional units, all the activities which take place during the establishment, maintenance, and release of the connection. (T) (2) A logical connection between two network accessible units (NAUs) that can be activated, tailored to provide various protocols, and deactivated, as requested. Each session is uniquely identified in a transmission header (TH) accompanying any transmissions exchanged during the session. (3) In L2TP, L2TP creates a session when an end-to-end PPP connection is attempted between a dial user and the LNS; regardless of whether the user initiates the session or the LNS initiates an outbound call. The datagrams for th session are sent over the tunnel between the LAC and LNS. The LNS and LAC maintain the state information for each user attached to an LAC.

Simple Network Management Protocol (SNMP). In the Internet suite of protocols, a network management protocol that is used to monitor routers and attached networks. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SNA management services (SNA/MS). The services provided to assist in management of SNA networks.

socket. (1) An endpoint for communication between processes or application programs. (2) The abstraction provided by the University of California's Berkeley Software Distribution (commonly called Berkeley UNIX or BSD UNIX) that serves as an endpoint for communication between processes or applications.

source route bridging. In LANs, a bridging method that uses the routing information field in the IEEE 802.5 medium access control (MAC) header of a frame to determine which rings or token-ring segments the frame must transit. The routing information field is inserted into the MAC header by the source node. The information in the routing information field is derived from explorer packets generated by the source host.

source routing. In LANs, a method by which the sending station determines the route the frame will follow and includes the routing information with the frame. Bridges then read the routing information to determine whether they should forward the frame.

source service access point (SSAP). In SNA and TCP/IP, a logical address that allows a system to send data to a remote device from the appropriate communications support. Contrast with *destination service access point (DSAP)*.

spanning tree. In LAN contexts, the method by which bridges automatically develop a routing table and update that table in response to changing topology to ensure that there is only one route between any two LANs in the bridged network. This method prevents packet looping, where a packet returns in a circuitous route back to the sending router.

sphere of control (SOC). The set of control point domains served by a single management services focal point.

sphere of control (SOC) node. A node directly in the sphere of control of a focal point. A SOC node has exchanged management services capabilities with its focal point. An APPN end node can be a SOC node if it supports the function to exchange management services capabilities.

split horizon. A technique for minimizing the time to achieve network convergence. A router records the interface over which it received a particular route and does not propagate its information about the route back over the same interface.

spoofing. For data links, a technique in which a protocol initiated from an end station is acknowledged and processed by an intermediate node on behalf of the final destination. In IBM 6611 data link switching, for example, SNA frames are encapsulated into TCP/IP packets for transport across a non-SNA wide area network, unpacked by another IBM 6611, and passed to the final destination. A benefit of spoofing is the prevention of end-to-end session timeouts.

standard MIB. In the Simple Network Management Protocol (SNMP), a MIB module that is located under the management branch of the Structure of Management Information (SMI) and that is considered a standard by the Internet Engineering Task Force (IETF).

static route. The route between hosts, networks, or both that is manually entered into a routing table.

station. An input or output point of a system that uses telecommunication facilities; for example, one or more systems, computers, terminals, devices, and associated programs at a particular location that can send or receive data over a telecommunication line.

StreetTalk. In the Virtual Networking System (VINES), a unique network-wide naming and addressing system that allows users to locate and access any resource on the network without knowing the network topology. See also *Internet Control Protocol (ICP)* and *RouTing update Protocol (RTP)*.

Structure of Management Information (SMI). (1) In the Simple Network Management Protocol (SNMP), the rules used to define the objects that can be accessed by means of a network management protocol. (2) In OSI, the set of standards relating to management information. The set includes the *Management Information Model* and the *Guidelines for the Definition of Managed Objects*

subarea. A portion of the SNA network consisting of a subarea node, attached peripheral nodes, and associated resources. Within a subarea node, all network accessible units (NAUs), links, and adjacent link stations (in attached peripheral or subarea nodes) that are addressable within the subarea share a common subarea address and have distinct element addresses.

subnet. (1) In TCP/IP, a part of a network that is identified by a portion of the IP address. (2) Synonym for *subnetwork*.

subnet address. In Internet communications, an extension to the basic IP addressing scheme where a portion of the host address is interpreted as the local network address.

subnet mask. Synonym for *address mask*.

subnetwork. (1) Any group of nodes that have a set of common characteristics, such as the same network ID. (2) Synonymous with *subnet*.

Subnetwork Access Protocol (SNAP). In LANs, a 5-byte protocol discriminator that identifies the non-IEEE standard protocol family to which a packet belongs. The SNAP value is used to differentiate between protocols that use \$AA as their service access point (SAP) value.

subnetwork mask. Synonym for *address mask*.

subsystem. A secondary or subordinate system, usually capable of operating independently of, or asynchronously with, a controlling system. (T)

switched virtual circuit (SVC). An X.25 circuit that is dynamically established when needed. The X.25 equivalent of a switched line. Contrast with *permanent virtual circuit (PVC)*.

synchronous. (1) Pertaining to two or more processes that depend upon the occurrence of specific events such as common timing signals. (T) (2) Occurring with a regular or predictable time relationship.

Synchronous Data Link Control (SDLC). (1) A discipline conforming to subsets of the Advanced Data Communication Control Procedures (ADCCP) of the American National Standards Institute (ANSI) and High-level Data Link Control (HDLC) of the International Organization for Standardization, for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex or half-duplex over switched or nonswitched links. The configuration of the link connection may be point-to-point, multipoint, or loop. (I) (2) Contrast with *binary synchronous communication (BSC)*.

synchronous optical network (SONET). A US standard for transmitting digital information over optical interfaces. It is closely related to the synchronous digital hierarchy (SDH) recommendation.

SYNTAX. In the Simple Network Management Protocol (SNMP), a clause in the MIB module that defines the abstract data structure that corresponds to a managed object.

system. In data processing, a collection of people, machines, and methods organized to accomplish a set of specific functions. (I) (A)

system configuration. A process that specifies the devices and programs that form a particular data processing system.

system services control point (SSCP). A component within a subarea network for managing the configuration, coordinating network operator and problem determination requests, and providing directory services and other session services for users of the network. Multiple SSCPs, cooperating as peers with one another, can divide the network into domains of control, with each SSCP having a hierarchical control relationship to the physical units and logical units within its own domain.

Systems Network Architecture (SNA). The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through, and controlling the configuration and operation of, networks. The layered structure of SNA allows the ultimate origins and destinations of

information, that is, the users, to be independent of and unaffected by the specific SNA network services and facilities used for information exchange.

T

TCP/IP. (1) Transmission Control Protocol/Internet Protocol. (2) A UNIX-like/Ethernet-based system-interconnect protocol originally developed by the US Department of Defense. TCP/IP facilitated ARPANET (Advanced Research Projects Agency Network), a packet-switched research network for which layer 4 was TCP and layer 3, IP.

Telnet. In the Internet suite of protocols, a protocol that provides remote terminal connection service. It allows users of one host to log on to a remote host and interact as directly attached terminal users of that host.

threshold. (1) In IBM bridge programs, a value set for the maximum number of frames that are not forwarded across a bridge due to errors, before a “threshold exceeded” occurrence is counted and indicated to network management programs. (2) An initial value from which a counter is decremented to 0, or a value to which a counter is incremented or decremented from an initial value.

throughput class. In packet switching, the speed at which data terminal equipment (DTE) packets travel through the packet switching network.

time division multiplexing (TDM). See *channelization*.

time to live (TTL). A technique used by best-effort delivery protocols to inhibit endlessly looping packets. The packet is discarded if the TTL counter reaches 0.

timeout. (1) An event that occurs at the end of a predetermined period of time that began at the occurrence of another specified event. (l) (2) A time interval allotted for certain operations to occur; for example, response to polling or addressing before system operation is interrupted and must be restarted.

token. (1) In a local area network, the symbol of authority passed successively from one data station to another to indicate the station temporarily in control of the transmission medium. Each data station has an opportunity to acquire and use the token to control the medium. A token is a particular message or bit pattern that signifies permission to transmit. (T) (2) In LANs, a sequence of bits passed from one device to another along the transmission medium. When the token has data appended to it, it becomes a frame.

token ring. (1) According to IEEE 802.5, network technology that controls media access by passing a token (special packet or frame) between media-attached stations. (2) A FDDI or IEEE 802.5 network with a ring

topology that passes tokens from one attaching ring station (node) to another. (3) See also *local area network (LAN)*.

token-ring network. (1) A ring network that allows unidirectional data transmission between data stations, by a token passing procedure, such that the transmitted data return to the transmitting station. (T) (2) A network that uses a ring topology, in which tokens are passed in a circuit from node to node. A node that is ready to send can capture the token and insert data for transmission.

topology. In communications, the physical or logical arrangement of nodes in a network, especially the relationships among nodes and the links between them.

topology database update (TDU). A message about a new or changed link or node that is broadcast among APPN network nodes to maintain the network topology database, which is fully replicated in each network node. A TDU contains information that identifies the following:

- The sending node
- The node and link characteristics of various resources in the network
- The sequence number of the most recent update for each of the resources described.

trace. (1) A record of the execution of a computer program. It exhibits the sequences in which the instructions were executed. (A) (2) For data links, a record of the frames and bytes transmitted or received.

transceiver (transmitter-receiver). In LANs, a physical device that connects a host interface to a local area network, such as Ethernet. Ethernet transceivers contain electronics that apply signals to the cable and that sense collisions.

Transmission Control Protocol (TCP). A communications protocol used in the Internet and in any network that follows the U.S. Department of Defense standards for internetwork protocol. TCP provides a reliable host-to-host protocol between hosts in packet-switched communications networks and in interconnected systems of such networks. It uses the Internet Protocol (IP) as the underlying protocol.

Transmission Control Protocol/Internet Protocol (TCP/IP). A set of communications protocols that support peer-to-peer connectivity functions for both local and wide area networks.

transmission group (TG). (1) A connection between adjacent nodes that is identified by a transmission group number. (2) In a subarea network, a single link or a group of links between adjacent nodes. When a transmission group consists of a group of links, the links are viewed as a single logical link, and the transmission group is called a *multilink transmission group (MLTG)*. A *mixed-media multilink transmission group (MMMLTG)* is

one that contains links of different medium types (for example, token-ring, switched SDLC, nonswitched SDLC, and frame-relay links). (3) In an APPN network, a single link between adjacent nodes. (4) See also *parallel transmission groups*.

transmission header (TH). Control information, optionally followed by a basic information unit (BIU) or a BIU segment, that is created and used by path control to route message units and to control their flow within the network. See also *path information unit*.

transparent bridging. In LANs, a method for tying individual local area networks together through the medium access control (MAC) level. A transparent bridge stores the tables that contain MAC addresses so that frames seen by the bridge can be forwarded to another LAN if the tables indicate to do so.

transport layer. In the Open Systems Interconnection reference model, the layer that provides a reliable end-to-end data transfer service. There may be relay open systems in the path. (T) See also *Open Systems Interconnection reference model*.

trap. In the Simple Network Management Protocol (SNMP), a message sent by a managed node (agent function) to a management station to report an exception condition.

trunk line. A high-speed line connecting two Nways Switches. It can be a coaxial cable, fiber cable, or radio wave, for example, and may be leased from telecommunication companies.

Tunnel. A tunnel is defined by an LNS-LAC pair. The tunnel carries PPP datagrams between the LAC and the LNS. A single tunnel can multiplex many sessions. A control connection operating over the same tunnel controls the establishment, release, and maintenance of all sessions and of the tunnel itself.

tunneling. To treat a transport network as though it were a single communication link or LAN. See also *encapsulation*.

T1. In the United States, a 1.544-Mbps public access line. It is available in twenty-four 64-Kbps channels. The European version (E1) transmits 2.048 Mbps.

U

universally administered address. In a local area network, the address permanently encoded in an adapter at the time of manufacture. All universally administered addresses are unique. Contrast with *locally administered address*.

User Datagram Protocol (UDP). In the Internet suite of protocols, a protocol that provides unreliable, connectionless datagram service. It enables an application program on one machine or process to send

a datagram to an application program on another machine or process. UDP uses the Internet Protocol (IP) to deliver datagrams.

V

V.24. In data communication, a specification of the CCITT that defines the list of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE).

V.25. In data communication, a specification of the CCITT that defines the automatic answering equipment and parallel automatic calling equipment on the General Switched Telephone Network, including procedures for disabling of echo controlled devices for both manually and automatically established calls.

V.34. An ITU-T Recommendation for modem communication over standard commercially available voice-grade 33.6-Kbps (and slower) channels.

V.35. In data communication, a specification of the CCITT that defines the list of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) at various data rates.

V.36. In data communication, a specification of the CCITT that defines the list of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) at rates of 48, 56, 64, or 72 kilobits per second.

version. A separately licensed program that usually has significant new code or new function.

VINES. Virtual NETworking System.

virtual circuit. (1) In packet switching, the facilities provided by a network that give the appearance to the user of an actual connection. (T) See also *data circuit*. Contrast with *physical circuit*. (2) A logical connection established between two DTEs.

virtual connection. In frame relay, the return path of a potential connection.

virtual link. In Open Shortest Path First (OSPF), a point-to-point interface that connects border routers that are separated by a non-backbone transit area. Because area routers are part of the OSPF backbone, the virtual link connects the backbone. The virtual links ensure that the OSPF backbone does not become discontinuous.

Virtual NETworking System (VINES). The network operating system and network software from Banyan Systems, Inc. In a VINES network, virtual linking allows all devices and services to appear to be directly connected to each other, when they may actually be thousands of miles apart. See also *StreetTalk*.

virtual route (VR). (1) In SNA, either (a) a logical connection between two subarea nodes that is physically realized as a particular explicit route or (b) a logical connection that is contained wholly within a subarea node for intranode sessions. A virtual route between distinct subarea nodes imposes a transmission priority on the underlying explicit route, provides flow control through virtual route pacing, and provides data integrity through sequence numbering of path information units (PIUs). (2) Contrast with *explicit route (ER)*. See also *path* and *route extension (REX)*.

W

wide area network (WAN). (1) A network that provides communication services to a geographic area larger than that served by a local area network or a metropolitan area network, and that may use or provide public communication facilities. (T) (2) A data communication network designed to serve an area of hundreds or thousands of miles; for example, public and private packet-switching networks, and national telephone networks. (3) Contrast with *local area network (LAN)* and *metropolitan area network (MAN)*.

wildcard character. Synonym for *pattern-matching character*.

X

X.21. An International Telegraph and Telephone Consultative Committee (CCITT) recommendation for a

general-purpose interface between data terminal equipment and data circuit-terminating equipment for synchronous operations on a public data network.

X.25. (1) An International Telegraph and Telephone Consultative Committee (CCITT) recommendation for the interface between data terminal equipment and packet-switched data networks. (2) See also *packet switching*.

Xerox Network Systems (XNS). The suite of internet protocols developed by the Xerox Corporation. Although similar to TCP/IP protocols, XNS uses different packet formats and terminology. See also *Internetwork Packet Exchange (IPX)*.

Z

zone. In AppleTalk networks, a subset of nodes within an internet.

Zone Information Protocol (ZIP). In AppleTalk networks, a protocol that provides zone management service by maintaining a mapping of the zone names and network numbers across the internet on the session layer.

zone information table (ZIT). A listing of network numbers and their associated zone name mappings in the internet. This listing is maintained by each internet router in an AppleTalk internet.

Index

Numerics

- 10/100 Ethernet configuration commands
 - accessing 259
- 10/100 Mbps Ethernet configuration commands
 - duplex 260
 - exit 261
 - ip-encapsulation 260
 - list 260
- 10/100 Mbps Ethernet monitoring commands 262
 - accessing 261
 - collisions 262
 - summary 262
- 2216
 - host definition, required activities 327

A

- AAA attributes, remote 713
- accessing
 - change management
 - accessing 43
 - summary 43
 - channel interface
 - configuring 367
 - console 386
 - console process 386
 - protocol
 - configuration process 21
 - operating (monitor) process 21
 - second-level process 13, 15
- accessing the mp configuration prompt 599
- accessing the mp monitoring commands 603
- activate
 - GWCON command 106
- activating spare interfaces 106
- add
 - add 635
 - ATM configuration command 289
 - ATM Virtual Interface configuration command 295
 - change management configuration command 44
 - channel adapter 368
 - CONFIG command 68
 - ELS configuration command 144
 - Frame Relay configuration command 488
 - SDLC configuration command 624
 - SDLC monitoring command 635
 - SDLC Relay configuration command 610
 - X.25 configuration command 424
 - XTP configuration command 457
 - XTP monitoring command 464
- add device example
 - multilink PPP 17
- adding 17
 - dial-in circuit
 - example 17
 - multilink PPP circuit
 - example 17

- address registration in LAN emulation 275
- address resolution in LAN emulation 275
- address wildcards, DTE 445
- addresses
 - ISDN 663
- addresses, entering
 - ATM 283
- advanced
 - ELS configuration command 144
 - ELS monitoring command 165
- analysis of problems 347
- AppleTalk Control Protocol
 - for PPP 542
- APPN
 - LA loopback, configuring 381
 - LSA
 - configuring the 2216 351
 - configuring the VTAM host 342
 - IBM 2216, configuring 355
- APPN HPR Control Protocol
 - for PPP 545
- APPN ISR Control Protocol
 - for PPP 545
- ARP configuration
 - config 306
 - list 307
 - remove 307
 - set 306
- ATCSTRxx, VTAM initialization file 346
- ATM
 - how to enter addresses 283
- ATM addresses of LAN emulation components 268
- ATM addressing 267
- ATM configuration commands
 - accessing 287
 - add 289
 - disable 294
 - enable 294
 - interface 288
 - LE-Client 287
 - LE-Services 287
 - list 289
 - qos 290
 - remove 290
 - set 290
 - summary 287
- atm-llc
 - ATM monitoring commands 297
- ATM LLC monitoring command
 - list 300
- ATM monitoring commands
 - accessing 296
 - atm-llc 297
 - interface 296, 297, 299
 - list 297
 - summary 296
 - trace 298
 - wrap 299

- ATM network interface
 - monitoring 287
 - using 283
- ATM Virtual Interface configuration commands
 - add 295
 - list 295
 - remove 295
 - summary 295
- ATM Virtual Interface monitoring commands
 - summary 300
- attributes, remote AAA 713
- authentication
 - configuring PPP interface 539
 - remote device
 - configuring PPP interface to use 540

B

- backup peer function, XTP 446
- Backward Explicit Congestion Avoidance 482
- Backward Explicit Congestion Notification (BECN)
 - Frame Relay 475
- Banyan VINES Control Protocol (BVCP)
 - for PPP 543
- basing configuration
 - on existing 12
- BCM 277
 - Support for IP 278
 - Support for IPX
 - BCM IPX Server Farm 278
 - preventing a LEC from being treated as 278
 - support for NetBIOS 279
 - NetBIOS Namesharing 279
 - support for Source Route Bridging 279
- BCM IPX Server Farm
 - preventing a LEC from being treated as 278
- benefits of LAN emulation 265
- bilateral closed user groups
 - overview 406
- boot
 - CONFIG command 75
- Boot CONFIG
 - process
 - entering from CONFIG 75
- Boot CONFIG commands
 - timeload 52
- boot configuration database
 - displaying 48
- bridging
 - through LCS
 - parameters 352
- bridging, configuring using quick configuration 699
- Bridging Control Protocol (BCP)
 - for PPP 543
- Broadcast and Unknown Server 266, 275
- broadcast manager 277
- buffer
 - GWCON command 106
- BUS 265, 266
 - connecting to 275
 - functions of 276

C

- cable type, clocking and 399
- call verification
 - ISDN 664
- callback
 - dial circuit monitoring command 696
- Callback Control Protocol (CBCP)
 - for PPP 543
- calls
 - ISDN monitoring command 682
 - V.25bis monitoring commands 654
- change
 - CONFIG command 75
 - Frame Relay configuration command 495
 - X.25 configuration command 430
 - XTP configuration command 460
- change management
 - accessing 43
 - commands available from 43
 - configuring 43
 - models 41
 - understanding 41
- change management configuration commands
 - add 44
 - copy 44
 - describe 45
 - disable 46
 - enable 46
 - erase 47
 - list 48
 - lock 49
 - set 50
 - tftp 51
 - unlock 54
 - update-firmware 55
- channel adapter
 - accessing the console process 386
 - configuration commands
 - add 368
 - delete 382
 - list 385, 386
 - mod 383
 - set 386
 - summary 368
 - configuring interface 365
 - interface monitoring commands
 - list 387
 - net 390
 - summary 387
- LAN Channel Station (LCS)
 - configuring the 2216 351
 - configuring the MVS host for TCP/IP 334
 - overview 350
- LCS interface monitoring commands
 - list 390
 - summary 390
- Link Services Architecture (LSA)
 - APPN connection 355
 - direct connection 354
 - DLSw local conversion 358
 - host control blocks 341

- channel adapter *(continued)*
 - Link Services Architecture (LSA) *(continued)*
 - overview 352
 - LSA interface monitoring commands
 - list 392
 - summary 392
 - MPC+ interface monitoring commands
 - list 394
 - summary 393
 - Multi-Path Channel+ (MPC+)
 - configuring APPN 361
 - configuring the MVS host for TCP/IP 336
 - configuring the VTAM host 345, 346
 - Local SNA Major Node control block 345, 346
 - overview 359
 - Transport Resource List (TRL) control block 345, 346
 - overview 348
 - TCP/IP passthru
 - configuring 2216 352
 - using 327
- channels
 - ISDN monitoring command 682
- CHAP
 - authentication for PPP 538
 - configuration 548
 - monitoring 566
- CIR
 - monitoring 481, 482
 - orphan permanent virtual circuit CIR 479
 - relationship to VIR 481
- Circuit congestion 481
 - responding with throttle down 481
- circuit contention
 - ISDN 663
- Circuit Information Rate (CIR) 478
- circuits
 - ISDN monitoring command 682
 - V.25bis monitoring commands 655
- clear
 - CONFIG command 81
 - ELS configuration command 144
 - ELS monitoring command 165
 - Frame Relay monitoring command 516
 - GWCON command 107
 - PPP monitoring command 566
 - SDLC monitoring commands 635
- clear-counters
 - LLC monitoring command 239
- clear-port-statistics
 - SDLC Relay monitoring command 617
- CLLM
 - description of 478
- CLLM support 484
- clock, setting and changing 102
- clocking and cable type 399
- closed user groups
 - configuring 407
 - cug 0 override 407
 - establishing X.25 circuits 406
- closed user groups *(continued)*
 - extended
 - types of 406
 - overview 405
 - XTP support
 - overview 447
- closing a telnet session 38
- collisions
 - 10/100 Mbps Ethernet monitoring command 262
 - Ethernet monitoring command 253
- command 11
 - exit 11
- command history 23, 34
- commands
 - entering 9
- Committed Burst Size
 - definition 479
 - relationship to maximum frame size 479
- components of LAN emulation 266
- CONFIG commands
 - add 68
 - boot 75
 - change 75
 - clear 81
 - delete 83
 - disable 84
 - enable 85
 - event 86
 - features 86
 - List 87
 - load 90
 - network 91
 - patch 92
 - protocol 94
 - qconfig 94
 - set 95
 - summary of 67
 - system retrieve 100
 - system view 101
 - time 102
 - unpatch 103
 - update 103
 - write 103
- Config-Only mode
 - description 58
 - entering automatically 58
 - manual entry 58
- CONFIG process
 - accessing 14
 - commands available from 67
 - description of 57
 - entering 14, 67
 - exiting 67
 - system dumps 66
- configuration
 - accessing commands 365
 - accessing the mp prompt 599
 - APPN
 - loopback 381
 - basing on existing 12

- configuration (*continued*)
 - channel adapter interface
 - add 368
 - required actions 365
 - channel interface
 - delete 382
 - list, command 385, 386
 - mod, command 383
 - set, command 386
 - summary of commands 368
 - displaying information about 108
 - first 11
 - GWCON command 108
 - host
 - planning for definition 327
 - required for defining connection 327
 - LCS
 - subchannel 370
 - virtual interface 369
 - LSA
 - APPN connection 355
 - direct connection 354
 - direct connection at VTAM host 341
 - DLSw connection at 2216 356
 - DLSw local conversion at 2216 358
 - subchannel 374
 - virtual interface 372
 - MPC+ 361, 362, 373
 - subchannel 377
 - virtual interface 376
 - MVS host for TCP/IP 334
 - network command, channel adapter 368
 - network interfaces 18
 - overview 327
 - reconfiguration 347
 - suggestions 11
 - updating 12
 - updating memory 103
 - VTAM host
 - APPN connection 342
 - DLSw connection 343
 - MPC+ 345, 346
- configuration commands
 - GWCON prompt 22
 - multilink PPP protocol (mp) 599
 - set prompt-level
 - add prefix to hostname 98
- configuring
 - DECnet 704
 - encryption 564
 - ESCON channel adapter 367
 - FDDI 227
 - IP 701
 - IPX 702
 - multilink PPP interface 595
 - for multi-chassis MP 597
 - on dial circuits 595
 - on Layer-2-Tunneling nets 596
 - on serial links 596
 - OPCON 31
 - parallel channel adapter (PCA) 367

- configuring (*continued*)
 - PPP callback 541
 - TCP/IP passthru 352
 - user access 59
 - virtual connections (VC) 546
 - XTP 457
- configuring spare interfaces 60
 - activating 106
 - configuring 60
 - defining 204
 - restrictions 61
- Congestion monitoring 482
- Congestion notification and avoidance
 - Backward Explicit Congestion Avoidance 482
 - Forward Explicit Congestion Avoidance 482
- connecting to a process 9
- connecting to the BUS 275
- connection request timer 447
- connector-Type
 - Ethernet configuration command 252
- considerations
 - multilink PPP protocol (MP) 594
 - virtual connections (VC) 545
- console process, accessing 386
- consolidated link layer management (CLLM)
 - description of 478
- copy
 - change management configuration command 44
- CPU
 - displaying memory usage of 114
- create
 - ELS net filter configuration commands 159
 - ELS net filter monitoring commands 186

D

- data direct VCCs 277
- Data Link Connection Identifier (DLCI)
 - Frame Relay 470, 474
- date, setting and changing 102
- DDN
 - default settings 707
- DECnet, configuring 704
- DECnet Control Protocol (DNCP)
 - for PPP 543
- default
 - ELS configuration command 145
- defining 2216
 - to operating system 332
- delete
 - channel adapter 382
 - CONFIG command 83
 - delete 635
 - dial circuit configuration command 690
 - ELS configuration command 145
 - ELS net filter configuration commands 160
 - ELS net filter monitoring commands 187
 - ISDN 84
 - SDLC configuration command 625
 - SDLC monitoring command 635
 - SDLC Relay configuration command 611

- delete (*continued*)
 - X.25 configuration command 432
 - XTP configuration command 460
 - XTP monitoring command 465
- describe
 - change management configuration command 45
- description of OPCON 29
- diags
 - OPCON command 32
- dial circuit configuration commands
 - delete 690
 - encapsulator 690
 - list 691
 - set 692
 - summary of 689
- dial circuit monitoring commands
 - callback 696
- dial circuits
 - adding 646, 671
 - configuring 647, 671
 - configuring for MP 595
 - ISDN 662
- dial-in circuit
 - add device example 17
- dial-in circuits
 - virtual connections (VC) 545
 - configuring 546
 - considerations 545
- direct connection, LSA, configuring 354
- disable
 - ATM configuration command 294
 - authentication protocols 548
 - change management configuration command 46
 - CONFIG command 84
 - data compression 548
 - ELS net filter configuration commands 160
 - ELS net filter monitoring commands 187
 - Frame Relay configuration command
 - cir-monitor 496
 - Frame Relay monitoring command 516
 - GWCON command 110
 - Lower DTR 548
 - multilink protocol 548
 - performance configuration command 196
 - performance monitoring command 198
 - SDLC configuration command 625
 - SDLC link establishment connection 635
 - SDLC Relay configuration command 611
 - SDLC Relay monitoring command 618
 - X.25 configuration command 415
 - XTP configuration command 462
- display
 - ELS configuration command 145
 - ELS monitoring command 166
- display hostname 99
- display hostname software VPD 99
- display hostname with carriage return 99
- display hostname with changes 99
- display hostname with date 99
- display hostname with time 99
- displaying
 - boot configuration database 48
- displaying monitoring prompt 387
- divert
 - OPCON command 32
- DLCI (Data Link Connection Identifier)
 - Frame Relay 470
- DLSw connection
 - configuring
 - 2216 356
 - local conversion at the 2216 358
 - VTAM host 343
 - LSA 356, 358
- DOS
 - assembling a load file 709
 - disassembling a load file 710
- DTE address wildcards 445
- dump
 - Fast Token-Ring monitoring command 218
 - Token-Ring monitoring command 209
- duplex
 - Ethernet configuration command 260
- duplicate policy values 273
- dynamic routing
 - OSPF 701
 - RIP 701

E

- ELAN name policy 272
- ELAN type policy 273
- ELS
 - capturing output using Telnet 128
 - concepts of 124
 - description of 123
 - entering 86
 - how to use 127
 - interpreting messages 125
 - message buffering
 - overview 139
 - monitoring 143
 - reloading 175
 - remote logging
 - additional considerations 138
 - duplicate logging 138
 - messages containing IP addresses 138
 - output 135
 - recurring sequence numbers 139
 - remote-logging 153, 175
 - setting up traps 129
 - storing 175
 - tracing 155, 178
 - trapping 177, 182
 - troubleshooting example 1 129
 - troubleshooting example 2 130
 - troubleshooting example 3 130
 - using to troubleshoot 129
- ELS configuration
 - entering and exiting 124
- ELS configuration commands
 - add 144

ELS configuration commands *(continued)*

- advanced 144
 - clear 144
 - default 145
 - delete 145
 - display 145
 - filter 146
 - list 146
 - message buffering 161
 - list 161
 - log 161
 - nolog 162
 - set 163
 - nodisplay 148
 - noremove 148
 - notrace 150
 - notrap 150
 - remote 151
 - set 153
 - summary of 143
 - trace 181
 - trap 158
- ## ELS configuration environment
- entering and exiting 143
- ## ELS console environment
- 2216 remote logging configuration 133
 - level
 - defined 131
 - remote logging 131
 - remote workstation configuration 131
 - syslog facility
 - defined 131
- ## ELS messages 126
- enabling logging to a remote file (Remote) 151, 173
 - explanation 126
 - groups 127
 - logging level 125
 - managing rotation 128
 - network information 127
 - suppressing display of 148
 - suppressing display of (nodisplay) 170
 - suppressing remote log (noremove) 148, 170
 - suppressing tracing 171
 - suppressing trapping 150, 172
 - suppressing trapping of (notrap) 172
 - trace 157
 - tracing 181
 - trapping 158, 182
- ## ELS monitoring commands
- advanced 165
 - clear 165
 - display 166
 - files 166
 - filter 167
 - list 167
 - message buffering 188
 - flush 189
 - list 189
 - log 189

ELS monitoring commands *(continued)*

- message buffering *(continued)*
 - nolog 190
 - read-file 190
 - set 191
 - tftp 192
 - view 192
 - write-buffer 193
 - nodisplay 170
 - noremove 170
 - notrace 171
 - notrap 172
 - remote 173
 - remove 174
 - restore 175
 - retrieve 175
 - save 175
 - set 175
 - statistics 180
 - summary 165
 - trap 182
 - view 183
- ## ELS net filter configuration commands
- create 159
 - delete 160
 - disable 160
 - enable 160
 - list 161
 - overview 158
- ## ELS net filter monitoring commands
- create 186
 - delete 187
 - disable 187
 - enable 188
 - list 188
 - overview 186
- ## ELS operating environment
- entering and exiting 164
- ## EMIF
- example IOCP definition 329
- ## enable
- ATM configuration command 294
 - authentication protocols 549
 - change management configuration command 46
 - CHAP 549
 - CONFIG command 85
 - data compression 549
 - ELS net filter configuration commands 160
 - ELS net filter monitoring commands 188
 - Frame Relay configuration command 498
 - Frame Relay monitoring command 517
 - GWCON command 111
 - Lower DTR 549
 - multilink protocol 549
 - PAP 549
 - performance configuration command 196
 - performance monitoring command 198
 - SDLC configuration command 625
 - SDLC monitoring command 636
 - SDLC Relay configuration command 612
 - SDLC Relay monitoring command 618

- enable (*continued*)
 - X.25 configuration command 414
 - XTP configuration command 462
- enable lmi 514
- encapsulation type 702
- encapsulator
 - dial circuit configuration command 690
- encryption
 - configuring 564
- end system identifier 267
- environment, lower level 11
 - exiting 11
- erase
 - Change management configuration command 47
- error
 - GWCON command 111
- ESCON
 - overview 348
- ESCON channel adapter
 - configuring 367
 - Multi-Path Channel+ (MPC+)
 - configuring TCP/IP 363
 - configuring UDP+ 362
- ESI 267
- Ethernet
 - 10/100 Mbps network interface
 - configuring 259
 - displaying statistics 247
 - displaying statistics 10/100 Mbps 255
 - encapsulation type 702
 - encapsulation types for IPX 703
 - network interface
 - configuring 251
 - Ethernet 10/100 Mbps network interface
 - using 255
 - Ethernet configuration commands
 - accessing 251
 - connector-Type 252
 - ip-encapsulation 252, 308
 - list 252
 - physical-address 252, 261
 - summary 251, 259
 - Ethernet monitoring commands 253
 - collisions 253
 - summary 253
 - Ethernet network interface
 - using 247
 - Ethernet operating commands
 - accessing 253
 - event
 - CONFIG command 86
 - GWCON command 112
 - event logging
 - subsystem 125
 - event number parameter 125
 - Events
 - Causes 124
 - examples
 - 2216 definition to HPDT UDP for MVS or VM 341
 - 2216 definition to TCP/IP for MVS or VM for LCS 337

- examples (*continued*)
 - 2216 definition to TCP/IP for MVS or VM for MPC+ 339
 - IOCP
 - definition for EMIF host 329
 - definition for ESCON channel 328
 - definition for parallel channel adapter 331
 - switched major node definition file
 - LSA APPN connection at VTAM host 342
 - LSA direct connection at VTAM host 342
 - LSA DLSw connection at VTAM host 343
 - LSA DLSw local conversion at VTAM host 344
 - VTAM control block 341
 - XCA major node definition file
 - LSA APPN connection at VTAM host 342
 - LSA direct connection at VTAM host 342
 - LSA DLSw connection at VTAM host 343
 - LSA DLSw local conversion at VTAM host 343
 - VTAM control block 341
- Excess Burst Size
 - definition 480
 - setting for Frame Relay 480
- exit
 - 10/100 Mbps Ethernet configuration command 261
- exit command 11
- exiting 11
 - lower level environments 11
- exiting the router 6

F

- Fast Token-Ring configuration commands
 - accessing 215
 - enabling for LLC 218
 - list 216
 - LLC 216, 219
 - media 216
 - packet-size 216
 - set 217
 - source-routing 217
 - speed 218
 - summary of 215
- Fast Token-Ring interface
 - statistics displayed for 219
- Fast Token-Ring monitoring commands
 - dump 218
 - summary of 218
- Fast Token-Ring network
 - configuring 215
- FDDI
 - configuring 227
 - GWCON 231
- FDDI (Fiber Distributed Data Interface)
 - using 223
- FDDI and GWCON 231
- FDDI configuration commands 227
 - accessing 227
 - list 228
 - set 228
- FDDI monitoring commands
 - accessing 230
 - list 230

- FDDI monitoring commands *(continued)*
 - SRT-STATS 230
- FDDI overview 223
- features 86
 - accessing configuration and console processes 20
 - bandwidth reservation 112
 - CONFIG command 86
 - GWCON command 112
 - MAC filtering 86, 112
 - WAN restoral 112
 - WAN restoral/reroute 86
- Fiber Distributed Data Interface
 - overview 223
 - protocols supported 223
- files
 - ELS monitoring command 166
- filter
 - ELS configuration command 146
 - ELS monitoring command 167
- first
 - configuration 11
- Flow control
 - packets 107
- flush
 - OPCON command 33
- forum-compliant LEC
 - ARP configuration 305
 - configuring a specific client 305
- Forward Explicit Congestion Avoidance 482
- Forward Explicit Congestion Notification (FECN)
 - Frame Relay 475
- Frame Relay 471
 - accessing configuration 484
 - Backward Explicit Congestion Notification 475
 - Bandwidth Reservation 484
 - circuit information rate 478
 - command/response 475
 - configuring 484, 487
 - congestion notification and avoidance 482
 - Data Link Connection Identifier (DLCI) 474
 - data rates 478
 - discard eligibility 475
 - DLCI (Data Link Connection Identifier) 470
 - enabling PVC management 485
 - enabling SVC management 486
 - excess burst size 480
 - extended address 475
 - Forward Explicit Congestion Notification 475
 - frame format 474
 - frame forwarding described 476
 - HDLC flags 474
 - interface initialization 471
 - introduction 469
 - LAPD datalink protocol 469, 474
 - line speed 480
 - LMI management entities 477
 - management status reporting 477
 - description 477
 - full status report 477
 - link integrity verification report 478
 - maximum information rate 481
- Frame Relay *(continued)*
 - minimum information rate 480
 - multicast emulation 476
 - network 470
 - network interface 487, 528
 - network management 477
 - orphan permanent virtual circuits 472
 - orphan switched virtual circuits 473
 - permanent virtual circuits 471
 - protocol address mapping 476
 - PVCs and 473
 - required groups 473
 - static ARP 490
 - SVC
 - FRF 4 477
 - user data 475
 - using 469
 - variable information rate 481
 - variable information rate (VIR) 481
 - virtual circuits 469
- Frame Relay configuration commands 496, 498
 - add 488
 - permanent-virtual-circuit 488
 - protocol-address 488
 - add-protocol
 - AppleTalk2 protocol 490
 - DN protocol 490
 - IPX protocol 490
 - add protocol-address
 - IP protocol 490
 - change 495
 - disable
 - cir-monitor 496
 - cllm 496
 - compression 496
 - congestion 482
 - congestion-monitor 496
 - dn-length-field 496
 - encryption 496
 - lmi 496
 - lower-dtr 496
 - multicast-emulation 496
 - no-pvc 496
 - notify-fecn-source 496
 - orphan-circuits 496
 - protocol-broadcast 496
 - throttle-transmit-on-fecn 496
 - enable
 - cir-monitor 498
 - cllm 498
 - compression 498
 - congestion 482
 - congestion-monitor 498
 - dn-length-field 498, 499
 - encryption 498
 - lmi 498
 - lower-dtr 498
 - multicast-emulation 498
 - no-pvc 498
 - notify-fecn-source 498
 - orphan-circuits 498

Frame Relay configuration commands (*continued*)

- enable (*continued*)
 - protocol-broadcast 498
 - throttle-transmit-on-fecn 498
- list 502
 - all 502
 - hdlc 502
 - lmi 502
 - permanent-virtual-circuits 502
 - protocol-address 502
- llc 508
- remove
 - permanent-virtual-circuit 508
 - protocol-address 509
- remove-protocol
 - DN protocol 509
- remove protocol-address
 - Appletalk2 protocol 509
 - IP protocol 509
 - IPX protocol 509
- set
 - cable 510
 - clocking 510
 - crc-type 510
 - default cir 510
 - frame-size 511
 - lmi-type 511
 - n1-parameter 511
 - n2-parameter 511
 - n3-parameter 511
 - p1-parameter 511
 - t1-parameter 511
 - transmit delay parameter 511
- summary of 487

Frame Relay Forum Implementation Agreement 4 (FRF 4) 477

Frame Relay monitoring commands

- clear 516
- disable 516
 - cllm 517
 - notify-fecn-source 517
 - throttle-transmit-on-fecn 517
- enable 517
 - cllm 517
 - notify-fecn-source 517
 - throttle-transmit-on-fecn 517
- list 517
 - all 517
 - circuit 517
 - lmi 517
 - permanent-virtual-circuits 517
 - pvc-groups 517
- llc 526
- notrace 526
- set 526
- summary of 516
- trace 528

Frame Relay permanent virtual circuits (SVC)

- changing 495

Frame Relay switched virtual circuits (SVC) 471

- adding 491

Frame Relay switched virtual circuits (SVC) (*continued*)

- changing 495
 - listing 507, 525
 - removing 510
- functions of the BUS 276

G

- getting help 10
- group
 - deleting 145
- group name parameter 127
- GTE-Telenet
 - default settings 707
- GWCON
 - commands
 - SDLC interface 642
 - X.25 interface 439
 - FDDI 231
 - process
 - entering 15
- GWCON and FDDI 231
- GWCON commands
 - activate 106
 - buffer 106
 - clear 107
 - configuration 108
 - disable 110
 - enable 111
 - error 111
 - event 112
 - features 112
 - interface 113, 203
 - memory 114
 - network 115
 - protocol 116
 - queue 116
 - reset 117
 - statistics 117
 - summary of 105
 - test 118
 - uptime 119
- GWCON process
 - description of 105
 - entering and exiting 105

H

- halt
 - OPCON command 33
- hardware configuration definition program 327
- HCD
 - MVS/ESA definition 333
 - program 327
- HDLC flags
 - in Frame Relay frame 474
- help 10
 - console command 10
- host
 - 2216 connection, required activities 327
 - control blocks 341
 - input/output configuration program 327

- host *(continued)*
 - programs
 - VTAM, configuring 345, 346
 - how to list the protocols 94
 - HPDT UDP
 - 2216 definition for MVS or VM, example 341
 - HSSI
 - set
 - cable 511, 559
 - circuit congestion defaults 511
 - clocking 512, 559
 - crc type 512
 - crc-type 510
 - line speed 514
- I
 - I.431 switch variant 673
 - I/O Configuration Data Set 328
 - IBM 2216
 - Config-Only mode 58
 - identifying prompts 10
 - ILMI functions in LAN emulation 269
 - image
 - loading at specific time 42
 - initialization file ATCSTRxx, for VTAM 346
 - intercept
 - OPCON command 34
 - intercept character 11
 - changing 34
 - interface
 - ATM configuration command 288
 - ATM monitoring commands 296, 297, 299
 - GWCON command 113
 - list of processes 6
 - user 6
 - interface device
 - adding 68
 - changing 75
 - interface monitoring commands
 - channel adapter 387
 - LCS 390
 - LSA 392
 - MPC+ 393
 - interface numbers, displaying 387
 - interfaces
 - configuring spare 60
 - spare 204
 - interfaces, restrictions 61
 - Interim Local Management Interface 269
 - IOCDS 328
 - IOCP
 - definitions 328
 - example definition for ESCON channel 328
 - example definition for parallel channel adapter 331
 - IP, configuring 701
 - IP (Internet Protocol), configuring using quick configuration 701
 - IP Control Protocol (IPCP)
 - for PPP 543

- ip-encapsulation
 - 10/100 Mbps Ethernet configuration command 260
 - Ethernet configuration command 252, 308
- IPv6 Control Protocol (IPv6CP)
 - for PPP 544
- IPX, configuring 702
- IPX (Internetwork Packet Exchange)
 - configuring using quick configuration 702
 - Ethernet encapsulation types 703
 - token ring encapsulation types 702
- IPX Control Protocol (IPXCP)
 - for PPP 544
- ISDN
 - accessing monitoring process 680
 - addresses 663
 - call verification 664
 - configuring 668, 675
 - cost control over demand circuits 663
 - delete address 84
 - dial circuit contention 663
 - dial circuits 662
 - GWCON commands 686
 - interface restrictions 668
 - overview 661
 - PPP configuration 668
 - requirements and restrictions 668
 - sample configurations 666
 - switches supported 668
- ISDN configuration commands
 - list 676
 - remove 676
 - set 676
 - set switch variant 679
 - summary of 675
- ISDN interface
 - using 661
- ISDN monitoring commands
 - calls 682
 - channels 682
 - circuits 682
 - L2_Counters 684
 - L3_Counters 684
 - parameters 684
 - statistics 685
 - summary of 681
 - TEI 684

K

- keepalive timer, setting for XTP 462
- key parameters for LAN emulation 282
- keywords 713

L

- L2_Counters
 - ISDN monitoring command 684
- L3_Counters
 - ISDN monitoring command 684
- LAN Channel Station (LCS)
 - configuring
 - 2216 351

- LAN Channel Station (LCS) *(continued)*
 - configuring *(continued)*
 - MVS host for TCP/IP 334
 - LCS interface monitoring commands
 - list 390
 - summary 390
 - overview 350
 - subchannel, configuring 370
 - virtual interface, configuring 369
- LAN destination policy (MAC address policy) 272
- LAN emulation 265
 - address registration to the LES 275
 - address resolution by the LES 275
 - addressing in ATM 267
 - ATM addresses of LAN emulation components 268
 - ATM addressing for 267
 - benefits 265
 - Broadcast and Unknown Server (BUS) 266
 - Broadcast Manager (BCM) 277
 - BUS 266
 - client 266
 - components 266
 - components, ATM addresses of 268
 - configuration of the signaling version 269
 - configuration server 266
 - configuration server, policies and policy values 271
 - connecting to the BUS 275
 - connecting to the LES 274
 - ELAN name policy 272
 - ELAN type policy 273
 - establishing data direct VCCs 277
 - functions of the BUS 276
 - ILMI functions, related 269
 - key configuration parameters 282
 - LAN Emulation Configuration Server, overview of 270
 - LECS, overview of 270
 - LECS, policies and policy values 271
 - LECS duplicate policy values 273
 - LECS LAN destination policy (MAC address policy) 272
 - LECS TLVs 273
 - locating the LECS using ILMI 269
 - max frame size policy 273
 - overview 265
 - overview of related ILMI functions 269
 - overview of router extensions for LAN emulation 277
 - redundancy 280
 - reliability 280
 - sample assignment policies for LECS 272
 - security 281
 - server 266
 - signaling version 269
 - LAN Emulation Client (LEC) 301
 - configuring 301, 303
 - LAN Emulation Configuration Server 270
 - LAN Emulation Server 274
 - layer 2 tunneling
 - relationship with multilink PPP (MP) 595
 - Layer 2 Tunneling nets
 - configuring for MP 596
 - LCS
 - bridging
 - parameters 352
 - LE client 266
 - LE-Client
 - ATM configuration command 287
 - LE-Services
 - ATM configuration command 287
 - LEC monitoring commands
 - accessing 318
 - list 319
 - mib 323
 - summary of 319
 - LECS 265
 - and LAN emulation 266
 - and LAN extensions 270
 - component of LAN emulation 270
 - duplicate policy values 273
 - ELAN name policy 272
 - ELAN type policy 273
 - LAN destination policy (MAC address policy) 272
 - max frame size policy 273
 - sample assignment policies 272
 - TLVs 273
 - LES 265, 266
 - address registration 275
 - address resolution 275
 - connecting to 274
 - Line Speed 480
 - Link Control Protocol (LCP)
 - packets 534
 - relationship to PPP 533
 - Link Services Architecture (LSA)
 - APPN connection
 - configuring the 2216 355
 - configuring the VTAM host 342
 - direct connection
 - at VTAM host, configuring 341
 - configuring the 2216 354
 - DLSw connection
 - configuring the 2216 356, 358
 - configuring the VTAM host 343
 - host
 - control blocks 341
 - LSA interface monitoring commands
 - list 392
 - summary 392
 - overview 352
 - subchannel, configuring 374
 - virtual interface, configuring 372
 - list 21
 - 10/100 Mbps Ethernet configuration command 260
 - ATM configuration command 289
 - ATM LLC monitoring command 300
 - ATM monitoring commands 297
 - ATM Virtual Interface configuration command 295
 - change management configuration command 48
 - channel adapter
 - configuration command 385, 386

list (continued)

- channel adapter (continued)
 - interface configuration command 368
 - interface monitoring command 387
- CONFIG command 87
- dial circuit configuration command 691
- ELS configuration command 146
- ELS monitoring command 167
- ELS net filter configuration commands 161
- ELS net filter monitoring commands 188
- Ethernet configuration command 252
- Fast Token-Ring configuration command 216
- Frame Relay configuration command 502
- Frame Relay monitoring command 517
- ISDN configuration command 676
- LCS interface monitoring command 390
- LEC monitoring command 319
- list 636
- LLC monitoring command 239
- LSA interface monitoring command 392
- MPC interface monitoring command 394
- performance configuration command 196
- performance monitoring command 198
- Point-to-Point configuration command 552
- PPP monitoring command 566
- SDLC configuration command 626
- SDLC monitoring command 636
- SDLC Relay configuration command 612, 613
- SDLC Relay monitoring command 619
- Token-Ring configuration command 205
- V.25bis configuration command 650
- X.25 configuration command 433
- X.25 monitoring command 436
- XTP configuration command 462
- XTP monitoring command 465
- list devices 287
- list devices command 17, 251, 259, 367, 547, 649
- listing the configuration 94
- llc
 - Fast Token-Ring configuration command 216
 - Fast Token-Ring configuration commands 216, 219
 - Fast Token-Ring monitoring command 219
 - Frame Relay configuration commands 508
 - Frame Relay monitoring commands 526
 - Point-to-Point configuration command 556
 - PPP configuration commands 556
 - PPP monitoring commands 589
 - Token-Ring configuration command 206
 - Token-Ring configuration commands 206, 210
 - Token-Ring monitoring command 210
- LLC configuration commands
 - accessing 235
 - list 236
 - set 237
 - summary 235
- LLC monitoring commands
 - accessing 238
 - clear-counters 239
 - list 239
 - set 244
 - summary 239

- LLC network interfaces
 - configuring 235
- LMI management entities 477
- load
 - CONFIG command 90
- load file, router
 - assembling under DOS 709
 - assembling under UNIX 709
 - creating from multiple disks 709
 - disassembling under DOS 710
 - disassembling under UNIX 711
- loading
 - at specific time 42
- local consoles 4
- local SNA Major Node control block 345, 346
- local terminals 4
- local XTP
 - description 447
- locating the LECS using ILMI 269
- lock
 - change management configuration command 49
- logging in
 - from local console 5
 - from remote console 5
 - remote login name 5
- login
 - disabling 84
- logout
 - OPCON command 34
- loopback, APPN, configuring 381

M

- MAC address policy (LAN destination policy) 272
- max frame size policy 271, 273
- maximum information rate
 - for frame relay 481
- media
 - Fast Token-Ring configuration command 216
 - Token-Ring configuration command 206
- memory
 - displaying information about 114
 - erasing information 174
 - GWCON command 114
 - obtaining information about 34
 - OPCON command 34
- message buffering
 - ELS configuration commands 161
 - list 161
 - log 161
 - nolog 162
 - set 163
 - ELS monitoring commands 188
 - flush 189
 - list 189
 - log 189
 - nolog 190
 - read-file 190
 - set 191
 - tftp 192
 - view 192
 - write-buffer 193

- message buffering (*continued*)
 - overview 139
- messages
 - explanation 126
 - interpreting 125
 - receiving 121
- messaging process
 - commands affecting 121
 - description of 121
 - entering and exiting 121
 - OPCON commands 121
 - receiving messages 121
- mib
 - LEC monitoring command 323
- minimum information rate
 - for frame relay 480
- mod, channel adapter configuration command 383
- monitoring
 - accessing the mp commands 603
 - ATM 287
 - network interfaces 20
 - performance monitoring commands 197
 - prompt, displaying 387
- monitoring commands
 - LAN Emulation Client (LEC) 303
 - multilink ppp protocol (mp) 603
- MONITR process
 - commands affecting 121
 - description of 121
 - entering and exiting 121
 - OPCON commands 121
 - receiving messages 121
- MPPE options
 - listing 552
- MS-CHAP
 - authentication for PPP 539
- multi-chassis MP 595
 - configuring 597
- Multi-Path Channel+ (MPC+)
 - configuring
 - MVS host for TCP/IP 336
 - configuring APPN 361
 - configuring TCP/IP 363
 - configuring the VTAM host 345, 346
 - configuring UDP+ 362
 - list, interface monitoring command 394
 - overview 359
 - subchannel, configuring 377
 - summary, interface monitoring commands 393
 - virtual interface, configuring 376
- multilink PPP protocol (MP)
 - configuration commands 599
 - configuring
 - dial circuits 595
 - Layer 2 Tunneling nets 596
 - multi-chassis MP 597
 - serial links 596
 - considerations 594
 - monitoring commands 603
 - multi-chassis 595
 - overview 593

- multilink PPP protocol (MP) (*continued*)
 - relationship with layer 2 tunneling 595
- multilink PPP protocol (mp) monitoring commands
 - accessing 603
- multilink protocol (mp) configuration prompt
 - accessing 599
- MVS/ESA
 - defining the 2216 to 333
 - hardware configuration definition 333
 - HCD 333
- MVS host, configuring for TCP/IP 334
- MVS/XA, defining the 2216 to 333

N

- national disable
 - X.25 configuration command 418
- national enable
 - X.25 configuration command 415
- national personality, setting 451
- national restore
 - X.25 configuration command 423
- national set
 - X.25 configuration command 418
- net, channel interface monitoring command 390
- network
 - command 368
 - CONFIG command 91
 - environment 91, 115
 - GWCON command 115
 - network command 18, 251, 259, 287, 318, 547, 649
 - Network Control Protocols (NCP)
 - for PPP interfaces 542
 - AppleTalk Control Protocol 542
 - APPN HPR Control Protocol 545
 - APPN ISR Control Protocol 545
 - Banyan VINES Control Protocol (BVCP) 543
 - Bridging Control Protocol (BCP) 543
 - Callback Control Protocol (CBCP) 543
 - DECnet Control Protocol (DNCP) 543
 - IP Control Protocol (IPCP) 543
 - IPv6 Control Protocol (IPv6CP) 544
 - IPX Control Protocol (IPXCP) 544
 - OSI Control Protocol (OSICP) 545
 - network interface
 - accessing configuration process 16
 - accessing console process 19
 - configuring 16, 203
 - console process 16, 203
 - deleting 83
 - disabling 110
 - displaying information about 87, 108, 113
 - displaying the configuration 18
 - enabling 118
 - GWCON interface command 203
 - monitoring 20, 203
 - SDLC 642
 - supported interfaces 18
 - verifying 118
 - X.25 439
 - network software
 - displaying statistical information about 117

- nodisplay
 - ELS configuration command 148
 - ELS monitoring command 170
- nonvolatile configuration memory
 - replacing 75
- noremote
 - ELS configuration command 148
 - ELS monitoring command 170
- notrace
 - ELS configuration command 150
 - ELS monitoring command 171
 - Frame Relay monitoring commands 526
- notrap
 - ELS configuration command 150
 - ELS monitoring command 172

O

- obtaining status of telnet session 38
- off
 - packet trace monitoring command 184
- on
 - packet trace monitoring command 184
- OPCON
 - accessing the channel interface 367
 - channel adapter interface, console 386
- OPCON commands
 - diags 32
 - divert 32
 - flush 33
 - halt 33
 - intercept 34
 - logout 34
 - memory 34
 - reload 35
 - status 35
 - summary of 31
 - talk 36
 - telnet 37
- OPCON interface
 - configuring 31
- OPCON process
 - accessing 31
 - commands available from 31
 - description 29
 - getting back to 11
 - summary 6
- operating system
 - defining the 2216 to 332
- orphan permanent virtual circuits
 - Frame Relay 472
- orphan switched virtual circuits
 - Frame Relay 473
- OSI Control Protocol (OSICP)
 - for PPP 545
- OSPF 701
- output
 - discarding 33
 - sending to other consoles 32
 - suspending 33
- overview
 - ELS net filter configuration commands 158
 - ELS net filter monitoring commands 186
 - of software 6
 - virtual connections (VC) 545
- overview of channel adapter 348
- overview of LAN emulation 265

P

- packet completion codes 126
- packet forwarder
 - entering CONFIG environment for 94
- packet-size
 - Fast Token-Ring configuration command 216
 - Token-Ring configuration command 207
- packet trace
 - packet trace monitoring command 172
- packet trace messages
 - tracing packets 172
- packet trace monitoring commands
 - off 184
 - on 184
 - packet Trace 172
 - reset 184
 - set 184
 - subsystems 185
 - trace-status 185
 - view 186
- PAP authentication for PPP 538
- parallel channel adapter (PCA)
 - configuring 367
 - example IOCP definition 331
 - overview 348
- parameter defaults
 - X.25 402
- parameters
 - configuring 95
 - event number 125
 - for LAN emulation 282
 - ISDN monitoring command 684
 - key LAN emulation 265
 - V.25bis monitoring commands 655
 - X.25 monitoring command 437
- password, setting for user 73
- passwords 5
- patch
 - CONFIG command 92
- PCA
 - configuring 367
 - example IOCP definition 331
 - overview 348
- perf command 196
- performance
 - configuring 195
- performance configuration commands
 - disable 196
 - enable 196
 - list 196
 - set 197
 - summary 196
- performance monitoring commands
 - accessing 197

- performance monitoring commands *(continued)*
 - disable 198
 - enable 198
 - list 198
 - report 198
 - set 198
 - summary of 197
- physical-address
 - Ethernet configuration command 252, 261
- pin parameter
 - setting 153
- planning and preparation
 - 2216 ESCON adapter 347
 - host 327, 347
- Point-to-Point configuration commands
 - accessing 547
 - list 552
 - LLC 556
 - summary of 548
- Point-to-Point interfaces
 - configuring 547
- Point-to-Point network interface
 - using 531
- Point-to-Point Protocol (PPP) 543
 - accessing the configuration process 547
 - address fields 533
 - AppleTalk Control Protocol 542
 - APPN HPR Control Protocol 545
 - APPN ISR Control Protocol 545
 - authentication 537
 - Banyan Vines Control Protocol (BVCP) 543
 - Bridging Control Protocol (BCP) 543
 - Callback Control Protocol (CBCP) 543
 - control field 533
 - DECnet Control Protocol (DNCP) 543
 - flag fields 533
 - frame check sequence field 533
 - frame structure 532
 - information field 533
 - IPv6 Control Protocol (IPv6CP) 544
 - IPX Control Protocol (IPXCP) 544
 - LCP packets 534
 - Link Control Protocol (LCP) 533
 - link establishment packets 536
 - link maintenance packets 537
 - link termination packets 537
 - Network Control Protocols (NCP) 542
 - OSI Control Protocol (OSICP) 545
 - overview 531
 - protocol field 533
- policies 265
 - agreement of 271
- policies and policy values 271
- PPP
 - IP Control Protocol (IPCP) 543
- PPP callback
 - configuring 541
- PPP configuration commands
 - list
 - ccp 552
 - ecp 552
- PPP configuration commands *(continued)*
 - set 556
 - setting IPCP parameters 556
 - setting LCP parameters 556
- PPP interface monitoring process
 - accessing 565
- PPP monitoring commands
 - clear 566
 - list 566
 - dn 587
 - dncp 587
 - osi 587
 - osicp 587
 - listing IPCP parameters 566
 - listing LCP parameters 566
 - llc 589
 - summary of 566
- problem analysis and resolution 347
- process
 - second-level
 - accessing 13, 15
- processes
 - communicating with 6
 - list of 6
- prompt, monitoring, displaying 387
- prompt-level
 - additional functions of
 - display hostname with carriage return 99
 - display hostname with changes 99
 - display hostname with date 99
 - display hostname with time 99
 - display hostname with VPD 99
 - configuration command
 - add prefix to hostname 98
 - display hostname 99
- prompts
 - CONFIG 10
 - GWCON 10
 - identifying 10
 - OPCON 10
 - router processes 10
- protocol
 - CONFIG command 94
 - configuration process 203, 204
 - console process 203, 204
 - entering configuration process 21
 - GWCON command 116
- protocol command 21, 22
- protocol console process
 - entering 22
- protocols
 - configuration and console processes
 - accessing 21
 - configuring using quick configuration 700
 - console process 15
 - displaying information about 108
 - entering configuration environment for 94
 - entering console process 22
 - generating a list of 94

Q

- qconfig
 - CONFIG command 94
- QoS
 - ATM configuration command 290
- queue
 - GWCON command 116
- Quick Config mode 59
 - manual entry 59
- quick configuration 8, 14
 - bridging configuration 699
 - description 58
 - protocol configuration
 - IP user interface 701
 - IPX user interface 702
 - procedure 700
- Quick Configuration Reference 698

R

- radius 713
- reconfiguration 347
- redundancy of LAN emulation servers 280
- reliability of LAN emulation 280
- reload
 - OPCON command 6, 35
- reloading 14
 - router 6
- remote
 - ELS configuration command 151
 - ELS monitoring command 173
- remote AAA attributes 713
 - keywords 713
 - radius 713
 - TACACS 714
- remote consoles 4
- remote device
 - authentication
 - configuring PPP interface for 539
 - configuring PPP interface to use 540
- remote DTE, searching for 446
- remote logging
 - additional considerations 138
 - duplicate logging 138
 - messages containing IP addresses 138
 - recurring sequence numbers 139
 - output examples 135
- remote login 5
- remote terminals 4
- remove
 - ATM configuration command 290
 - ATM Virtual Interface configuration command 295
 - ELS monitoring command 174
 - Frame Relay configuration command 508
 - ISDN configuration command 676
- report
 - performance monitoring command 198
- reset
 - GWCON command 117
 - packet trace monitoring command 184
- restarting the IBM 2216 706

- restore
 - ELS monitoring command 175
- retrieve
 - ELS monitoring command 175
- RIP 701
- route descriptor policy 271
- router
 - deleting configuration information 81
 - displaying information about 87
 - displaying time statistics about 119
 - exiting 6
 - rebooting 35
 - reloading 6, 14
- router consoles
 - local 4
 - remote 4
 - using 3
- router extensions for LAN emulation 277
- router load file
 - assembling under DOS 709
 - assembling under UNIX 709
 - creating from multiple disks 709
 - disassembling under DOS 710
 - disassembling under UNIX 711
- router processes
 - attaching to 36
 - connecting to 9
 - displaying information about 35
- router software
 - communicating with 116
 - reloading 35
 - user interface 3

S

- sample, quick configuration 698
- save
 - ELS monitoring commands 175
- SDLC
 - accessing configuration 623
 - configuration procedure 621
 - configuration requirements 622
 - configuring 621, 623
 - network interface 642
 - switched call-in interface
 - configuring 621
- SDLC configuration commands
 - add 624
 - delete 625
 - disable 625
 - enable 625, 636
 - list 626
 - set 628
 - summary of 624
- SDLC connections
 - support for 624
- SDLC monitoring commands
 - accessing 634
 - clear 635
 - link counters 636
 - list 636

- SDLC monitoring commands *(continued)*
 - summary of 634
- SDLC Relay
 - accessing configuration 609
 - accessing monitoring environment 616
 - configuring 609
- SDLC Relay configuration commands
 - add 610
 - delete 611
 - disable 611
 - enable 612
 - list 612, 613
 - set 614
 - summary of 610
- SDLC Relay monitoring commands
 - clear-port-statistics 617
 - disable 618
 - enable 618
 - list 619
 - summary of 617
- second-level
 - process
 - accessing 13, 15
- security of LAN emulation 281
- selector 267
- serial line interface
 - accessing the configuration process 399
- serial line interfaces
 - configuring 399
- serial PPP links
 - configuring for MP 596
- session
 - terminating 34
- set
 - ATM configuration command 290
 - change management configuration command 50
 - channel adapter
 - configuration command 386
 - CONFIG command 95
 - dial circuit configuration command 692
 - ELS configuration command 153
 - ELS monitoring command 175
 - Fast Token-Ring configuration command 217
 - Frame Relay configuration command 510
 - Frame Relay monitoring command 526
 - ISDN configuration commands 676
 - LLC monitoring command 244
 - packet trace monitoring command 184
 - performance configuration command 197
 - performance monitoring command 198
 - PPP configuration command 556
 - SDLC configuration command 628
 - SDLC monitoring command 639
 - SDLC Relay configuration command 614
 - Token-Ring configuration command 207
 - V.25bis configuration command 651
 - X.25 configuration command 410
 - XTP configuration command 462
- setting and changing time, date, and clock 102
- signaling version configuration in LAN emulation 269

- software
 - overview 6
 - user interface 6
- source-routing
 - Fast Token-Ring configuration command 217
 - Token-Ring configuration command 208
- speed
 - Fast Token-Ring configuration command 218
 - Token-Ring configuration command 208
- start-up parameter for VTAM, ATCSTRxx 346
- statistics
 - clearing 107
 - ELS monitoring command 180
 - GWCON command 117
 - ISDN monitoring command 685
 - V.25bis monitoring commands 656
 - X.25 monitoring command 437
- status
 - OPCON command 35, 547
- subchannels
 - LCS, configuring 370
 - LSA, configuring 374
 - MPC+, configuring 377
 - number provided 348
- subsystems
 - packet trace monitoring command 185
- suggestions
 - configuration 11
- switch variant 673
 - setting for ISDN 679
- switched major node definition file, examples
 - LSA APPN connection at VTAM host 342
 - LSA direct connection at VTAM host 342
 - LSA DLSw connection at VTAM host 343
 - LSA DLSw local conversion at VTAM host 344
 - VTAM control block 341
- switched SDLC call-in interface
 - configuring 621
- system dumps, using 66
- system retrieve
 - CONFIG command 100
- system view
 - CONFIG command 101

T

- TACACS 714
- talk
 - OPCON command 16, 36, 195, 197
- TCP/IP
 - 2216 definition for MVS or VM for LCS, example 337
 - 2216 definition for MVS or VM for MPC+, example 339
 - configuring LAN Channel Station (LCS) 334
 - configuring Multi-Path Channel+ (MPC+) 336
 - configuring MVS host 334
- TCP/IP, transporting X.25 traffic over 443
- TCP/IP passthru
 - configuring 352
- TDM (time division multiplexing) 469

- technical support access 60
- TEI
 - ISDN monitoring command 684
- telnet
 - closing a connection 38
 - obtaining status of Telnet session 38
 - OPCON command 37
 - quitting a session 38
- telnet command 37
- telnet connections 5
 - closing 38
 - obtaining status of 38
- test
 - GWCON command 118
 - SDLC monitoring commands 641
 - test 641
- tftp
 - change management configuration command 51
- TFTP
 - description of
 - related to change management 41
- time
 - activated load of image 42
 - CONFIG command 102
 - setting and changing 102
- timedload
 - Boot CONFIG command 52
- Tinygram compression 556
- TLVs
 - defined on an ELAN basis 273
- token ring
 - encapsulation types for IPX 702
- Token-Ring configuration commands
 - accessing 205
 - enabling for LLC 208
 - list 205
 - LLC 206
 - llc 210
 - media 206
 - packet-size 207
 - set 207
 - source-routing 208
 - speed 208
 - summary of 205
- Token-Ring Interface
 - statistics displayed for 210
- Token-Ring monitoring commands
 - accessing 208, 218
 - dump 209
 - summary of 209
- Token-Ring network interfaces
 - configuring 205
- trace
 - ATM monitoring commands 298
 - ELS configuration commands 181
 - Frame Relay monitoring commands 528
- trace-status
 - packet trace monitoring command 185
- Transport Resource List (TRL) control block 345, 346
- trap
 - ELS configuration commands 158

- trap (*continued*)
 - ELS monitoring command 182
- type length values 273

U

- UNIX
 - assembling a load file 709
 - disassembling a load file 711
- unlock
 - change management configuration command 54
- unpatch
 - CONFIG command 103
- update
 - CONFIG command 103
- update-firmware
 - change management configuration command 55
- updating
 - configuration 12
- uptime
 - GWCON command 119
- user access
 - adding user 73
 - changing password 80
 - changing user 80
 - configuring 59
 - deleting user 84
 - listing user information 90
 - setting password 73
- user interface
 - processes 6
 - software 6

V

- V.25bis
 - accessing configuration 649
 - accessing monitoring process 653
 - adding addresses 645
 - configuring 645, 649
 - GWCON commands 658
- V.25bis configuration commands
 - list 650
 - set 651
 - summary of 649
- V.25bis monitoring commands
 - calls 654
 - circuits 655
 - parameters 655
 - statistics 656
 - summary of 653
- V25bis address 90
- variable information rate
 - for frame relay 481
- VCs
 - Frame Relay 469
- view
 - ELS monitoring command 183
 - packet trace monitoring command 186
- virtual
 - interface
 - LCS, configuring 369

- virtual (*continued*)
 - interface (*continued*)
 - LSA, configuring 372
 - MPC+, configuring 376
 - network handlers 348
- virtual connections (VC)
 - configuring 546
 - considerations 545
 - overview 545
- VM/ESA, defining the 2216 to 332
- VM/SP, defining the 2216 to 332
- VM/XA, defining the 2216 to 332
- VSE/ESA, 2216 definition 333
- VTAM
 - configuring the host
 - APPN connection, LSA 342
 - DLSw connection 343
 - MPC+ 345, 346
 - initialization file ATCSTRxx 346
 - LSA direct connection, configuring 341
 - start-up parameter 346

W

- wildcards, DTE address 445
- wrap
 - ATM monitoring commands 299
- write
 - CONFIG command 103

X

- X.25
 - parameter defaults 402
- X.25 configuration commands
 - add 424
 - change 430
 - delete 432
 - disable 415
 - enable 414
 - list 433
 - national disable 418
 - national enable 415
 - national restore 423
 - national set 418
 - set 410
 - summary of 409
- X.25 interfaces
 - bilateral closed user groups
 - overview 406
 - closed user groups
 - configuring 407
 - establishing circuits 406
 - extended types 406
 - overriding processing for cug 0 407
 - overview 405
- X.25 monitoring commands
 - list 436
 - parameters 437
 - statistics 437
 - summary of 436

- X.25 network interface
 - accessing the monitoring process 435
 - configuring 409
 - national personality 402, 707
 - statistics 439
 - using 401
- X.25 Transport Protocol (XTP) 443
- XCA major node definition file, examples
 - LSA APPN connection at VTAM host 342
 - LSA direct connection at VTAM host 342
 - LSA DLSw connection at VTAM host 343
 - LSA DLSw local conversion at VTAM host 343
 - VTAM control block 341
- XTP
 - backup peer function 446
 - closed user groups
 - overview 447
 - configuration commands
 - Add 457
 - Change 460
 - Delete 460
 - Disable 462
 - Enable 462
 - List 462
 - Set 462
 - configuration procedures 448
 - configuring 457
 - configuring commands 457
 - local XTP
 - description 447
 - monitoring commands
 - Add 464
 - Delete 465
 - List 465
 - setting keepalive timer 462
 - setting national personality 451
 - using 443

Readers' Comments — We'd Like to Hear from You

**Nways Multiprotocol Access Services
Software User's Guide
Version 3.2**

Publication No. SC30-3886-04

Overall, how satisfied are you with the information in this book?

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Overall satisfaction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How satisfied are you that the information in this book is:

	Very Satisfied	Satisfied	Neutral	Dissatisfied	Very Dissatisfied
Accurate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Easy to find	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Easy to understand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Well organized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Applicable to your tasks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please tell us how we can improve this book:

Thank you for your responses. May we contact you? Yes No

When you send comments to IBM, you grant IBM a nonexclusive right to use or distribute your comments in any way it believes appropriate without incurring any obligation to you.

Name

Address

Company or Organization

Phone No.



Fold and Tape

Please do not staple

Fold and Tape



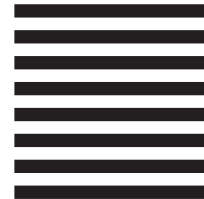
NO POSTAGE
NECESSARY
IF MAILED IN THE
UNITED STATES

BUSINESS REPLY MAIL

FIRST-CLASS MAIL PERMIT NO. 40 ARMONK, NEW YORK

POSTAGE WILL BE PAID BY ADDRESSEE

IBM Corporation
Design & Information Development
Department CGF/Bldg. 656
PO Box 12195
Research Triangle Park, NC 27709-9990



Fold and Tape

Please do not staple

Fold and Tape



Printed in the United States of America
on recycled paper containing 10%
recovered post-consumer fiber.

SC30-3886-04



Spine information:



Nways Multiprotocol Access
Services

MAS V3.2 Software User's Guide

SC30-3886-04