Nways Multiprotocol Switched Services Server

# Interface Configuration and Software User’s Guide

SC30-3818-03

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**Note**

Before using this document, read the general information under “Notices” on page xxi.

## Fourth Edition (April 1998)

This edition applies to Version 2.1 of the IBM Multiprotocol Switched Services (MSS) and to all subsequent releases and modifications until otherwise indicated in new editions or technical newsletters.

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# Preface

This manual contains the information you will need to use the command line interface for configuration and operation of the IBM Nways Multiprotocol Switched Services (MSS) or the A-MSS Server Module, hereafter referred to as “the router,” installed on your IBM Multiprotocol Switched Services (MSS). With the help of this manual, you should be able to perform the following processes and operations:

- Configure, monitor, and use the Multiprotocol Switched Services (MSS) base code on your IBM Nways Multiprotocol Switched Services (MSS) or your A-MSS Server Module
- Configure, monitor, and use the interfaces and Link Layer software supported by your router.

**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.

## 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 shown in the following example:

   reload

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

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 -**

- Names of keyboard keys are indicated like this: **Enter**

## MSS Server Library

The following hard copy publications are shipped with the product. The manuals in this list are also included in displayable softcopy form on the Multiprotocol Switched Services (MSS) Softcopy Library CD-ROM (SK2T-0378). This CD-ROM is shipped with initial orders for the MSS Server.

The reference cards, the International Program License Agreement, and the safety information booklet are shipped in hard copy only and are not included on the CD-ROM.

- *IBM 8210 Nways Multiprotocol Switched Services (MSS) Server Setup and Problem Determination Guide,* GA27-4140
- *IBM 8210 Nways Multiprotocol Switched Services (MSS) Server Operations Reference Card,* GX27-4017
- *IBM Multiprotocol Switched Services (MSS) Server Configuration and Operations Guide,* SC30-3821
- *CAUTION: Safety Information - Read This First,* SD21-0030
- *International Program License Agreement*
- *IBM Nways Multiprotocol Switched Services (MSS) Server Module Reference Card,* GX27-4018
- *IBM Nways Multiprotocol Switched Services (MSS) Server Module Setup and Problem Determination Guide,* GA27-4141

The following publications are not shipped in hard copy, but are offered in soft copy form on the Multiprotocol Switched Services (MSS) Softcopy Library CD-ROM (SK2T-0378). All of these manuals can be separately ordered in hard copy form through your IBM marketing representative.

- *IBM Multiprotocol Switched Services (MSS) Server Introduction and Planning Guide,* GC30-3820
- *IBM Multiprotocol Switched Services (MSS) Server Interface Configuration and Software User's Guide,* SC30-3818
- *Multiprotocol Switched Services (MSS) Configuring Interfaces and Features,* SC30-3819
- *Event Logging System Messages Guide,* SC30-3682
- *IBM 8210 Nways Multiprotocol Switched Services (MSS) Server Service and Maintenance Manual,* GY27-0354
- *IBM 8210 Multiprotocol Switched Services Server (MSS) Server Module Installation and Initial Configuration Guide* GA27–4141

## Summary of Changes For Version 2.1

The following are the new functions in this release:

- Support for Fast Token Ring (FasTR)
- Support for MPOA clients and server
- Support for DLSw

- Support for APPN and Banyan VINES over FDDI
- Support for LAN Emulation version 2
- Support for Broadcast Manager IPX Server Farms
- Support for High Performance Routing (HPR) over IP
- Support for Quality of Service (QOS) version 2
- Support for enhanced LAN Emulation Client (LEC) security and other PVLAN enhancements
- Support for Classical IP Peer Redundancy
- Support for Distributed IP Redundant Gateways
- Support for VLAN Port Filtering
- Support for Duplicate MAC addresses in a single emulated LAN (ELAN).

The technical changes and additions are indicated by a vertical line (|) to the left of the change.

## Under Reconstruction

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

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

This effort will take a number of editions. Please help us during this effort by reporting any corrections using the Reader's Comment Form in the back of the book.

# User's Guide

# Chapter 1. Getting Started

This chapter shows you how to get started with using the following components related to the IBM Nways Multiprotocol Switched Services (MSS) Server Module (IBM 8210) and the IBM 8210 Multiprotocol Switched Services Server:

- Router console terminals
- Router software (IBM 8210 Multiprotocol Switched Services Server)
- Router software user interface

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


- “Before You Begin” on page 1-3
- “Migrating to the Current Release” on page 1-5
- “Accessing the Software Using Local and Remote Consoles” on page 1-5


## MSS Family Client Configuration Concepts

The following sections are intended to clarify some of the concepts behind configuring your MSS Family Clients. The sections are not intended to be a configuration guide. The configuration concepts described are:


- “Bridging”
- “Routing” on page 1-2
- “Multiple MSS Family Clients” on page 1-2
- “One Hop Routing Model” on page 1-3


### Bridging

To enable the enhanced SRB bridging support, you must configure SRB bridging support on the MSS Family Clients. Simply installing the MSS Family Client hardware in the base LAN switch will not enable this function. You must explicitly configure SRB bridging support on the MSS Family Clients. When you enable this support, the MSS Family Clients will reconfigure the base SRB support in the LAN switch to distributed SRB functionality. You can still view the SRB configuration and statistical information on the base LAN switch, but you will not be able to change configuration information for SRB on the LAN switch. When the MSS Family Client becomes disabled, the base LAN Switch SRB configuration is restored and the system administrator can make configuration changes to the SRB feature on the LAN Switch.

One significant difference between the MSS Client’s ATM support and the ATM UFC is that you can place the ATM UFC in the same domain as legacy LAN switch ports. This cannot be done with the MSS Client’s ATM support. The SRB feature in the MSS Client must be used to bridge between LAN switch domains and the MSS Client’s ATM interface.

Although you can use external bridges to enhance overall network performance, these bridges take up physical port space and are limited to a physical port’s bandwidth. The MSS Family Clients attach virtual bridging interfaces, which are limited only by the LAN switch’s internal bus between the ports and not the 16-Mbps speed of a physical Token-Ring port. Each MSS Family Client’s bridge port is attached to a domain virtually and is involved with processing Explorer frames, managing Spanning Tree Protocol (STP) frames, and LNM frames.

The MSS Family Clients do not automatically configure support for PVLANs. You must configure PVLANs on the MSS Family Client and enable SRB bridging support. (PVLANs provide a way for system administrators to limit broadcast scope among domains but do not want to enable routing at the edge of the network.)

## Routing

The system administrator must explicity configure the routing support provided by the MSS Family Client. When you define a routing interface, the MSS Family Clients attach a virtual routing interface to a domain in the base LAN Switch. The switch is not aware that the domains are being routed. The switch performs the intra-domain management while the MSS Family Clients handle all inter-domain communication.

One significant benefit of using the MSS Family Clients for routing instead of an external router is that the virtual interface's bandwidth is limited by the switch's internal bandwidth and not by the bandwidth of the physical port. Because the interface is virtual, the system uses no physical port resources but can still communicate with any existing routers in the network without any cable modifications to the network.

Enabling routing allows the MSS Family Clients to limit broadcasts to high-speed network links such as the ATM UFC and Fast Ethernet UFC. The MSS Family Clients can act as front ends to the high-speed links, allowing only routed frames to pass through to these links.

## Multiple MSS Family Clients

Because the MSS Family Clients are not limited to physical port bandwidth, they can achieve higher performance. To further extend this model, you can place multiple MSS Family Clients in a single LAN switch and achieve even greater throughput. Although multiple MSS Family Clients can reside in the same LAN switch, you can configure only one for enhanced bridging support. The base LAN switch is capable of the following MSS Family Clients combinations, depending on slot availability:

- 1 MSS Client, 1 MSS Domain Client
- 2 MSS Domain Clients
- 2 MSS Clients

**Note:** You can install only 1 MSS Client or 1 MSS Domain Client if you have already installed an ATM UFC in the LAN switch. You cannot install any MSS Family Clients if 2 ATM UFCs are in the LAN switch.

Installing two MSS Family Clients allows the system to distribute routing functionality between two processors, which provides performance benefits similar to those gained by distributing the SRB bridging function between the base Token-Ring LAN switch and the MSS Family Clients. The system can also use the two clients to separate the routing and bridging functions performed by the MSS Family Clients.

## One Hop Routing Model

In the preceeding sections, the MSS Family Clients have been described as having enhanced bridging or routing support for traffic management. There is also a third model that you can configure on the MSS Family Clients which makes use of bridging and routing functions. This model is known as One Hop Routing and makes use of the MSS Family Client's hardware speeds for bridging and broadcast scope management through routing. In general, going between two LAN segments through a bridge is faster than going through a router; however, broadcast and multicast traffic traverses every device in the bridge model. Routing limits the broadcast scope of traffic, but imposes delays. These two models can be seen in Figure 1-1 on page 1-4.

Because the bridging and routing models have limitations, the MSS Family Clients, combined with the base Token-Ring LAN switch, provides several One Hop Routing solutions that route all outbound traffic and bridge all inbound traffic. This third model, depicted in Figure 1-2 on page 1-5, takes advantage of LAN Emulation to create a separate ELAN for managing traffic on each bridge network segment and the ability to route and bridge traffic to the same domain.

When a source on Subnet A needs to forward data to a destination on Subnet B, Router #1 routes to ELAN X, and Bridge #2 has an interface on ELAN X. Because the data is routed when it leaves Subnet A and bridged in by the hardware to Subnet B, the term One Hop Routing is used to describe the flow. Once Bridge #2 receives the data, it forwards the data to the bridged network of Subnet B. In the reverse path, data traveling from Subnet B to ELAN Y is routed, and Bridge #1 has an interface on ELAN Y. Bridge #1 forwards the data to the bridged network of Subnet A. This transmission creates a One Hop Routing environment between multiple subnets while limiting the scope of broadcast traffic, thereby taking advantage of faster bridging speeds, and protecting the high-speed backbone's bandwidth.

The One Hop Routing model also has several performance advantages from the system's viewpoint. Because all outbound traffic is bridged to a separate ELAN than the inbound traffic, the system can process twice as many packets because the path between Subnet A and Subnet B is full duplex.

There are three methods of performing One Hop Routing with the MSS Family Clients in a Token-Ring LAN switch. The first method is to configure the ELANs and routing interfaces on the MSS Client or use the MSS Domain Client and the ATM UFC. The second method is to use the MSS Client and the NHRP feature. The third method is to use the MSS Client and the MPOA feature. Although each method is different, the same fundamental One Hop Routing procedure is used.

## 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 8210 and your service terminal is unreadable, you

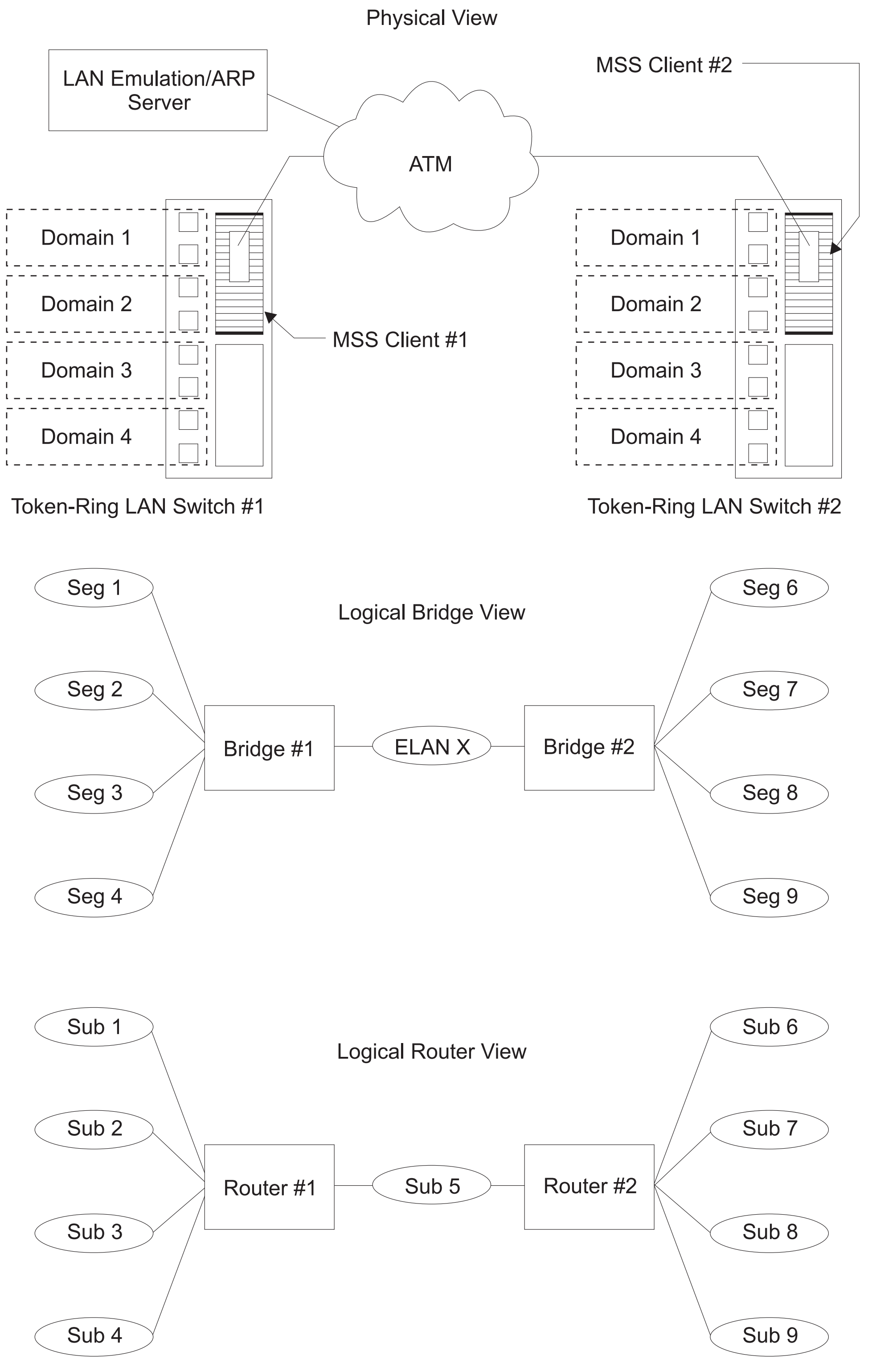


*Figure 1-1. Standard Bridge/Router Models*

need to change some parameters in your configuration. (See "Service Terminal Display Unreadable" in IBM Nways Multiprotocol Switched Services (MSS) Server Module Service and Maintenance Manual.)

- Connected your router to the network using the correct network interfaces and cables?

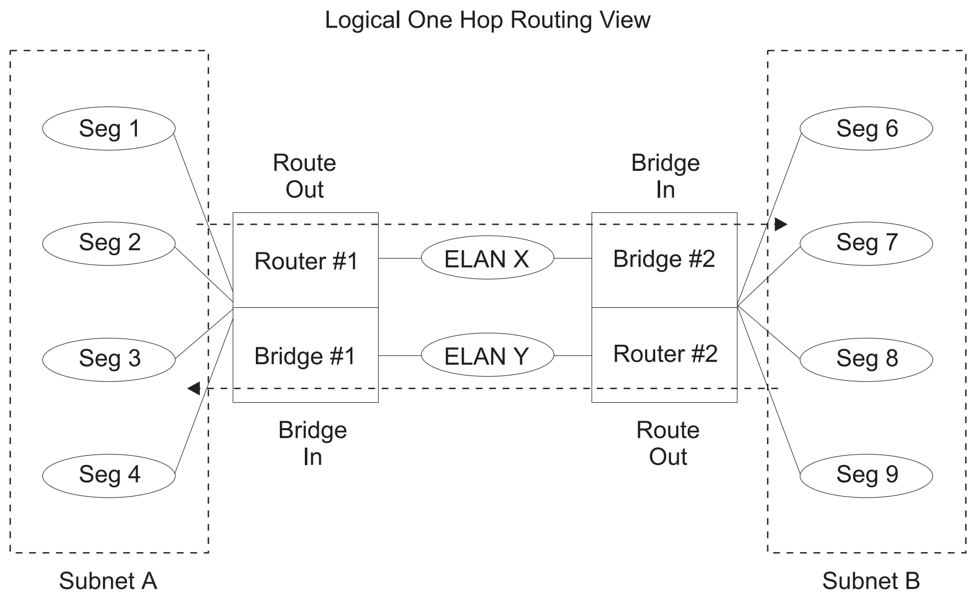


*Figure 1-2. MSS Family Client One Hop Routing Model*

- Run all necessary hardware diagnostics?

For more information on any of these procedures, refer to the *IBM Nways Multiprotocol Switched Services (MSS) Server Module Installation and Initial Configuration Guide*.

## Migrating to the Current Release

Refer to the *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 (IBM 8210 Multiprotocol Switched Services Server). 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 *Multiprotocol Switched Services (MSS) Configuring Protocols and Features* 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.

Your IBM 8210 Multiprotocol Switched Services Server software may have been pre-configured at the factory. If it was, you do not need to use a local console to perform initial configuration. If, however, your IBM 8210 Multiprotocol Switched Services Server was not pre-configured at the factory, you will need to use an ASCII terminal attached to the 8210 service port to initially configure it.

**Important:** Garbage, random characters, reverse question marks, or the inability to connect your terminal to the 8210 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 8210.

  If the IBM 8210 is set to a specific baud rate, the terminal or terminal emulator must be set to the same baud rate.

  If the IBM 8210 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).

- Defective terminal or device (ac) grounds.
- Defective, incorrectly shielded, or incorrectly grounded EIA 232 (RS-232) cable between the terminal and the IBM 8210.
- Defective terminal or terminal emulator.
- Defective IBM 8210 system board.
- High ambient electromagnetic interference (EMI) levels.
- Power line disturbances.

(See “Service Terminal Display Unreadable” in the *IBM Nways Multiprotocol Switched Services (MSS) Server Module Service and Maintenance Manual*.)

Once the IBM 8210 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 Nways Multiprotocol Switched Services (MSS) Server Module 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 if your IBM 8210 was not pre-configured at the factory.

### 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. 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 re-enter a command. See "Command History for GWCON and CONFIG Command Line" on page 2-12 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" on page 1-8.

## Reloading the Router

Whenever you change a user-configurable parameter that is not dynamically configurable, you must reload the router for the change to take effect. To do so, enter the OPCON **reload** command. 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 (IBM 8210 Multiprotocol Switched Services Server) 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 8210.

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 2-1 on page 2-2 for an overview of the processes.

Figure 1-3 on page 1-9 shows the processes and how they fit within the structure of the router software.

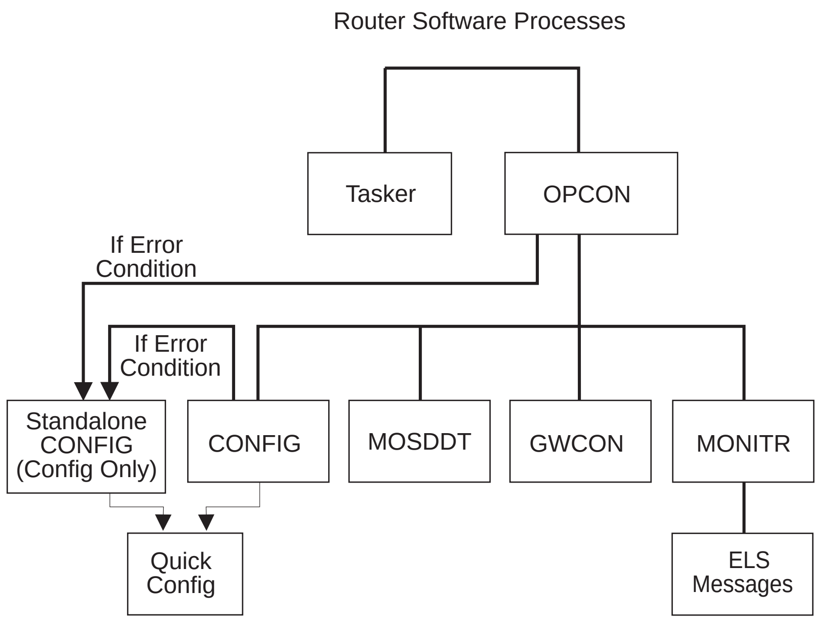


*Figure 1-3. IBM 8210 Multiprotocol Switched Services Server*

Figure 1-4 is an example of the relationship between the various process levels.

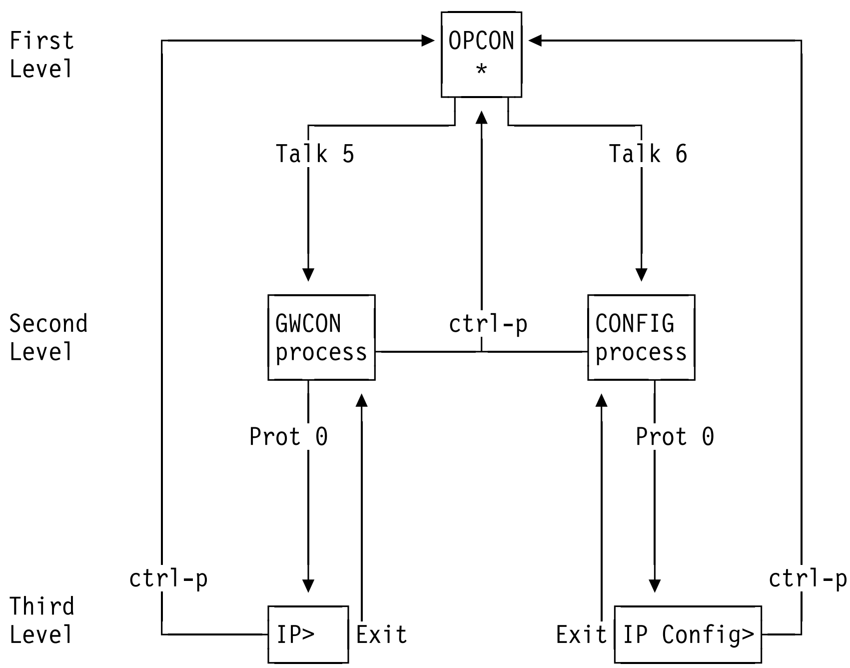


*Figure 1-4. Relationship of Processes and Commands. Also shown are the various commands to access each process level and return from each process level.*

See Chapter 7, “The OPCON Process and Commands” on page 7-1 for more information about OPCON and “Config-Only Mode” on page 9-1 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, start, or restart 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 also be added using the **add user** command. See “Configuring User Access” on page 9-4 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

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 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    COpCON    RDY    TTY0
2    Monitr    DET     --
3    Tasker    RDY     --
4    MOSDDT    DET     --
5    CGWCon    DET     --
6    Config    DET     --
7    ROpCon    IDL    TTY1 128.185.210.125
8    ROpCon    IDL    TTY2
9    WEBCon    IDL     --
```

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 7, “The OPCON Process and Commands” on page 7-1.)

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

## 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 2-1. 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) |
| MOSDDT | level 2 - diagnostic environment | **talk 4** | $ |

**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 re-enter a command. See “Command History for GWCON and CONFIG Command Line” on page 2-12 for information on how to access previously entered commands.

## Getting Help

At any of the prompts just described, 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 8210. 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 (the default intercept character is **Ctrl-P**) from a third-level or lower level process to return to the * prompt, the next time you use the **talk** command, you will re-enter the third level process. This link goes away when the router is reinitialized.

## Some Configuration Suggestions

Configuring a 8210 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 8210 that contains a configuration similar to the one for the 8210 you are configuring. The procedure also assumes that you have just taken the 8210 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 8210 for the first time:

1. Examine the 8210 you are configuring to determine what interfaces you need to configure. Note these for later use.
2. Connect to the 8210 as described in "Accessing the Software Using Local and Remote Consoles" on page 1-5.
3. Initially configure a port on the 8210 and at least an internal IP address for the device using quick config as described in "Quick Configuration" on page 9-2 or Appendix A, "Quick Configuration Reference" on page A-1. 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 2-7.
5. Configure the interfaces. Access the interface configuration process as described in "Accessing the Network Interface Configuration Process" on page 2-8.
6. Configure any required features. Access the feature configuration process as described in "Accessing Feature Configuration and Operating Processes" on page 2-9.
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 2-10.

   **Note:** At the very least, you will configure IP in this step.
8. Reload the router as described in "Reloading the Router" on page 1-8.

## Basing a Configuration on an Existing Configuration

This section describes how to:

- Base a configuration on the configuration in an operating 8210
- Permanently update the configuration in a 8210
- Temporarily updating the configuration of a 8210 while the 8210 is operating

## Basing on an Existing Configuration

If you already have a 8210 that has the same interfaces, features, and protocols that you will configure on a new 8210, you can save time during configuration by basing the configuration on the existing 8210. You can perform this type of configuration either using the command line interface or by using the configuration program that comes with the 8210. In both cases, the procedures assume that the 8210 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'll be using.
   a. Enter **talk 6** at the OPCON (*) prompt.
   b. Enter **boot** at the `Config>` prompt.
   c. Enter the **copy configuration** *file* at the `Boot config>` prompt. See Chapter 11, "Using BOOT Config to Perform Change Management" on page 11-1 for more information.
2. Connect to the 8210 that you are configuring.
3. Load the configuration you obtained in step 1 into the 8210 using TFTP. See Chapter 11, "Using BOOT Config to Perform Change Management" on page 11-1.
4. Update the configuration.
5. Write the configuration. See Chapter 9, "The Configuration (CONFIG) Process and Commands (Talk 6)" on page 9-1.
6. Reload the 8210.

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

1. Start the configuration program.
2. Retrieve the configuration from the 8210 on which you want to base this 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 8210 you are configuring.
6. Reload the 8210.

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

### Permanently Updating a Configuration

To permanently update a configuration:

1. Access the 8210 you are updating as described in “Accessing the Software Using Local and Remote Consoles” on page 1-5. You should 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 9, “The Configuration (CONFIG) Process and Commands (Talk 6)” on page 9-1.
6. Reload the 8210.

### Temporarily Updating a Configuration

The ability to temporarily update a configuration allows you to make changes to some of the operating characteristics of a 8210 until such time that you can make permanent updates to the configuration. This enables you to implement changes immediately that would 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 8210 you are updating as described in “Accessing the Software Using Local and Remote Consoles” on page 1-5. You should see the * prompt.
2. Enter the **talk 5** command to access the operating/monitoring process.
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 1-8

## 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 9, “The Configuration (CONFIG) Process and Commands (Talk 6)” on page 9-1 and Chapter 13, “The Operating/Monitoring Process (GWCON - Talk 5) and Commands” on page 13-1.

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 9-2).

### 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 8210 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.

## Acessing the Third-Level Processes

After accessing the second level, you will need to enter commands on the third level to configure or operate the interfaces, features, and protocols in your IBM 8210. 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 7, "The OPCON Process and Commands" on page 7-1.)

   ```
   * 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.

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 CHARM ATM Adapter          Slot: 1  Port: 1
   ```

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 `ATM Config>` for ATM), 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
```

***Configuring the Network Interface:*** Refer to the specific chapters in this guide for complete information on configuring your IBM 8210's network interfaces.

The MSS Client supports a 155 Mbps ATM interfaces.

### 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

   Nways 8210 Multiprotocol Switching Server
   Host name: [not configured]
   Version: 1.0

   Num Name  Protocol
   0   IP    DOD-IP
   3   ARP   Address Resolution
   11  SNMP  Simple Network Management Protocol
   12  OSPF  Open SPF-Based Routing Protocol
   23  ASRT  Adaptive Source Routing Transparent Enhanced Bridge

   Num Name  Feature
   2   MCF   MAC Filtering
   6   QOS   Quality of Service

   3 Networks:
   Net Interface  MAC/Data-Link         Hardware         State
   0   ATM/0      ATM                   CHARM ATM        Up
   ```

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

   ```
    + network 0
   ATM>
   ```

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

***Monitoring the Network Interface:*** Refer to the specific chapters in this manual for complete information on monitoring your IBM 8210's network interfaces.

## Accessing Feature Configuration and Operating Processes

To help you access the IBM 8210 Multiprotocol Switched Services Server 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 IBM 8210 Multiprotocol Switched Services Server 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 ?

QOS
MCF

Feature name or number [2] ?
```

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 10-3 on page 10-9 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 10-10 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 *Multiprotocol Switched Services (MSS) Configuring Protocols and Features* 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

     Nways 8210 Multiprotocol Switching Server
   Host name: NCE #2
   Version:  16.0[R1]

   Num Name  Protocol
   0   IP    DOD-IP
   3   ARP   Address Resolution
   7   IPX   Netware IPX
   11  SNMP  Simple Network Management Protocol
   12  OSPF  Open SPF-Based Routing Protocol
   23  ASRT  Adaptive Source Routing Transparent Enhanced Bridge

   Num Name  Feature
   2   MCF   MAC Filtering
   6   QOS   Quality of Service

   6 Networks:
   Net Interface  MAC/Data-Link        Hardware          State
   0   ATM/0      ATM                  CHARM ATM         Up
   1   ATM/1      ATM                  CHARM ATM         Up
   2   TKR/0      Token-Ring/802.5     CHARM ATM         Up
   3   Eth/0      Ethernet/IEEE 802.3  CHARM ATM         Up
   4   TKR/1      Token-Ring/802.5     CHARM ATM         Up
   5   Eth/1      Ethernet/IEEE 802.3  CHARM ATM         Down
   ```

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 *Multiprotocol Switched Services (MSS) Configuring Protocols and Features* 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 hitting **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 les`**

**`display sub lec`**

Enter:

**`display sub les`**, then press **Enter**

**Ctrl-B** for Backward, and the current line is replaced with-

**`display sub les`**

Press **Backspace** and replace "s" with "c" to get

**`display sub lec`** 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 7, “The OPCON Process and Commands” on page 7-1 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. Using MSS Server Firmware

The MSS Server contains firmware that tests the hardware each time the MSS Server is powered on. If the MSS Server has not loaded its operational code, the firmware will be running.

One of the functions is to perform hardware checking after a power-on, and decide which version of the operational code will be loaded. It also allows you to change some of the hardware-related parameters, and manage the operational code and your configuration files.

The System Management Services menu appears when the MSS Server is set up to boot up in “Attended Mode.”

**Important:**

1. You can also access the firmware by stopping the boot process. To do this, you must have a TTY console directly attached to the EIA 232 service serial port. When the server starts its boot process, press and hold **Ctrl-C** or **F1** at the terminal keyboard.
2. If the firmware panels do not appear after you complete the above step:
   a. Be sure that your workstation is connected to the EIA 232 service serial port on the server.
   b. Reset or power down and power up the server.
3. You can use the up(↑) and down arrow (↓) keys or the Tab key to move around the firmware panels.

## Accessing the Firmware Prompt

Before booting the server, note that:

- You will need a terminal connected to the server. This can be a VT100 TTY device connected directly through the serial port.

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

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

## Boot Options Available for the MSS Server

The MSS Server 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 or three 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 12-8 for a description of file statuses.

## Attended Mode

When the server is configured to come up in attended mode, you have access to the Firmware System Management Services.

Connection in attended mode is through a TTY connection. You can transfer files using the Xmodem protocol for TTY or TFTP for IP connections.

In attended mode, you can start booting the server by pressing **F9** or by pressing **Ctrl+A**, then **9**, and then **Enter** to start the operating system. The system will prompt you to enter the supervisory password. The default password is **mss**.

## Unattended Mode

This is the normal mode for the 8210. It will come up on the Active, Local, or Pending image and config based on your choice.

A password is not required to boot up in unattended mode.

# Starting the MSS Server Firmware

You can begin using the information in this section after you have prepared your service terminal and have established connection with the server.

From the Main Menu panel (as shown in Figure 3-1 on page 3-3), you can select one of four services. The following sections explain these services and provide instructions for going through the associated panels:

- “Managing the Configuration” on page 3-3
- “Selecting the Boot Sequence” on page 3-4
- “Selecting a Device To Test” on page 3-4
- “Using the Utilities” on page 3-6

```
IBM server Firmware
Version 3.2
(C) Copyright IBM Corporation, 1996, 1998. All rights reserved.
                           System Management Services


Select one:
  1. Manage Configuration
  2. Boot Sequence Selection
  3. Select Device to Test
  4. Utilities








 Enter    -   Esc=Quit    -   F1=Help    -   F3=Reboot  -   F9=Start OS -
-----------  --------------  -------------  -------------  --------------
```

*Figure 3-1. Main Menu Panel*

## The Function Keys

As seen in Figure 3-1, various function keys appear at bottom of the panels. These keys are common among the MSS Server Firmware panels. On other panels the functions keys are stacked at the right of the panel. Use the F1 Help key to get descriptions for the function keys associated with the MSS Server Firmware.

If your terminal does not support function keys, use the key combination, **Ctrl A** *#* to emulate the function keys.

| **Note:** With some terminal emulators, you may need to define the keys as follows:

| Key | Definition |
|---|---|
| **F6** | ^[[006q |
| **F9** | ^[[009q |

## Obtaining Help

Online helps are available for panels whenever the F1 key appears at the lower portion of the panel. Pressing F1 presents a pop-up help window with information relating to the currently active panel.

## Managing the Configuration

Managing the configuration involves defining and modifying some configuration values. You can change the operational parameters for the EIA 232 service serial port and the PCMCIA modem by pressing the F6 Modify key.

**Note:** Although you can modify the speed, parity, data bits, and so on, of either the EIA 232 service serial port or the PCMCIA modem, it is recommended that you modify only the PCMCIA modem and not the EIA 232 service serial port.

1. Select **1. Manage Configuration** from the main menu as shown in Figure 3-1.
2. The *System Configuration Information* panel appears as shown in Figure 3-2.

   **Note:** Only the fields under Serial Ports can be changed (modified). To change the specifications for a port, move the cursor to the field, press **F6**, and type in the new value.

   Use the down arrow (↓) key to scroll to the next panel.
3. Press **Enter** to make the change effective.
4. To display serial ports, press **F6** after selecting the processor type.

```
IBM server Firmware
Version 3.2
(C) Copyright IBM Corporation, 1996, 1998. All rights reserved.
                        System Management Services
          +---------------System Configuration Information--------------+
          |                                                              |
Select one|   Processor Type       166MHz 603EV                          |
  1. Manag|   Memory               64 Megabytes                       >  |
  2. Boot |                                                              |
  3. Selec|   L2 Cache             512KB Installed                       |
  4. Utili|                                                              |
          |   PCI Slots                                                  |
          |     Name of adapter    Slot #      Device ID    Revision ID  |
          |     8260 ATM Interface    1           1410         03        |
          |                                                              |
          |   Serial Ports                                               |
          |     COM1 (x' 8c0')     Serial Port                           |
          |     COM2 (x' 2f8')     PCMCIA Modem                          |
          |                                                              |
          |                                                              |
 Enter    |   Enter    -   Esc=Quit    -   F1=Help    -   F6=Modify   -  |
--------- |------------  -------------  -------------  -------------    |
          +--------------------------------------------------------------+
```

*Figure 3-2. System Configuration Information*

## Selecting the Boot Sequence

This function enables you to select a sequence for the various boot devices, display the current boot device settings, restore the default setting, and boot from other boot devices.

**Attention:** It is not recommended that you use this function. Use the Change Management option under the Utilities menu instead. See Chapter 11, "Using BOOT Config to Perform Change Management" on page 11-1 for more information about change management.

## Selecting a Device To Test

The firmware performs hardware tests when the MSS Server boots up. But there may be times when you have removed and replaced a failing part and you want to run an individual test before a full boot up or reset. The firmware allows you to run these individual tests:

- Test All Subsystems: This test runs all the subsystem tests that are listed on this panel.

  **Note:** This list is a variable list and the entries are based on diagnostic files.

- Test Memory: This test searches all available memory regions, tests the regions, and presents a consolidated list of test results.
- Test System Board: This tests the PowerPC CPU, the System Board interrupts, the PCMCIA controller, the system board temperature sensor and its interrupt mechanism, and turns the LEDs on and off (you must visually confirm that the LEDs are indeed on or off).
- Test 8260 Mailbox: This tests the Mailbox communications interface with the 8260 or 8265.
- Test IDE Devices: This tests the IDE hard drive devices
  - Device self test
  - Read/Seek test
  - Buffer test

  It also allows low-level formatting of the hard drive.

  **Note:** Perform low-level formatting only under the guidance of service support personnel.

- ATM Interface to Hub: This tests the ATM subsystem in the A-MSS Server Module.
- 155-Mbps ATM Adapter: This tests the ATM adapter and allows the testing of the physical interface in the MSS Server when used with an optical wrap plug.
- FDDI Adapter: This tests the FDDI adapter in the MSS Server.

To test a device:

- Select **3. Select Device to Test** from the main menu.

  The *Select Device to Test* panel appears (Figure 3-3 on page 3-6).

  **Note:** The *Select Device to Test* panel is created dynamically, depending on what diagnostics have been loaded. What items appear depend on whether you have an MSS Server or an A-MSS Server Module.

```
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                           System Management Services


Select one:
  1. Manage Configuration
  2. Boot Sequence +----------------Select Device to Test----------------+
  3. Select Device |                                      Esc=Quit      -|
  4. Utilities     |                                     ----------------|
                   |                                      F1=Help       -|
                   |                                     ----------------|
                   |  {>} Test All Subsystems           Spacebar=Choose -|
                   |  { } Test Memory                   ----------------|
                   |  { } Test System Board             F4=Parm Setup  -|
                   |  { } Test 8260 Mailbox             ----------------|
                   |  { } Test IDE Devices              F6=Execute     -|
                   |  { } ATM Interface to Hub          ----------------|
                   |                                F9=Display Error Log -|
 Enter   -         |                                    ----------------|
----------         |                                                    |
                   +----------------------------------------------------+
```

*Figure 3-3. Test Selection Panel*

- Use the spacebar and up arrow and down arrow keys to select the test that you want to run.
- Move the cursor to a selection and press **F4** to define additional test parameters.

  **Note:** Errors encountered during diagnostics are logged in the hardware error log.
- The *Test Parameters* panel appears. From this panel you can select:
  – Run Interactive Test
  – Run Wrap Tests
  – Stop On Error
  – Loop Tests
  – Loop Count

  Press **Esc** to return to the *Select Device Test* panel.
- Press **F6** to start a test.
- After the test is complete, press **Esc** to return to the main menu panel.

| The adapter diagnostics are stored on the hard drive in the MSS Server. These
| diagnostics can be installed by using the “Copy Remote Files” utility and storing the
| file in the C:\DIAGS directory. The file extension of the adapter diagnostics is .6DG.

## Using the Utilities

To use the utilities:

1. Select **4. Utilities** from the main menu.

   A panel listing the available utilities appears (Figure 3-4 on page 3-7).

```
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Select one:
  1. Set Supervisory Password
  2. Enable Unattended Start Mode
  3. Disable Unattended Start Mode
  4. Remove Supervisory Password
  5. Update System Firmware
  6. Display Event / Error Log
  7. View or Set Vital Product Data
  8. Copy Remote Files
  9. Remote Initial Program Load Setup
 10. Manipulate Dead Man Timer
 11. Verify Hard Disk Format
 12. Change Management
 13. Prepare Hard Disk

 Enter    -   Esc=Quit    -   F1=Help    -
-----------  --------------  -------------
```

*Figure 3-4. Utilities Selection Panel*

2. Make your selection. Additional panels appear to prompt you for additional information, and messages appear to indicate that the task is completed.

## Setting the Supervisory Password

If a password is set and the server is configured to come up in unattended mode, you must enter the password before you can access the firmware System Management Services. The MSS Server is initially shipped with a password of **mss**. This utility allows you to set and change the password.

**Note:** You can perform this function only if you do it immediately after you perform a power-on reset.

1. Select **Set Supervisory Password** from the utilities panel.

   The *Set Supervisory Password* panel appears (Figure 3-5 on page 3-8 ).

2. Type your new password and press **Enter**. The system prompts you to enter your new password again.

   **Note:** The supervisory password can consist of from 1 to 8 characters with no restrictions on which characters can be used.

```
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                           System Management Services


Select one:
  1. Set Supervisor+--------Set Supervisory Password----------+
  2. Enable Unatten|                                          |
  3. Disable Unatte|  Type your new password, and then        |
  4. Remove Supervi|    press Enter.                          |
  5. Update System |                                          |
  6. Display Event |                                          |
  7. View or Set Vi|   Enter  -   Esc=Quit  -   F1=Help  -    |
  8. Copy Remote Fi|  ---------  ------------  -----------    |
  9. Remote Initial+------------------------------------------+
 10. Manipulate Dead Man Timer
 11. Verify Hard Disk Format
 12. Change Management
 13. Prepare Hard Disk

 Enter    -   Esc=Quit    -   F1=Help    -
-----------  --------------  -------------
```

*Figure 3-5. Set Supervisory Password Panel*

3. Type the password again and press **Enter**.
4. The *Password Saved* panel appears with the message that your supervisory password has been saved.

## Enabling Unattended Start Mode

The default is that the unattended start mode is enabled, which causes the MSS Server to load operational code automatically.

**Note:** You can perform this function only if you do it immediately after you perform a power-on reset.

1. Select **Enable Unattended Start Mode** from the utilities panel.

   The *Unattended Start Mode Changed* panel appears. See Figure 3-6 on page 3-9.

```
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                           System Management Services


Select one:
  1. Set Supervisory Password
  2. Enable Unatten+------Unattended Start Mode Changed-------+
  3. Disable Unatte|                                         |
  4. Remove Supervi|    Unattended Start mode has been       |
  5. Update System |    enabled.                             |
  6. Display Event |                                         |
  7. View or Set Vi|                                         |
  8. Copy Remote Fi|                                         |
  9. Remove Initial+-----------------------------------------+
 10. Manipulate Dead Man Timer
 11. Verify Hard Disk Format
 12. Change Management
 13. Prepare Hard Disk


 Enter    -   Esc=Quit    -   F1=Help    -
-----------  --------------  -------------
```

*Figure 3-6. Unattended Start Mode Changed (Enabled) Panel*

**Note:** Once unattended start mode has been enabled, you can enter the firmware by pressing and holding **Ctrl-C** or pressing **F1** at the terminal keyboard when the boot process begins.

## Disabling Unattended Start Mode

The default for the MSS Server firmware is that the unattended start mode is enabled. You disable Unattended Start Mode using this utility.

**Note:** You can perform this function only if you do it immediately after you perform a power-on reset.

1. Select **Disable Unattended Start Mode** from the utilities panel.

   The *Unattended Start Mode Changed* panel appears. See Figure 3-7 on page 3-10.

```
IBM server Firmware
Version 3.2
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                           System Management Services


Select one:
  1. Set Supervisor Password
  2. Enable Unattended Start Mode
  3. Disable Unatte+------Unattended Start Mode Changed-------+
  4. Remove Supervi|                                          |
  5. Update System |     Unattended Start mode has been       |
  6. Display Event |     disabled.                            |
  7. View or Set Vi|                                          |
  8. Copy Remote Fi|                                          |
  9. Remote Initial|                                          |
 10. Manipulate Dea+------------------------------------------+
 11. Verify Hard Disk Format
 12. Change Management
 13. Prepare Hard Disk

 Enter    -   Esc=Quit    -   F1=Help    -
-----------  --------------  -------------
```

*Figure 3-7. Unattended Start Mode Changed (Disabled) Panel*

## Removing Supervisory Password

The use of a supervisory password allows you a degree of security by preventing unauthorized access to the MSS Server's System Management Services (firmware). Removing the enforcement of a password, however, could be a convenience while servicing the MSS Server.

**Note:** You can perform this function only if you do it immediately after you perform a power-on reset.

1. Select **Remove Supervisory Password** from the utilities panel.

   The *Remove Supervisory Password* panel appears. See Figure 3-8 on page 3-11.

```
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Version 3.2
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                           System Management Services


Select one:
  1. Set Supervisory Password
  2. Enable Unattended Start Mode
  3. Disable Unatte+-------Remove Supervisory Password--------+
  4. Remove Supervi|                                         |
  5. Update System |  Do you want to remove the              |
  6. Display Event |  Supervisory password?                  |
  7. View or Set Vi|                                         |
  8. Copy Remote Fi|   Yes (Y)  -    No (N)  -               |
  9. Remote Initial|  -----------  -----------              |
 10. Manipulate Dea+-----------------------------------------+
 11. Verify Hard Disk Format
 12. Change Management
 13. Prepare Hard Disk

 Enter    -   Esc=Quit    -   F1=Help    -
-----------  --------------  -------------
```

*Figure 3-8. Remove Supervisory Password Panel*

2. Type **Y** if you want to remove the supervisory password.
3. The *Password Removed* panel appears. This panel informs you that the supervisory password has been removed.

## Updating System Firmware

Use this utility to update the MSS Server firmware.

**Note:** Do not power off or reset the MSS Server during the process of updating the firmware. If the update fails, the MSS Server will boot a backup firmware image. If this happens, repeat the update procedure to reload the onboard firmware image.

1. Select **Update System Firmware** from the utilities panel.

   The *System Firmware Update* panel appears. See Figure 3-9 on page 3-12.

```
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Version 3.2
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                           System Management Services


Select one:
  1. Set Supervisory Password
  2. Enable Unattended Start Mode
  3. Disable Unattended Start Mode
  4. Remove Supervisory Password
  5. Update System +----------F/W Update Options--------------+
  6. Display Event |                                          |
  7. View or Set Vi|  1. TFTP a Remote Image File             |
  8. Copy Remote Fi|  2. XMODEM a Remote Image File           |
  9. Remote Initial|  3. Use a Local Image File               |
 10. Manipulate Dea|                                          |
 11. Verify Hard Di|   Enter -  Esc=Quit -   F-1=Help         |
 12. Change Managem| -------   ---------    ------------------|
 13. Prepare Hard D+------------------------------------------+

 Enter    -   Esc=Quit    -   F1=Help    -
-----------  --------------  -------------
```

*Figure 3-9. Update System Firmware Panel*

2. Select the option that you want to use from those listed. For TFTP, the system prompts you for the remote (the “from”) file name that you want to use.

   If you need to set the IP address of the MSS Family Client, use the **Remote Initial Program Load** menu.

   The firmware update process begins. It informs you that the system firmware has been updated.

## Displaying the Event/Error Log

To display the Event/Error Log:

1. Select **Display Event / Error Log** from the utilities panel.

   The *Event / Error Log* panel appears. See Figure 3-10 on page 3-13.

```
IBM server Firmware
Version 3.2
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                           System Management Services


Select one:
  1. Set Supervisory Password
  2. Enable Unattended Start Mode
  3. Disable Unattended Start Mode
  4. Remove Supervisory Password
  5. Update System Firmware
 +-----------------------Event Log-----------------------------------------+
 |                                                                         |
 |  1. Src     1 08/src/arp/sysext/c200/io_int.c:324     00000005,012B     |
 |  2. Bootup  0********************            00-01, 21 01/03/96 16:23:27 |
 |  3. Src     1 08/src/arp/sysext/c200/io_int.c:324     00000005,012B     |
 |                                                                         |
 |    Enter     -     Esc=Quit  -     F1=Help   -   F2=Clear Log -         |
 |  -------------   -------------   -------------  ---------------         |
 +-------------------------------------------------------------------------+
 Enter   -   Esc=Quit   -    F1=Help  -
----------  -------------   -----------
```

*Figure 3-10. Event/Error Log Panel*

If the log is too large to appear on one panel, you can move through the log by using the up and down arrow keys or the PgUp/PgDn keys.

2. Press **F2** to clear the log.

## Hardware Error Codes

The error log that is displayed when you use the Display Event/Error Log firmware utility contains error codes. Table 3-1 explains these codes.

*Table 3-1 (Page 1 of 2). Hardware Error Codes*

| Error Code | Physical Location | Software Sub-system | Explanation |
|---|---|---|---|
| 00010000 | System Board | Processor | Error occurred during processor test |
| 00011000 | System Board | NVRAM | Non-volatile RAM Test Failure |
| 00015001 | System Board | Firmware | Error occurred while erasing the system firmware |
| 00015002 | System Board | Firmware | Error occurred while updating the system firmware |
| 00015011 | System Board | Main Flash Array | Error occurred while erasing the system main flash array |
| 00015500 | System Board | Interrupts | System board interrupt test failure |
| 00015501 | System Board | Interrupts | Error occurred during processor interrupt test |
| 00015502 | System Board | Interrupts | Error occurred during real-time clock interrupt test |
| 00015503 | System Board | Interrupts | Error occurred during timer interrupt test |
| 00015504 | System Board | Interrupts | Error occurred during dead-man timer interrupt test |
| 00016000 | System Board | RTC-NVRAM | CRC error |
| 00016002 | System Board | RTC-NVRAM | Read/write failure |
| 00017001 | System Board | RTC-NVRAM | Battery drained |
| 00017006 | System Board | RTC-NVRAM | Security data missing or not valid |

*Table 3-1 (Page 2 of 2). Hardware Error Codes*

| **Error Code** | **Physical Location** | **Software Sub-system** | **Explanation** |
|---|---|---|---|
| 00017007 | System Board | Security | Maximum unsuccessful attempts to enter password was reached |
| 00170000 | IDE | IDE | Unable to allocate memory for IDE diagnostics |
| 001701xy | IDE | IDE | IDE device id y on controller x is not responding |
| 001702xy | IDE | IDE | Formatter device error occurred on IDE device ID y on controller x |
| 001703xy | IDE | IDE | Sector buffer error occurred on IDE device ID y on controller x |
| 001704xy | IDE | IDE | Controlling microprocessor error occurred on IDE device ID y on controller x |
| 001706xy | IDE | IDE | Two masters may not be present on IDE controller x. This configuration is not valid. |
| 001707xy | IDE | IDE | IDE device id y on controller x not is responding |
| 001708xy | IDE | IDE | IDE device id y on controller x not is responding |
| 2209E000 | System Board | Thermal Sensor | Thermal sensor configuration error occurred |
| 2259E000 | System Board | Thermal Sensor | Thermal sensor interrupt error occurred |
| 2269Exxx | System Board | Thermal Sensor | Thermal sensor reached maximum operating conditions. xxx=temperature over maximum conditions in degrees Celsius in hexadecimal |
| 30001000 | IDE | IDE | Error occurred while running the IDE diagnostics |
| 30002000 | IDE | IDE | Error occurred while preparing the hard drive |
| 5abcdefg | System Board | PCMCIA | Error occurred during the PCMCIA test<br>abcdefg = detailed information |
| 50001100 | System Board | Firmware | The level of System Management Services does not match the level of system firmware |
| 710sdddd | 155-Mbps MMF adapter | ATM diagnostics | Error occurred with ATM adapter in slot<br>“s” dddd = detailed status |
| 720sdddd | 155-Mbps SMF adapter | ATM diagnostics | Error occurred with ATM adapter in slot<br>“s” dddd = detailed status |
| 740sdddd | 8260 ATM interface | ATM diagnostics | Error with the 8260 ATM interface<br>dddd = detailed status |
| 750sdddd | FDDI Adapter | FDDI diagnostics | Error occurred with FDDI adapter in slot<br>“s” dddd = detailed status |
| 7msceddd | PCI slots | | Adapters m=unique for adapter type<br>s=subtest, c=slot id, e=error id,<br>ddd = debug |
| 80000000 | System Board | 8260 Interface | Echo Response test with 8260 failed |
| 801000xy | System Board | Mailbox Memory | Error mailbox memory<br>x = indicates page 2 error<br>y = indicates page 1 error |
| 81xyzzzz | System Board | Memory | Error occurred while testing main flash array memory pages<br>x, y, zzzz = detailed information |

## Viewing Vital Product Data

This utility allows you to view vital product data (VPD) for the MSS Server

```
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                           System Management Services


Select one:
  1. Set Supervisory Password
  2. Enable Unattended Start Mode
  3. Disable Unattended Start Mode
  4. Remove Supervisory Password
  5. Update System Firmware
  6. Display Event / Error Log
  7. View or Set Vital Produc+-----View or Set Vital Product Data-----+
  8. Copy Remote Files       |                                         |
  9. Remote Initial Program L|                                         |
 10. Manipulate Dead Man Time| Firmware Part Number                    |
 11. Verify Hard Disk Format | Hardware Vital Product Data             |
 12. Change Management       |                                         |
 13. Prepare Hard Disk       |                                         |
                             |    Enter  -  Esc=Quit  -   F1=Help  -   |
 Enter    -   Esc=Quit    -  | ----------- ------------ ------------   |
-----------  --------------  +-----------------------------------------+
```

*Figure 3-11. View of Set Vital Product Data*

1. Select **View or Set Vital Product Data** from the utilities panel.

   The *View or Set Vital Product Data* panel appears (Figure 3-11 ). From this panel you can select the type of vital product data you want to view.

2. For each selection, a *View Part Number* panel appears that contains the part number you selected. Version number and dates are provided for the firmware and System Management Services.

3. Select **Hardware Vital Product Data** if you want to view vital product data. VPD is stored in keyword format. The following is a list of the keywords and their meanings. Depending on the configuration of your system, all of the keywords listed may not be present or have meaningful values.

   Vital product data fields are:

   AT - Main logic card type

   DS - Text description of card

   FN - FRU number

   PN - Manufacturing part number

   ML - Maintenance level

   MF - Manufacturing location

   SN - Serial number

   BF - Boot flash level and ID

   NA - Burned in MAC Address in ASCII Format

   ZB - Burned in MAC Address in Hex Canonical Format

TM - Machine type and model

F# - Feature Number

BS - Box serial number

RC - Recycle count

Z0 - Vendor ID

4. Press **Esc** when you are through.

## Copying Remote Files

This utility allows you to copy remote files from another machine into the hard file. There are two methods of file transfer, TFTP from a server using the Ethernet port, or Xmodem over the active serial port.

1. Select **Copy Remote Files** from the utilities panel.

   The *Copy Remote Files* panel appears (Figure 3-12 ). From this panel you select the method of file transfer. Subsequent panels allow you to enter the names of the files that you want to copy.

```
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                           System Management Services


Select one:
  1. Enable Unattended Start Mode
  2. Disable Unattended Start Mode
  3. Update System Firmware
  4. Display Event / Error Log
  5. View or Set Vital Product Data
  6. Copy Remote Files       +---------- Copy Remote Files------------+
  7. Remote Initial Program L|                                         |
  8. Manipulate Dead Man Time|  1. TFTP a Remote File                  |
 11. Verify Hard Disk Format |  2. Xmodem a Remote File                |
 12. Change Management       |                                         |
 13. Prepare Hard Disk       |                                         |
                             |    Enter  -  Esc=Quit  -   F1=Help  -   |
 Enter    -   Esc=Quit    -  | ----------- ----------- ------------    |
-----------  --------------  +-----------------------------------------+
```

*Figure 3-12. Copy Remote Files Panel*

## Setting Up Remote Initial Program Load

Before you can configure an MSS Server in the network, it must have an IP address that is recognized within your network and it must have the addresses of your ATM adapters.

This utility allows you to load this minimum information to install this device in your network so that you can send it a configuration file, or otherwise communicate with it. This utility allows you to Ping the MSS Server, after loading its minimum network parameters, to see if you can communicate with it.

1. Select **Remote Initial Program Load Setup** from the utilities panel.

The *Network Parameters* panel appears (Figure 3-13 on page 3-17 ). From this panel you can select to enter the IP address of the MSS Server and the host, input adapter parameters, or Ping from the MSS Server to the host.

```
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                           System Management Services


Select one:
  1. Set Supervisory Password+---------- Network Parameters ----------+
  2. Enable Unattended Start |                                        |
  3. Disable Unattended Start|          1. IP Parameters              |
  4. Remove Supervisory Passw|          2. Adapter Parameters         |
  5. Update System Firmware  |          3. Ping                       |
  6. Display Event / Error Lo|                                        |
  7. View or Set Vital Produc|                                        |
  8. Copy Remote Files       |    Enter  -  Esc=Quit  -   F1=Help  -  |
  9. Remote Initial Program L| ----------- ------------ ------------  |
 10. Manipulate Dead Man Time+----------------------------------------+
 11. Verify Hard Disk Format
 12. Change Management
 13. Prepare Hard Disk

 Enter    -   Esc=Quit    -   F1=Help    -
-----------  --------------  -------------
```

*Figure 3-13. Setup Remote Initial Program Load Panel*

- If you select **IP Parameters**, a panel appears on which you can enter:
  - Client IP Address (the IP address of the MSS Server)
  - Server IP Address
  - Gateway IP Address
  - Subnet Mask

  An MSS Server 8210-001 2-wide blade comes from the factory with the following default IP addresses:

  | | |
  |---|---|
  | **Client** | 10.1.1.2 |
  | **Server** | 10.1.1.1 |
  | **Gateway** | 10.1.1.1 |
  | **Subnet Mask** | 255.255.255.0 |

  An A-MSS Server Module 1-wide blade comes from the factory with the following default IP addresses:

  | | |
  |---|---|
  | **Client** | 10.1.2.2 |
  | **Server** | 10.1.2.3 |
  | **Gateway** | 10.1.2.3 |
  | **Subnet Mask** | 255.255.255.0 |

2. If you select **Adapter Parameters**, a panel appears with a list of any configurable adapters.

3. The **Ping** option allows you to test connectivity.

   **Note:** Do not Ping your current terminal connection via SLIP.

## Manipulating the Dead Man Timer

This utility allows you to selectively enable or disable the dead man timer. The default is disabled.

1. Select **Manipulate Dead Man Timer** from the utilities panel.

   A *Dead Man Timer Options* panel appears. From this panel you can enable or disable the timer.

```
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                           System Management Services


Select one:
  1. Set Supervisory Password
  2. Enable Unattended Start Mode
  3. Disable Unattended Start Mode
  4. Remove Supervisory Password
  5. Update System Firmware
  6. Display Event / Error Log
  7. View or Set Vital Product Data
  8. Copy Remote Files
  9. Remote Initial Program L
 10. Manipulate Dead Man Time+---------Dead Man Timer Options---------+
 11. Verify Hard Disk Format |                                        |
 12. Change Management       |      1. Enable Dead Man Timer          |
 13. Prepare Hard Disk       |      2. Disable Dead Man Timer         |
                             |                                        |
 Enter    -   Esc=Quit    -  |    Enter  -  Esc=Quit  -   F1=Help  -  |
-----------  --------------  | ----------- ----------- ------------   |
                             +----------------------------------------+
```

*Figure 3-14. Manipulate Dead Man Timer Panel*

If you have enabled the timer and the server locks up, the timer automatically resets the hardware after the time expires.

## Verifying Hard Disk Format

This utility allows you to verify whether the hard disk is correctly formatted so that code images, configuration files, and dump data can be written to the hard disk as needed.

1. Select **Verify Hard Disk Format** from the utilities panel.

   A *Hard Disk Format* panel appears, informing you whether or not the hard disk is correctly formatted.

```
IBM server Firmware
Version 3.2
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                           System Management Services


Select one:
  1. Set Supervisory Password
  2. Enable Unattended Start Mode
  3. Disable Unattended Start Mode
  4. Remove Supervisory Password
  5. Update System Firmware
  6. Display Event / Error Log
  7. View or Set Vital Product Data
  8. Copy Remote Files
  9. Remote Initial Program L
 10. Manipulate Dead Man Timer
 11. Verify Har+-------------Hard Disk Format Correct-----------------+
 12. Change Man|                                                      |
 13. Prepare Ha|       The hard disk is correctly formatted.          |
               |                                                      |
 Enter    -   E|   Enter    -                                         |
-----------  --|  -----------                                         |
               +------------------------------------------------------+
```

*Figure 3-15. Verify Hard Disk Format Panel*

# Change Management

Change Management enables you to manipulate the server level of software code that will run on the server See Chapter 11, “Using BOOT Config to Perform Change Management” on page 11-1 for detailed information about change management.

## Xmodem Software Selection

Xmodem is supported only from the Firmware prompt. To access the Firmware prompt, you must either interrupt the boot-up sequence or bring up the server in attended mode. The Change Management command is available from the Utilities option of the Main Menu. From that point, the server directs you as to what to transfer in and where to put the image.

**Notes:**

1. When the server is in firmware mode, there is no Active configuration or image. Therefore, you should use caution when specifying where to write new images or configurations.
2. When using Xmodem to transfer a multiple load module image (in the form of several files ending in .ld), ***you must*** transfer each of the modules (.ld files) one by one to get the entire load module image.

   When an entire load image has transferred, the status of the bank will change from CORRUPT to AVAIL. Transfer file LML.ld first. Unless you see an information message `ERROR WRITING FILE` appear, assume each individual transfer has been successful.

When you are finished with file transfer, select **List software** on the Change Management menu. The status will have changed to AVAIL for that bank that has the new load image.

The following sample menus are associated with Xmodem download. These menus show the text that is displayed when you choose Change Management.

**Examples:**

```
IBM server Firmware
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                          Change Management Software Control

            Select one:
            1.  Add Description Data
            2.  Describe Software
            3.  Control Rebooting of Router
            4.  Control Dumping of Router
            5.  Copy Software
            6.  Erase Software
            7.  List Software
            8.  Lock Config File
            9.  Set Boot Information
            10. TFTP Software
            11. Unlock Config File
            12. XMODEM Software


            Enter   -   Esc=Quit -   F1=Help  -
           ----------   ----------   ----------
```

1. Select **Copy Software**.

```
IBM server Firmware
Version 3.2
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                          Change Management Software Control


            1.  Add Description Data
            2.  Describe Software
            3.  Control Rebooting of Router
            4.  Control Dumping +--------------Select Type-----------------+
            5.  Copy Software   |                                          |
            6.  Erase Software  |            1. Config                     |
            7.  List Software   |            2. Load Image                 |
            8.  Lock Config File|                                          |
            9.  Set Boot Informa|      Enter  -  Esc=Quit  -   F1=Help  -  |
            10. TFTP Software   |   ----------- ------------ ------------  |
            11. Unlock Config Fi+------------------------------------------+
            12. XMODEM Software


               Enter   -   Esc=Quit -   F1=Help  -
              ----------   ----------   ----------
```

2. Select either **Config** (for configuration file) or **Load Image** (for the operational software file).

The following figure is an example of the Load Image selection.

```
IBM server Firmware
Version 3.2
(C) Copyright IBM Corporation, 1996, 1998. All rights reserved.

+-------- BANK A --------+------------Description------------+------Date-------+
| IMAGE - AVAIL          |                                    |-14256 Jan 1970 -|
| CONFIG 1 - PENDING     |                                    |-14256 Jan 1970 -|
| CONFIG 2 - NONE        |                                    |-14256 Jan 1970 -|
| CONFIG 3 - NONE        |                                    |-14256 Jan 1970 -|
| CONFIG 4 - NONE        |                                    |-14256 Jan 1970 -|
+-------- BANK B --------+------------Description------------+------Date-------+
|  IMAGE - PENDING       |                                    |-14256 Jan 1970 -|
|  CONFIG 1 - NONE       |                                    |02 Jan 1994 20:39|
|  CONFIG 2 - NONE       |                                    |02 Jan 1994 20:41|
|  CONFIG 3 - NONE       |                +--------- -------------+ 1994 20:43|
|  CONFIG 4 - NONE       |                |                        | 1994 20:45|
+------------------------+----------------|                        |-----------+
   * - Last Used Config       L - Config F|               Enter    |
                                          | 1. Bank A     ---------|
       XMODEM Software                    | 2. Bank B     Esc=Quit |
                                          |               ---------|
 Enter   -   Esc=Quit -   F1=Help -       |               F1=Help  |
---------   ----------   ---------        +------------------------+
```

The following figure is an example of the Config selection.

```
IBM server Firmware
Version 3.2
(C) Copyright IBM Corporation, 1996, 1998. All rights reserved.

+---------------------------------------+---------------------------------
|         BANK A                        |         BANK B
 IMAGE - PENDING                        | IMAGE - AVAIL
 CONFIG 1 - PENDING                     | CONFIG 1 - NONE
 CONFIG 2 - NONE                        | CONFIG 2 - NONE
 CONFIG 3 - NONE                        | CONFIG 3 - NONE
| CONFIG 4 - NONE                       | CONFIG 4 - NONE
+---------------------------------------+---------------------------------

                                 +Select Destination Config+
      XMODEM Software            |                         |
                                 |               Enter   - |
                                 | Config 1     ---------- |
                                 | Config 2     ---------- |
                                 | Config 3     ---------- |
                                 | Config 4     ---------- |
                                 |              ---------- |
Enter  -   Esc=Quit - F1=Help  - |                         |
--------   ---------- ---------- +-------------------------+
```

## Preparing the Hard Disk

This utility allows you to verify whether the hard disk is correctly formatted so that code images, configuration files, and dump data can be written to the hard disk as needed.

**Note:** This procedure takes approximately 45 minutes on the PCMCIA IDE hard file and approximately 10 minutes on the internal IDE hard file.

1. Select **13. Prepare Hard Disk** from the utilities panel.

   A *Prepare Hard Disk*. panel appears, warning you that your user data on the hard disk will be destroyed if you continue.

```
IBM server Firmware
Version 3.2
(C) Copyright IBM Corporation, 1996, 1998. All rights reserved.
                   +---------------Attention------------------+
                   |                                          |
                   |  All user data on the drive shown        |
Select one:        |  below will be destroyed if you          |
  1. Set Supervisor|  continue.                               |
  2. Enable Unatten|                                          |
  3. Disable Unatte|  IBM-DDLA-21620    1626 MB Disk  ID       |
  4. Remove Supervi|  0, Controller 0                         |
  5. Update System |                                          |
  6. Display Event |  Are you sure you want to continue?      |
  7. View or Set Vi|                                          |
  8. Copy Remote Fi|  Yes (Y)  -    No (N)  -                 |
  9. Remote Initial| -----------  -----------                 |
 10. Manipulate Dea+------------------------------------------+
 11. Verify Hard Disk Format
 12. Change Management
 13. Prepare Hard Disk

 Enter    -   Esc=Quit    -   F1=Help    -
-----------  --------------  -------------
```

*Figure 3-16. Prepare Hard Disk Panel*

2. Type **Y** and press **Enter**, if you want to reformat the hard disk.

   The *Hard Disk Formatted* panel appears. This panel informs you that the hard disk has been reformatted.

3. Type **N** and press **Enter** if you do not want to reformat the hard disk.

The 8210 model 002 and the 1-wide blade support an optional PCMCIA Flash drive. Use the “Prepare Hard Disk” utility to format this card for use in the MSS Server.

# Chapter 4. Getting Started with Configuring the 8210

This chapter explains how to access the 8210 using a workstation and how to manage operational software images and configuration files. It also provides a brief overview of the configuration methods available for the 8210.

## Physical Access Methods

Before the 8210 has been configured, it cannot yet function in the ATM network. Therefore, you have to access it in one of the following ways:

- Through a null modem cable attached to the EIA 232 service port. This is known as local connection.
- Through one of the PCMCIA modems, or through a modem attached to the EIA 232 service port. The PCMCIA modems are the Voice/Data/Fax Modem and the Data/Fax Modem. These are the forms of remote connection, which rely on the telephone lines.

You can set up both a local and a remote connection to the 8210. However, only one port can be active at any given time. If a workstation is connected locally to the serial port and a call comes in over the Voice/Data/Fax Modem or the Data/Fax Modem, priority is given to the call. After the call, the workstation will have to log back into the 8210.

With local or remote connection, you can use a teletypewriter (TTY) connection. TTY requires communications software to enable file transfer.

Alternatively, you can use Serial Line Internet Protocol (SLIP) over the local or remote connection. If you use SLIP, you must have Transmission Control Protocol/Internet Protocol (TCP/IP) running on your workstation.

You can continue to use local or remote access to the 8210 after it has been configured. However, after configuration, you can also use Internet Protocol (IP) to access the 8210 through the network. For the IBM 8210 Nways Multiprotocol Switched Services (MSS) Server, the connection is made over optical fiber from one of the ATM connectors. For the IBM Nways Multiprotocol Switched Services (MSS) Server Module, the connection is made through the ATM switch in which the module is installed.

Figures 4-1, 4-2, and 4-3 show local connection, remote connection using the PCMCIA modem, and connection over the network.

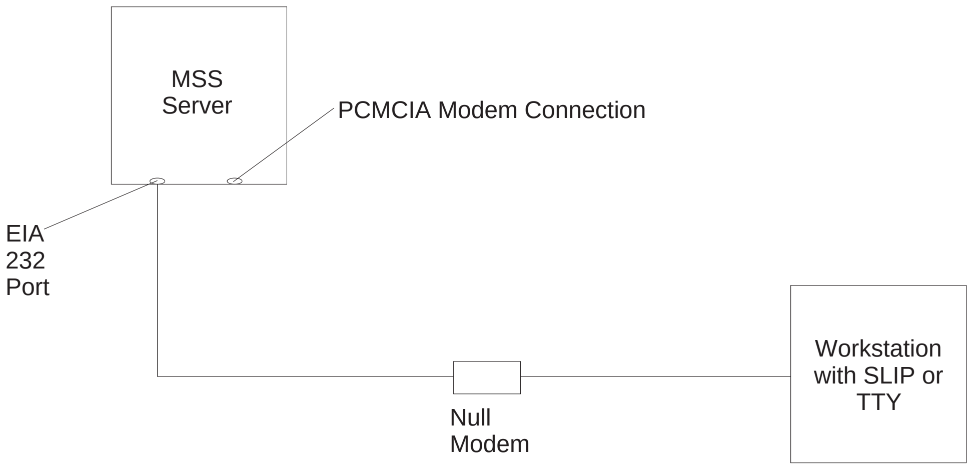



*Figure 4-1. Local Serial Connection to the EIA 232 Port*

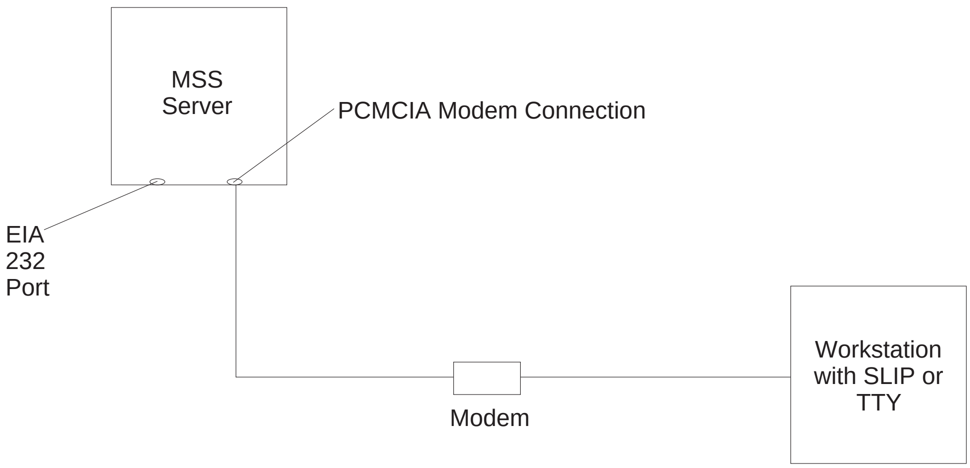



*Figure 4-2. Remote Serial Connection to the PCMCIA Modem (Voice/Data/Fax Modem or Data/Fax Modem)*

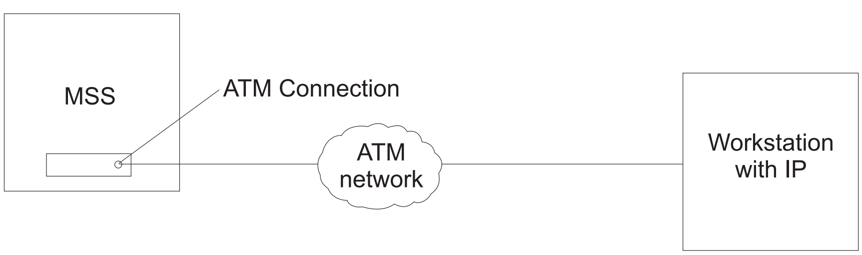



*Figure 4-3. Connection Using IP Over the ATMNetwork. The server must be operational in the network to use this connection.*

## SLIP Addresses

To configure SLIP, use these addresses:

**The IP address of the workstation**
10.1.1.3

**The IP address of the 8210**
10.1.1.2

For instructions about installing SLIP on your workstation, refer to the documentation for your version of TCP/IP.

## Serial Port and Data/Fax Modem Default Settings

These are the default settings for the serial port:

**Speed** 19.2 Kbps
**Parity** None
**Data Bits** 8
**Stop Bits** 1

The Data/Fax Modem is a 28.8-Kbps V.32 bis modem. It is set up with a default speed of auto detect. The parity, data bits, and stop bits are the same as those of the serial port: None, 8, and 1.

Once the operational code has loaded, the line speed for the serial port is automatically set to 19200 baud.

## Configuration and Monitoring Tools

These are the various configuration and monitoring tools that are supported by the physical connections:

**Multiprotocol Switched Services Client Configuration Program**
This is a standalone program that is installed in a workstation which uses TCP/IP to connect to the 8210. You must use this program differently before and after the initial configuration of the 8210.

**Before configuration:**

Initial configuration of the 8210 must be through a modem or the service port, over a serial link. When the 8210 is in this state, you cannot use the Communications options of the Configuration Program. You can create configuration files and download them later to the 8210 over the serial link using TFTP over SLIP. The workstation must be running TCP/IP with a TFTP daemon.

**Note:** If you are using a Windows 95 workstation, you must obtain a TFTP daemon as the daemon is not part of the base TCP/IP software.

**After configuration:**

The configuration file that download over a serial link can provide an IP address and subnet mask to the 8210, or establish LAN emulation. After configuring the 8210 and making it operational in the ATM network, you can access the 8210 through the network.

When the 8210 is in this state, you can use the Communications Send option of the Configuration Program to send configuration files from the workstation over the network to the 8210. When using the version of the Configuration Program that is supported by AIX, you can also use the Communications Retrieve option of the Configuration Program to retrieve configuration files from the 8210. For more information, see *IBM 8210 Multiprotocol Switched Services Server Configuration Program User's Guide for Nways Multiprotocol Access, Routing, and Switched Services*, GC30-3830.

**Web browser Hypertext Markup Language (HTML) interface**
The Web browser interface is a configurator that is a home page and is accessed by a Web browser from a workstation that is connected to the 8210.

You need a Web browser that can display clickable images and tables. The Web browser interface can be accessed using SLIP or IP. You must use the serial line connection and SLIP before the 8210 is operational in the network.

If you supply the Web browser the SLIP address, one of the configured IP addresses of the 8210, or its name (when using an IP name server), the Web browser interface will come up.

**Note:** The configured IP addresses of the 8210 include the IP addresses of all the LAN emulation clients and Classical IP clients.

**Command line interface**

The command line interface is a teletypewriter (TTY) text interface that requires you to enter commands to use it. The workstation that accesses it must be either an ASCII terminal, a personal computer (PC), or other intelligent programmable workstation emulating an ASCII terminal.

This interface must be reached over a serial link before the 8210 is operational in the network; you can use TTY or SLIP to access it. If you use SLIP, you can Telnet into the 8210.

After the 8210 is operational in the network, you can Telnet into the 8210 over IP to bring up this interface. If one connection to the 8210 is a Telnet session, the 8210 can support two connections at one time.

The command line interface is marked by an asterisk (*) prompt. Refer to the *IBM Multiprotocol Switched Services (MSS) Server Interface Configuration and Software User's Guide* for a full description of this interface.

**Important:** If you use a serial connection, (either local or remote), you ***must press a key*** to bring up the asterisk that is the prompt for the command line interface. When you make the connection, the message `Please press a key to obtain console` appears and reminds you to do this.

**Voice/Data/Fax Modem or Data/Fax Modem**

The Voice/Data/Fax Modem is an integrated modem with both voice and fax capabilities that is shipped with the 8210 in the U.S. and Canada. It provides access using touch tone telephone input with automated voice responses. In addition to faxing an alert after the 8210 has had a failure and has restarted, it can fax other reports that monitor the 8210 and it can change a few dynamic parameters that help to maintain the 8210 in the network.

The Data/Fax Modem is an integrated PCMCIA modem that handles data and can fax an alert from the 8210. For example, it can fax an alert from the 8210 if the 8210 has had a failure and has then automatically restarted.

Both of these modems provide full text console access to the command line interface. They provide remote connection that supports either the TTY or SLIP access. The Voice/Data/Fax Modem provides access using the voice interface to several configuration parameters, including enabling or disabling thermal shutdown for the standalone server only.

## Fax Accumulation

If several undeliverable faxes are sent from the Voice/Data/Fax interface, they will not be deleted. They will accumulate as new faxes are added and sent when possible. The most common cause of fax delivery failure is a missing or incorrect fax telephone number.

## Local and Remote Console Access

When accessing the 8210 locally on a null modem cable attached to the EIA service port or remotely through the PCMCIA modem, use VT100 terminal emulation. Because VT100 does not define function keys above F4, edit the keyboard mapping manually as follows: For F6, enter the mapping (ESC)OU. For F9, enter the mapping (ESC)(Left square bracket)009q.

**Note:** (ESC) represents the carat symbol followed by the left square bracket.

Also note that a PING done on the PCMCIA modem may take up to 2 minutes.

## Remote Voice Access

When dialing the number for voice access to the MSS Server, detection of the user is not automatic, as implied in "Voice/Data/Fax Modem Menu Items" on page 6-4. The user will be asked to press the # key. If the user fails to do this, the server assumes the caller is a modem and will subsequently send a carrier signal. If the # key is pressed, operation proceeds as given in "Voice/Data/Fax Modem Menu Items" on page 6-4.

# File Transfer

Table 4-1 defines the ways in which configuration files and operational software files can be transferred to and from the 8210.

*Table 4-1 (Page 1 of 2). File Transfer*

| File Transfer Method | Type of Connection |
|---|---|
| TFTP Get command from the 8210 to the workstation that has the binary configuration file, to download operational software images and configuration files to the 8210. Files sent using TFTP must be binary, or the 8210 cannot use them. You should use the Create command of the Configuration Program to save configuration files in binary format before downloading them to the 8210.<br><br>After the 8210 is operational in the network, you can use the TFTP Put command over IP to upload a file from the 8210 to a workstation. The file will be uploaded in binary format. Both operational software and configuration files can be uploaded.<br><br>You should use the Read router configuration option of the Configuration Program to make an uploaded configuration file usable by the Configuration Program so that you can change some parameter values in it.<br><br>**Note:** Using TFTP Put is a way to retrieve files from the 8210 if the Retrieve option of the Configuration Program is not available. | • SLIP connection (using the TFTP Get command to download files to the 8210).<br>• IP connection of operational 8210 over functioning network (using the TFTP Get and Put commands to download and upload files). |

*Table 4-1 (Page 2 of 2). File Transfer*

| File Transfer Method | Type of Connection |
|---|---|
| The Communications Option of the Configuration Program (actually, the protocol for this is SNMP). This method cannot be used until the 8210 is operational in the network. The files are not binary, but are in a format that is internal to the Configuration Program. This function can send configuration files to the 8210 and retrieve them from the server. | IP connection of operational 8210 over functioning network. |

## Initial Configuration

After the 8210 has passed its hardware diagnostics, it is in a ready state for configuration. These are two examples of ways to complete the first configuration:

## First Example

1. Use the Configuration Program to create a binary configuration file.
2. Download the file to the 8210 using TFTP over SLIP.
3. Restart the 8210 to make the configuration active. If your configuration file included all the necessary parameters, the 8210 should now be completely operational in the network.

## Second Example

1. Perform a minmial configuration using one of the following methods:
   - Use a SLIP or a TTY connection over a serial link to access the IBM 8210.
   - Bring up the Web browser interface or the command line interface.
   - Use quick configuration to do a minimal configuration of the IBM 8210, including IP address and SNMP. See “Quick Configuration” on page 4-7.
2. Restart the IBM 8210 to activate the quick configuration.
3. Next, make and save a configuration file using the Configuration Program. Use either the TFTP Get command over SLIP or IP or use the Communications Options Send command of the Configuration Program to download the configuration file.

   When using TFTP, you must use the Create option of the Configuration Program to create binary files and then TFTP them to the IBM 8210.
4. Restart the IBM 8210 to make the configuration active. If the configuration file included all the necessary parameters, the IBM 8210 should now be completely operational in the network.

## Tips for Managing Configuration Problems

**Important:** After the IBM 8210 is configured and operational, ***always*** back up the active configuration file. Keeping this file enables you to re-establish the IBM 8210 on the network should the active configuration become corrupted.

Back up the active configuration file by retrieving it and storing it in the workstation. See “File Transfer” on page 4-5 for more information.

## Reconfiguring

You may find it hard to detect problems caused by configuration errors. A configuration error can initially appear to be a hardware problem because the IBM 8210 will not start or data will not flow through a port. In addition, problems with configuration may not result in an error initially; an error may occur only when specific conditions are encountered or when heavy network traffic occurs.

If you cannot resolve a problem after making a few changes to the configuration or after restoring the active configuration file, it is recommended that you generate a new configuration. Too many changes to a configuration often compound the problem, whereas you can usually generate and test a new configuration within a few hours.

## Quick Configuration

Quick configuration is a process for initial configuration that is available either from the Web browser interface or from the command line interface. It produces a simple configuration that will enable the IBM 8210 to run in the network. The Web browser interface, which is the more usable of the two interfaces, is recommended. See "Quick Configuration Using the Web Browser Interface" on page 5-5 for a description of quick configuration using the Web interface.

## Completing the Configuration After Quick Configuration

After completing quick configuration, reload the IBM 8210 to activate the configuration. Then, you can access the IBM 8210 over the network, if you have configured an IP address for it.

The configuration provided by QCONFIG depends upon many default values for parameters, some of which may not be appropriate to your installation. You may need to modify the configuration created using QCONFIG to customize the IBM 8210 to work in your network. Do this using any of these methods:

- Configuration Program
- Web browser HTML interface
- Command line interface

However, the Configuration Program is the preferred configuration method for these reasons:

1. It enables you to keep a number of copies of configuration files on a server for uploading to the appropriate IBM 8210s.
2. It does not alter any configuration parameters dynamically. This feature helps control changes to the IBM 8210 configurations.
3. It performs more input validation and cross-checking of the configuration parameters than the other methods.

The command line interface and the Web browser interface cause certain parameters to be altered dynamically. The binary files that they create are saved on the hard disk ofthe IBM 8210, not in the workstation. These characteristics make them more difficult to use for managing the configuration of the IBM 8210. However, they can be used to monitor the operations of the IBM 8210, whereas the Configuration Program cannot. They are also useful when you want to change one of the parameters that can be dynamically altered.

## How Software Files Are Managed

To help manage operational software upgrades and configurations, the IBM 8210 has a software change management feature. This utility enables you to determine which operational software file andwhich configuration file is active while the IBM 8210 is running. In addition to storing the active operational software andthe active configuration file, the IBM 8210 stores two backup images of the operational software andup to 11 configuration files in non-volatile memory.

## How to View the Files

To use the change management tool in the command line interface to view the operational software image and the configuration files, follow these steps:

1. From the prompt for OPCON, which is an asterisk (*), type **talk 6**. The prompt `Config>` appears.
2. Enter **boot**. You will see the prompt `Boot config>`.
3. Enter **list** to display information about which load images and configuration files are available and active.

   See "List" on page 12-8 for sample list output and a description of file statuses.

## How to Reset the IBM 8210

**Note:** A reset interrupts the function of the IBM 8210 for up to 90 seconds. Be sure that the network is prepared for the interruption.

As previously stated, PENDING and LOCAL files are not loaded into active memory until you reset the IBM 8210.

You can reset the IBM 8210 using any one of these methods:

- Press the hardware reset button.
- At the `Config only>` prompt, type **reload**.

  **Note:** The `Config only>` prompt appears when no configuration file is active. Lack of an active configuration file indicates that an active configuration has become corrupted or that the IBM 8210 is not configured.
- At the OPCON prompt (*), type **reload**.

## File Transfer Using TFTP

See "TFTP" on page 12-11 for a sequence of commands to transfer a file from a workstation or server to the IBM 8210 using TFTP. You will need to substitute your own values for the IP address and path, which are given as examples.

## Storing Configuration Files Using the Command Line Interface or the Web Browser Interface

To store a configuration file created using the command line interface, type **write** at the `Config>` prompt. When using the Web browser interface, select **Write**. The Write command creates a binary configuration file that contains the most current value of each of the configuration parameters.

This file is stored in the ACTIVE bank and is given PENDING status. If the status of the file is not changed by a Set command, it becomes the ACTIVE configuration when the IBM 8210 is reset.

## Changing the Statuses of Files

These are the ways to change the statuses of image and configuration files:

- You can cause the IBM 8210 to perform a reset by using the Send command from the Communications Option of the Configuration Program. When you do this, the file sent can arrive as a PENDING file or as an AVAIL file. If it is a PENDING file, it becomes the ACTIVE configuration and the previously ACTIVE file becomes AVAIL when the IBM 8210 is reset.

  If it is an AVAIL file, resetting the IBM 8210 does not change its status.

- Use the Set config (set config) commands from the `Boot config>` prompt manually to change the status of any files except the ACTIVE files. If you set a file to PENDING, it becomes ACTIVE and the ACTIVE file becomes AVAIL when a reset is performed.
- Use the Write command to store a configuration file that you have created using the command line interface or the Web browser interface, it is stored with a PENDING status.
- If you copy a file from one location to another, the file receives the status of the file that was there before it and that it overwrites. For example, copying a file with the status of AVAIL over a file that has the status of PENDING, the new file will keep the status of the original file, which is PENDING.

## Using the Configuration Program to Manage the Configuration Files

For optimal configuration management, it is recommended that you use the Configuration Program and its configuration database to manage all IBM 8210 configuration files.

The design of change management facilitates good control of the configuration files. Keeping the ACTIVE file and the file that is stored in the configuration database the same assures that a copy of the ACTIVE file is always available.

Use the Send option to send a new configuration to the IBM 8210, the new configuration is written to the ACTIVE bank and overwrites the file located in the position just below the currently ACTIVE configuration. The new configuration is PENDING if a time is set for a reset. If the configuration file is sent without a specified time for the reset to occur, it gets AVAIL status.

For example, suppose that CONFIG 2 is ACTIVE. The new configuration file is written to CONFIG 3. It has a status of PENDING if a reset time is associated with it; if not, it has a status of AVAIL.

If the file has a status of PENDING, CONFIG 2 becomes AVAIL and CONFIG 3 becomes ACTIVE when a reset occurs. The next file that is sent from the Configuration Program will be placed in CONFIG 4. If a reset time is associated with the file, it will have the PENDING status and will become ACTIVE when the next reset occurs. If another file is then sent, it is placed in CONFIG 1 because the currently ACTIVE file is now in CONFIG 4. This arrangement results in a circular queue.

If the downloaded file has a status of AVAIL, a reset does not change its status. If another file is sent down, it overwrites that file because the ACTIVE file has not changed and the newly downloaded file always occupies the location just behind the ACTIVE file.

## Using the Set Commands

See “SET” on page 12-10 for information about the **set** command.

## Other Change Management Functions

These are the other change management commands:

- Describe load images
- Describe config images
- Disable dumping
- Enable dumping
- Erase files

### Describe

See “Describe” on page 12-5 for information about the **Describe** function.

### Disable Dumping

The IBM 8210 can be set up to dump the contents of memory to permanent storage in the unlikely event of a complete system failure. If dumping is enabled, using this selection will cause the IBM 8210 *NOT* to dump to disk.

To disable dumping, type **t 6** at the *, press **Enter** and then type **disable dump** or **dis du** at the `Config>` prompt. You will see the message:

```
Config> Automatic memory dump disabled
```

### Enable Dumping

This command enables the dumping of memory without intervention from anyone in the event that the IBM 8210 has a catastrophic error. The IBM 8210 will dump memory onto the hard disk. Once a successful dump has been taken, the IBM 8210 attempts to restart. Depending upon the failure of the IBM 8210, it cannot always restart. In this case, you should restart it manually and call a service person, who will dial into the IBM 8210 to determine the nature and the causes of the failure.

To enable dumping, type **t 6** at the *, press **Enter** and then type **enable dump** or **ena du** at the `Config>` prompt. You will see the message:

```
Config> Automatic memory dump enabled
```

The default state is to have dumping enabled.

### Erase Files

See “Erase” on page 12-6 for information about the **erase** command.

## Using the Copy Command

The Copy command moves a file from one location in the storage area to another. This command allows you to change the status as well. The file moved always receives the status of the storage area that it is moved to. For example, suppose that you have this scenario:

- The configuration file in BANK A CONFIG 1 is AVAIL. The configuration file in BANK B CONFIG 1 is PENDING.
- You copy the configuration in BANK A CONFIG 1 to BANK B CONFIG 1.

In this case, the original configuration file in BANK A CONFIG 1 remains unchanged and AVAIL. The configuration that was in BANK B CONFIG 1 is overwritten by a copy of the configuration file that is in BANK A CONFIG 1. This copy retains the status of the file that it overwrote, in this case, PENDING.

See “Copy” on page 12-3 for additional information about the **copy** command.

## Using the Lock Command

The **lock** command prevents the server from overwriting the selected configuration with any other configuration.

See “Lock” on page 12-9 for additional information about the **lock** command.

## Using the Unlock Command

The **unlock** command removes the lock from a configuration allowing the configuration to be updated.

See “Unlock” on page 12-16 for additional information about the **unlock** command.

# Chapter 5. Using the World Wide Web Interface

The MSS Family Client provides a World Wide Web interface to monitor and configure the product. The Web browser interface performs all of the functionality of the command line interface, but in a graphical, more user-friendly manner.

## Connecting to the World Wide Web Interface

There are four mechanisms for accessing the Nways MSS Server using the Web interface:

- Locally, over the service port with a workstation that communicates using Serial Line IP (SLIP).
- Remotely, over an external modem connection to the service port. As with the local connection, the workstation must support SLIP.
- Remotely, using the integrated Voice/Data/Fax Modem or the Data/Fax Modem PCMCIA modem. This connection must also support and be running SLIP.
- Through a LAN emulation (LE) client or Classical IP interface running over the ATM adapter. This connection works over an IBM 8210 that has been configured and is operational in the network.

  To use this connection, provide the browser with the IP address of a LE client or Classical IP interface.

Use any web browser that supports HyperText Markup Language (HTML) tables and clickable images. Examples of browsers that support this feature are WebExplorer Version 1.03 or higher, Netscape Navigator Version 1.1N or higher, and Mosaic Version 2.1.1 or higher.

To access the Home Page of the IBM 8210, point your browser to the Universal Resource Locator (URL) `http://<machine>/`, where <machine> is either the name or one of the configured IP addresses of the IBM 8210.

You will be shown the Home Page that is described in the next section.

**Note:** Before using the Web browser, the IBM 8210 must have been configured with an IP address. This address can either be a network address or a SLIP address. The default SLIP address for the IBM 8210 is:

```
10.1.1.2
```

Use this source IP address to identify the workstation:

```
10.1.1.x
```

The letter *x* stands for any value.

## Rules for Using the Web Interface

When configuring using the Web browser interface, observe the following guidelines:

- Many configuration options require you to enter data on two or more Web pages (or forms). If you fill in and submit the first form in a series, be sure to complete the remaining forms. If you do not fill in and submit all the forms, the configuration parameter could be left in an unknown state.

- More than one person should not perform configuration at the same time. They can interfere with one another. For example, one person could delete an interface while the other person is in the middle of configuring a protocol on that interface.
- Disable the caching feature of the browser. If you do not do this, the browser may pull a page out of memory instead of going to the IBM 8210 to get the latest information. The browser will display old data. This problem is more likely to occur when you use the *Back* button on the browser.

## Home Page Structure

Figure 5-1 shows the IBM 8210 Home Page.

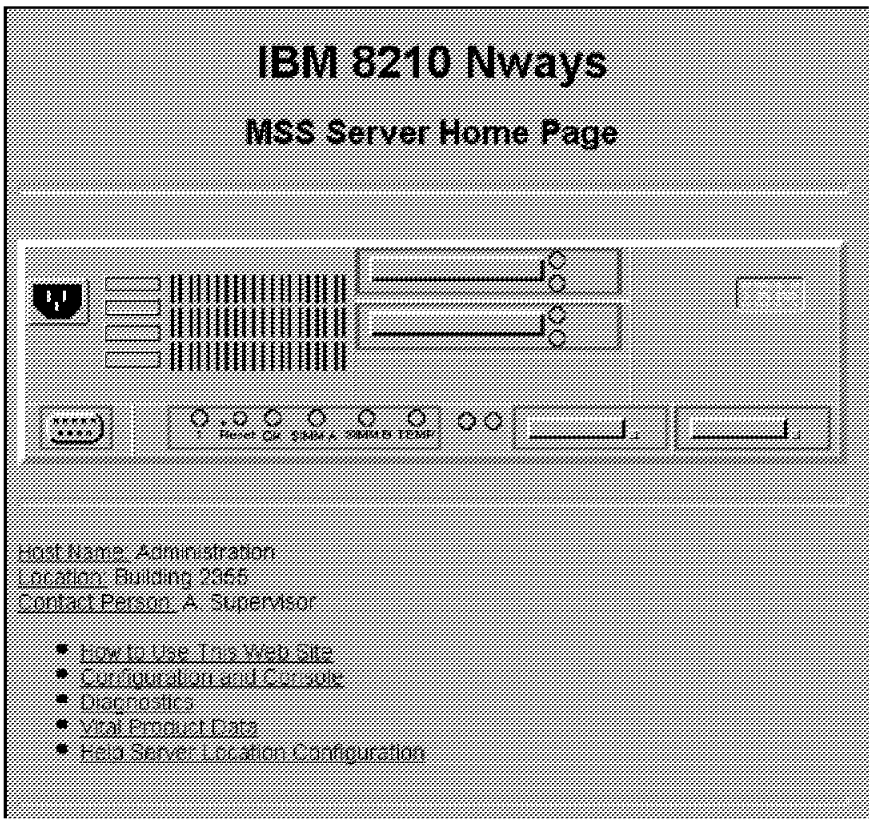



*Figure 5-1. IBM 8210 Home Page*

This Home Page provides a graphic that shows the status of the IBM 8210. It indicates the current network interfaces installed and shows the status of each port (for example, installed, enabled, or disabled). The current state of each LED is also shown, as well as the indication of the devices that are installed in the two PCMCIA slots. If the Web browser supports dynamic refresh, then this page will automatically refresh itself approximately every 80 seconds. If you click any of these ports or interfaces, a more detailed description of its status will be shown on a separate Web page.

Click **How to use this Web Site** for instructions about using this site.

Click **Configuration and Console** to bring up the menu shown in Figure Figure 5-2 on page 5-3.

Click **Diagnostics** to bring up the menu shown in Figure Figure 5-3 on page 5-3.

Click **Vital Product Data** for information about the hardware and operational software. This panel, which is usually used for diagnostics, is not displayed here.

Click **Help Server Location Configuration** to set the path for the optional Help Server. You will need to set this path if you want to use the optional help files for the Web Browser interface.

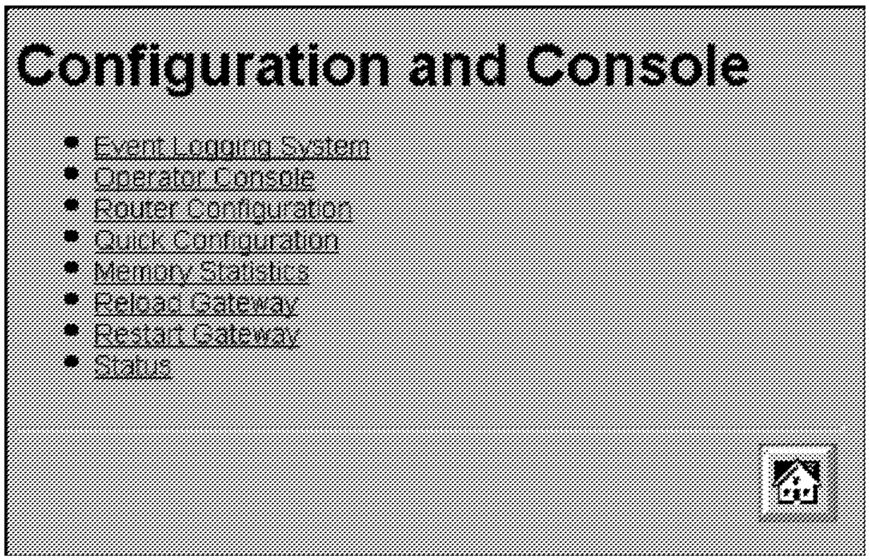



*Figure 5-2. Configuration and Console Page 1*

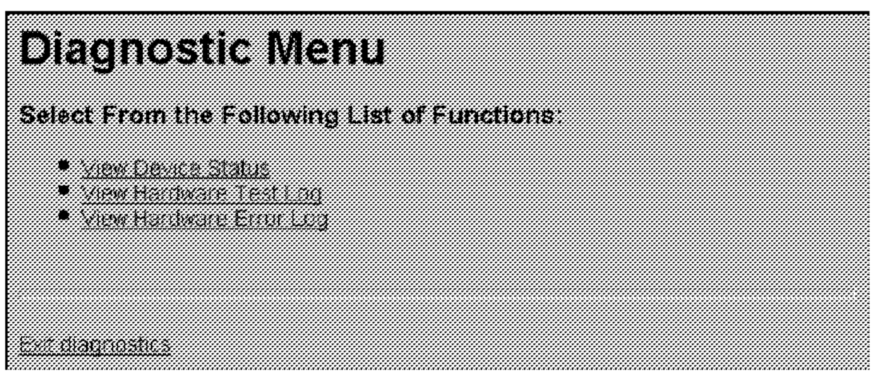



*Figure 5-3. Diagnostic Menu*

## Configuration and Console Menu

This menu can lead you into various aspects of configuration. To start with quick configuration, click **Quick Configuration**. Figure 5-4 shows the quick configuration menu. See "Quick Configuration Using the Web Browser Interface" on page 5-5 for information about quick configuration and guided configuration.

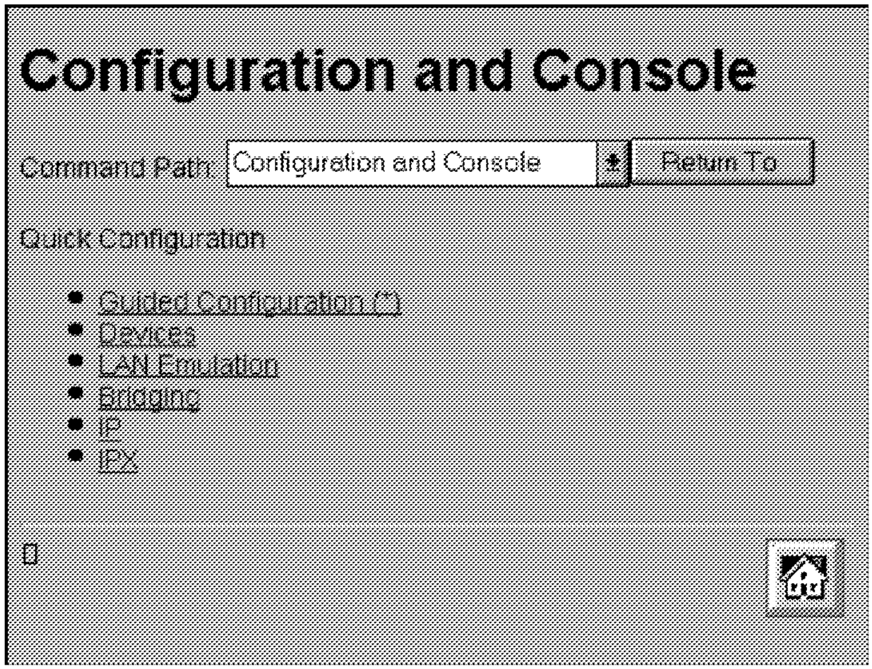



*Figure 5-4. Configuration and Console Page 2*

## Event Logging System

One of the links on the Configuration and Console page 1 is to the Event Logging System (ELS). The ELS display is similar to the one provided on the command line interface. On the Web interface, going into the ELS will display the most recent events stored in the system memory. In order to get future updates, press the Reload button on your browser. For more details about the ELS message facility, refer to the *Event Logging System Messages Guide*.

## Operator Console

The console monitoring interface provides real-time status information very similar to that offered in the command line interface. The menus from the command line interface are presented as a hierarchy of Web links that can easily be traversed with the click of a mouse button. It is possible to jump back several levels in the hierarchy with a single push of a button.

## Router Configuration

**Important:** Exercise caution when using the Web browser to change configuration parameters. Changes to the configuration that are made using the Web browser are written directly to static random access memory (SRAM). You can make unintentional configuration changes that do not take effect until you reset the IBM 8210. To check that you have the correct parameters, look over the settings for any parameters that you have configured before submitting them.

The Web interface greatly simplifies the configuration of network and protocol parameters. In many cases where it is necessary to remember the individual network numbers on the command line interface, those options are now all presented as menu options on the Web. Also, the Web interface uses the graphical features available to it, such as pick lists, selection lists, radio buttons, and check boxes.

If a particular configuration option needs to prompt you for answers to several questions, those questions are now presented on a single Web page. After all of the questions are filled in, you should press the *Submit* button to send the data back to the IBM 8210 for validation.

The hierarchy of the Web browser interface is very similar to that of the command line interface.

## History Function

The Web Configurator uses a selection list and a *Return to* button to provide an advanced history function. Depending upon your choice of HTML browser, a pick list, choice box or pull-down list box will be displayed. This list of selections contains the names of the pages visited under the current branch of the software structure. To return to a previously visited page within the current command pathway, select that entry from the list and click the *Return To* button.

## Help System for the Web Browser Interface

Optional, free-of-charge, help files for the Web Browser interface can be downloaded from the Web. Use of the help button located at the bottom of Web Browser configuration panels requires the installation of these help files.

For download instructions and additional information about the help files, point your browser to URL `http://www.networking.ibm.com/nes/neshome.html`.

## Quick Configuration Using the Web Browser Interface

**Note:** This section is most helpful when it is used while you are viewing the IBM 8210 Web interface.

Quick Configuration for the IBM 8210 using the Web interface is divided into the following steps:

- Guided configuration
- Devices
- LAN Emulation
- Bridging
- IP
- IPX
- LAN Emulation (MSS Client only)

## Guided Configuration

To view the individual steps that are required for quick configuration, select **Guided Configuration** from the menu on Configuration and Console page 2, shown in Figure 5-4 on page 5-4. On each step, you will be presented with a link that allows you to skip to the next step. When you submit the form for a step, the results page will contain a link that takes you to the next step in the guided configuration. The results page in the last step of the guided configuration contains a link to take you back to the home page.

If you complete the guided configuration, you will have been through every step of a quick configuration. If you want to change only certain aspects of a quick configuration, use each of the separate steps. For example, to change only LAN emulation parameters, select that step.

## Devices

Selecting **Devices** presents a list of the currently configured devices, which are the ATM devices. Select an interface and click on the **Submit** button to add the device using the next available network and slot numbers. A **Submit** button is included on the results page if there is still room to add more devices. A **Submit** will not be included on the results page once all the available slots have been filled, so it is impossible to attempt to add too many devices.

## LAN Emulation

Selecting **LAN Emulation** presents a form that allows the LAN Emulation Configuration Server (LECS), LAN Emulation Server (LES), Broadcast Manager, and LAN Emulation Client (LEC) to be configured for each ATM device that has been added.

When you add multiple ATM devices, radio buttons are presented that allow you to configure the ATM device that the LECS will use.

For each ATM device that you add, you have the option of adding one emulated token ring, one emulated Ethernet, neither or both. Each emulated LAN (ELAN) is added by selecting its associated check box. For each ELAN that you configure, you must specify the name and selector to be used by the LES. You can also specify which types of broadcast management will be performed by selecting the appropriate check boxes for:

- IP
- IPX
- NetBIOS
- Source Routing (token-ring ELANs only)

When you click on the Submit button, all of the LAN Emulation components are configured based on the input from the form. A LES is added for each ELAN. The LESs are configured to use the burned-in ESI of the ATM device along with the selector byte that you previously specified for the ELAN.

Broadcast management is configured for each ELAN as specified by the check boxes from the form.

An LE client is also added for each ELAN. The clients are configured to request the ELAN name configured from the form and to use the burned-in ESI of the ATM device along with a selector byte automatically generated by the system.

The LECS is configured with policies for the ELAN by name and for the ELAN by type. ELAN by name is given the highest priority. When a LE client joins and specifies one of the configured ELAN names, it will be sent to the appropriate LES. Clients joining an ELAN by type will be sent to the LES of the desired type that is on the ATM device that the LECS is configured to use.

When you submit the form by clicking on the Submit button, LAN emulation is configured according to the submitted data and the results are displayed on a new page. Quick configuration allows you to configure only one ELAN per ATM device. If you need to configure additional ELANs, click on the links that are included on this page to provide links to the more detailed configuration pages for the LECS and each LES and LE client.

When you are done with this step, all ELAN interfaces have been added to the configuration. This step combined with the previous step provides the network interfaces necessary for performing bridging, IP, and IPX configuration in the subsequent steps.

## Bridging

Selecting **Bridging** presents a form that allows bridging to be configured on each network interface that can support bridging. You can also configure the bridge parameters required for source route bridging, which include the bridge number and the virtual segment number. For each emulated token-ring interface capable of bridging, you are given the option to enable source routing and to configure a segment number if source route bridging is enabled.

When the form is submitted by clicking on the Submit button, transparent bridging is automatically enabled for all token-ring and Ethernet LE clients. Bridging can be done only on the LE clients and not directly on the ATM devices. The results are displayed on a new page.

## IP

Selecting **IP** presents a form that allows IP to be configured on each network interface. For each interface, enable IP by selecting the associated check box. When enabling IP, provide an IP address and mask using the dotted decimal format. The IP address and the subnet mask are the only parameters required to enable IP on an ELAN.

When enabling IP on an ATM device, you are actually configuring Classical IP (RFC 1577). In this case, select a radio button to choose between a *client-only* configuration or a *client and server* configuration. If you select *client-only*, specify the 20-byte ATM address of the remote ARP server that the client will use. If you select *client and server*, specify the selector. The burned-in ESI and the specified selector make up the portion of the ATM address that can be configured.

**Note:** For quick configuration, the burned-in ESI is the only choice. You are required to set the selector.

When the form is submitted by clicking on the Submit button, IP is configured according to the submitted data and the results are displayed on a new page.

## IPX

Selecting **IPX** presents a form that allows IPX to be configured on each network interface that can support IPX. Each eligible interface can be enabled for IPX by selecting the associated check box. If you enable IPX, configure a network number and select the encapsulation type to be used by choosing the appropriate value from the select list presented for each interface.

When you submit the form by clicking the Submit button, IPX is configured according to the submitted data and the results are displayed on a new page.

# An Example of Quick Configuration Using the Web Browser Interface

The following procedure shows how to use Quick Configuration to configure LAN emulation using the Web Browser interface:

1. Connect to the IBM 8210 using a SLIP connection. Configure your SLIP stack to use 10.1.1.2 as the IP address of the IBM 8210 and 10.1.1.3 as your IP address.
2. Open the following URL: http://10.1.1.2/
3. From the MSS home page, click **Configuration and Console**.
4. From Configuration and Console click **Quick Configuration**.
   a. Click **LAN Emulation**.

      Change ELAN names if desired, and then click **Submit**.

      LES/BUS, LEC and LECS are now configured for one Token-Ring and one Ethernet ELAN. Either or both ELANs can be omitted if desired.

      LEC is now configured for one Token-Ring and one Ethernet ELAN. Either or both ELANs can be omitted if desired.

      Select **Quick Configuration** from the Command History and click **Return to**.

   b. Click **IP**.

      Enable IP on the desired interfaces. IP must be enabled on at least one interface. The choices are:

      - Enabling Classical IP on the ATM adapter interface
      - Enabling IP on each of the ELAN interfaces defined in the previous step

      Change the IP addresses and masks to appropriate values for your network.

      If Classical IP is configured as a client only, the ATM address of the ARP Server must be entered.

      Click **Submit**.

      IP is now configured on the specified interfaces.

      Click the home icon at the bottom of the screen.
5. From the MSS home page, click **Configuration and Console**.

   From Configuration and Console click **Router Configuration**

   Click **RELOAD**.

Select **Yes** and click the **Submit** button to restart the IBM 8210.

The IBM 8210 will now be accessible from the network using the IP addresses that were specified in step 4b on page 5-8.

# Chapter 6. MSS Server Voice/Data/Fax Modem Support

A PCMCIA Voice/Data/Fax Modem is shipped with the MSS Server in the U.S. and Canada; in most other countries, the PCMCIA Data/Fax Modem is shipped. Check with your IBM representative if you want to determine whether you will receive the Data/Fax Modem.

If you do not use the Voice/Data/Fax Modem or the Data/Fax Modem, you can purchase a modem and attach it externally to the EIA 232 port for remote access to the MSS Server. Information about the types of modem supported is found in the *IBM Multiprotocol Switched Services (MSS) Server Introduction and Planning Guide,* GC30-3820.

## Installation of the Voice/Data/Fax Modem

Follow these steps to install the Voice/Data/Fax Modem:

1. Use the eject button to remove the Data/Fax Modem, if it is present.
2. Insert the Voice/Data/Fax Modem in the available PCMCIA slot.

The Voice/Data/Fax Modem is hot-pluggable. It will re-initialize when it is inserted in the PCMCIA slot.

If you use the serial service port at the same time that you use the Voice/Data/Fax Modem or the Data/Fax Modem, you need an analog telephone line for each connection.

## Data/Fax Modem

This PCMCIA modem allows remote connection of a workstation to the MSS Server over telephone lines to access the command line interface, the Web browser interface, or the Configuration Program. You must use serial line Internet protocol (SLIP) over the telephone line to access the Configuration Program.

In addition, it can be configured to fax a report whenever the MSS Server sends an alert. See “Voice Pager Messages” on page 6-4 for a example of the kinds of alerts that the Data/Fax Modem sends.

Neither the Data/Fax Modem nor the Voice/Data/Fax Modem require any special configuration.

## MSS Server Voice Access Using the Voice/Data/Fax Modem

When you place a voice call to the Voice/Data/Fax Modem, you will hear a voice menu. Items on this menu will allow you to access the MSS Server and to exercise limited control over it. The four capabilities enabled by the Voice/Data/Fax Modem are:

1. Performance monitoring
2. Remote problem determination
3. Network monitoring
4. Limited configuration

The Voice/Data/Fax Modem lacks speech synthesis, so verbal output is limited to the capabilities of the prerecorded voice files. The model implemented for the MSS Server uses a fax machine as an output device and the telephone primarily as an input device. You press a touch-tone telephone key to give information to the MSS Voice Response Unit.

As a result, most of the information obtained from the Voice/Data/Fax Modem is in the form of faxed reports. Files containing the report information will be constructed and passed to the fax function.

## Performance Information

A menu option that provides selected performance information and predefined performance and configuration reports is available using the Voice/Data/Fax Modem.

## Remote Service

For remote service, the Voice/Data/Fax Modem provides a menu of activities that the caller can utilize, including:

- Resetting the MSS Server
- Reviewing pager log entries
- Reviewing nonvolatile memory log entries
- Obtaining a report on field replaceable unit (FRU) status

## Network Monitoring

Network monitoring is generally provided using SNMP input that is handled by a network manager. However, the Voice/Data/Fax Modem provides some limited ability to access or retrieve information for the caller. The following menus are offered:

- Network management statistics and information
- Predefined reports available using fax

## Configuration

The Voice/Data/Fax Modem allows you to change a limited number of configuration parameters. See “Option 5—Configuration” on page 6-7 for more information.

**Important:** Exercise caution when you use the voice menu to change configuration parameters. Changes to the configuration that are made using the voice menu cause the current configuration to be written directly to static random access memory (SRAM). When these changes are written to SRAM, any temporary changes that have been made using the Web browser interface or the command line interface are also written to SRAM and become part of the active configuration. Before you use the voice menu to change any parameters, you should make sure that all temporary parameter settings are acceptable.

# MSS Server Voice Pager Support

The voice pager is included as a way to alert you that there is a problem, for example, that the MSS Server has become overheated or has had to reload due to an unrecoverable error of the software.

The voice pager function can call a telephone number and deliver a voice message describing a problem. The pager attempts to detect that the telephone has been answered before it speaks the message. It can speak its message to a person, a voice mail system, or a voice paging service. It cannot determine which of these methods was used to answer the telephone.

You can configure multiple telephone numbers to receive the pager messages. The pager will try them in sequence until one answers. Whenever one of the numbers is answered, the pager message is considered delivered.

## Voice Pager Configuration Parameters

You can control the sending of outbound telephone call page messages. These are the paging parameters:

- PagerNum character strings

  These are the telephone numbers to call for the outbound voice messages generated by problem conditions. The telephone numbers will be called until one answers so that the voice message can be delivered. You can have from zero to 4 numbers. If there are zero telephone numbers, outbound page messages will not be attempted.

  - Quantity of telephone numbers
    - Maximum 4
    - Minimum 0
    - Default 0 (no telephone numbers)
  - Length of the telephone number
    - Maximum 64
    - Minimum 0
    - Default 0 (no telephone number)
  - Content of the telephone number

    The telephone numbers can contain digits 0 through 9 and commas. A comma will cause the outbound dialer to pause for 2 seconds. This feature is often used when dialing an outside line or calling a second number.

- Retry Interval integer

  High-severity voice page messages will be sent until the machine is called by the receiver of the message and the receipt of the page message is acknowledged. This parameter gives the time in minutes to wait before re-sending the voice page message. This parameter is known as the *nag interval*. If this number is zero, high-severity page messages will be sent only once.

  - Length of minutes in the retry interval

    This parameter specifies the length of time during which the pager will continue to re-send high-severity voice messages.

    - Maximum 840 (24 hours)
    - Minimum 0
    - Default 60 (1 hour)

## Voice Pager Messages

All page messages start with the same prefix:

```
This is a message from an IBM MSS Server serial number nnnnnnnn
```

The page prefix message will be followed by a unique problem message. Currently, there are three problem messages that the pager will deliver:

1. The MSS Server has rebooted due to an unrecoverable error.
2. The MSS Server is over recommended operating temperature. Further temperature increases may cause the MSS Server to shut down.
3. The MSS Server has exceeded maximum operating temperature and is shutting down.

## Maintenance Log

The maintenance log keeps a record of fax and paging activity. The log entries are time-stamped. The log can be sent to a fax machine for viewing.

## Maintenance Log Configuration Parameter

You can control the size of the maintenance log. This log is a wrap-around file that never changes size. If the file is defined to have 100 entries, it will be created to contain 100 entries. When the log is filled, the oldest log entry will be replaced. Each log file entry takes approximately 250 bytes of disk space.

The configuration parameter is an integer—MaintenanceLogSize— that specifies the number of log entries contained in the file.

- Maximum 4096
- Minimum 32
- Default 64 (16 000 bytes disk space)

## Voice/Data/Fax Modem Menu Items

When the Voice/Data/Fax Modem receives a call, it requests that the caller press the pound (#) key. If the # is pressed, the Voice/Data/Fax Modem recognizes that this is a voice call. The voice menu takes control and requests the MSS Server personal identification number (PIN).

**Note:** The default value for this PIN is 8210001. Whichever PIN is configured first is the supervisory PIN. If only one PIN is configured, it is the supervisory PIN. If you configure one PIN and delete 8210001, then the PIN that you have configured becomes the supervisory PIN.

Each additional PIN that is configured is placed in a sequence. For example, if you configured three PINs, and then deleted the default PIN and the first PIN, the second PIN would become the supervisory PIN.

**Note:** At this point, the functions offered by the Voice/Data/Fax Modem are the same as certain functions that you can access using the command line interface. Refer to the two volumes of the *Command Line Interface User's Guide and Protocol Reference* for more information about these functions. In the description of the Voice/Data/Fax Modem menu that follows, keywords from the command line interface are provided to help you find the relevant information in the *Command Line Interface User's Guide and Protocol Reference*.

The main voice menu offers the following options:

| Voice Message | Function |
|---|---|
| Press **1** to reset | MSS Server Reset |
| Press **2** for operational statistics | Status and statistics |
| Press **3** for router protocol reports | Reports |
| Press **4** for event log reports | Event logs |
| Press **5** for configuration options | Configuration |
| Press **6** for device presence and status | Device presence and status report |
| Press **7** to resend last fax report | Resend fax |
| Press **8** for disconnect call | Disconnect |
| Press **9** for repeat menu | Repeat menu |

The options are repeated approximately every 15 seconds until a valid entry is made or until the call has been terminated.

## Option 1—Reset

When you use the Voice/Data/Fax Modem to perform a reset, you are prompted to confirm that you want to perform the reset. If you do not confirm the reset, the main menu is repeated. If you do confirm the reset, the voice message responds, "The MSS Server will be reset." Your connection to the MSS Server is then broken and the reset occurs.

**Attention:** A reset interrupts the function of the MSS Server for up to 90 seconds. Be sure that the network is prepared for the interruption.

## Option 2—Status and Statistics

Statistics are available from several sources. The following general MSS Server statistics will be packaged as a single report and faxed upon request.

1. Status of Micro Operating System (MOS) processes (as reported by the *STATUS* keyword from the MOS operator console)
2. Memory
   - Number of bytes (as reported by the *MEMORY* keyword from the MOS operator console)
   - Heap and buffer memory (as reported by the *MEMORY* keyword from the configuration gateway [CGW] console)
   - Network interface buffers (as reported by the *BUFFER* keyword from the CGW console)
3. Interface (as reported by the *INTERFACE* keyword from the CGW console)
4. Network (as reported by the *STATISTICS* keyword from the CGW console)
5. Uptime (as reported by the *UPTIME* keyword from the CGW console)
6. Queue length (as reported by the *QUEUE* keyword from the CGW console)
7. Error counts (as reported by the *ERROR* keyword from the CGW console)
8. Event Logging Statistics (as reported by the *STATISTICS* keyword from the *EVENT* keyword from the CGW console)

9. Gateway configuration (as reported by the *CONFIGURATION* keyword from the CGW console)
10. Log level (as reported by the *LOG* keyword from the CGW console)
11. Code image and configuration information (available and active)
12. Thermal status of the hardware

When you request *Status and statistics*, you will hear one of these two messages: “MSS Server statistics will be faxed.” or “Statistics not available.” If you do not disconnect the call, the voice menu starts again.

## Option 3—Reports

You can also request protocol reports other than statistics from the voice menu.

- IP

  The following IP information will be provided in a report:

  – Access control list (as reported by the *ACCESS* keyword from IP from PROTOCOL on the CGW console)
  – Address cache (as reported by the *CACHE* keyword from IP from PROTOCOL on the CGW console)
  – Counter values (as reported by the *COUNTERS* keyword from IP from PROTOCOL on the CGW console)
  – Interface addresses (as reported by the *INTERFACE* keyword from IP from PROTOCOL on the CGW console)
  – Table, buffer, cache sizes (as reported by the *SIZES* keyword from IP from PROTOCOL on the CGW console)
  – Static routes (as reported by the *STATIC* keyword from IP from PROTOCOL on the CGW console)
- IPX
  – Interface addresses (as reported by the *CONFIG* keyword from IPX from PROTOCOL on the CGW console)
  – Cache information (as reported by the *CACHE* keyword from IPX from PROTOCOL on the CGW console)
  – Counters (as reported by the *COUNTERS* keyword from IPX from PROTOCOL on the CGW console)
- LAN emulation (as reported by the *LIST* keyword from LE-SERVICES from ATM from NETWORK on the CGW console)
  – LES/BUS Pairs (as reported by the *LIST* keyword from LE-SERVICES from ATM from NETWORK on the CGW console; an ATM interface must have been selected)
- Bridging
  – Brief universal summary of the state of the bridge (as reported by the *LIST BRIDGE* keywords from ASRT from PROTOCOL on the CGW console)

When you choose *Reports*, you will be prompted to select the protocol report option. Select IP, IPX, LAN Emulation, or bridging. Then you will hear either “Report not available” or “MSS Server Protocol Report will be faxed.” If you do not disconnect the call, the voice menu starts again.

## Option 4—Event Logs

The MSS Server maintains several logs. Information contained there may be of interest to the systems administrator.

- Nonvolatile memory error log (accessed through the firmware log interface)
- Operational diagnostics log (using the Diagnostics Control System interface)
- Pager log entries (new)

**Note:** MSS Server trouble reports (critical problems) can be automatically faxed. These reports are not part of the voice menu structure.

When you choose *Event logs*, you will hear the voice message “MSS Server event logs will be faxed.” or “Event logs not available.” If you do not end the call, the voice menu starts again.

## Option 5—Configuration

The Voice/Data/Fax Modem provides a limited configuration input capability. You can access the following configuration options using the Voice/Data/Fax Modem:

- Fax telephone number (up to 64 digits)
- Thermal shutdown mode (enabled or disabled)—Standalone MSS Server only
- Auto-Fax for trouble reports (On or Off)
- Pager telephone numbers (up to 64 digits)
- Personal identification number (PIN) maintenance

The functions of the Voice/Data/Fax Modem are protected by up to 10 personal identification numbers. Any person with knowledge of the supervisory PIN can add, delete, or modify PINs. The supervisory PIN is the first one in the list of 10 allowed PINs.

**Note:** The Voice/Data/Fax Modem is shipped with a default supervisory PIN of 8210001.

When you choose *Configuration*, you will hear the voice message “Change Voice/Data/Fax Modem PINs.” Then, you are prompted to add, delete, or change the PINs. When you are done, if you do not disconnect the call, the voice menu starts again.

## Option 6—Device Presence and Status Report

Remote service is normally provided over the TTY or SLIP interface. In addition to the reporting and reset capabilities previously described, you can request a report that provides detailed device presence and status (DPS) information. This information can be obtained in a verbal message or in a more detailed fax report.

The verbal message begins with a statement of the number of recognized devices followed by a statement of the number of those that are enabled. If any are disabled, it will then state the number disabled. Finally, if any are out of service for other reasons, it will state the number of devices in non-operational states other than disabled.

Device presence and status fax reports contain the same information that is accessible when you select the *DIAGS* keyword from the MOS operator control and then select Option 1, Device Status, from the DIAGS menu.

You can also obtain this information from the Web browser interface by selecting *Diagnostics* from the main menu.

## Option 7—Resend Last Fax Report

You should request this option before you select another fax report because the previous fax report file is recreated for each call. If you make this request before you request the next fax report, the file for the previous call is retained and any additional requests will be appended to it.

## Option 8—Disconnect Call

You can request that the modem disconnect the call. When you choose *Disconnect call*, you will hear the voice message “Are you sure you want to disconnect?” and you will be prompted to respond. If you do not disconnect the call, the voice menu starts again.

## Option 9—Repeat Menu

You can request a repetition of the menu.

# Chapter 7. The OPCON Process and Commands

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

- “What is OPCON?”
- “Accessing the OPCON Process” on page 8-1
- “OPCON Commands” on page 8-1

## What is OPCON?

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)
- Return to the Base LAN Switch console
- 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 8. Configuring 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, there is an extensive set of commands that you enter 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 8-1 on page 8-2. To use them, access the OPCON process and enter the appropriate command at the OPCON prompt (*).

| Table 8-1. 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 2-3. |
| 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. |
| 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.

**Syntax:**

dia**gs**

## 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 8-3.

**Syntax:**

**divert** *pid tty#*

**Example: `divert 2 1`**

```
* divert 2 1
* status
Pid  Name      Status TTY  Comments
1    COpCon    IOW    TTY0 gzs
2    Monitr    IDL    TTY0
3    Tasker    RDY     --
4    MOSDBG    DET     --
5    CGWCon    DET     --
6    Config    DET     --
7    ROpCon    IDL    TTY1
8    ROpCon    RDY    TTY2 jlg@128.185.40.40
9    WEBCon    IDL    --
```

## Flush

Use the **flush** command to clear the output buffers of the MONITR process. This command is generally used prior to 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    COpCon    IOW    TTY0 gzs
2    Monitr    IDL    SNK
3    Tasker    RDY     --
4    MOSDBG    DET     --
5    CGWCon    DET     --
6    Config    DET     --
7    ROpCon    IDL    TTY1
8    ROpCon    RDY    TTY2 jlg@128.185.40.40
9    WEBCon    IDL    --
```

## 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    COpCon    IOW    TTY0 gzs
2    Monitr    IDL     --
3    Tasker    RDY     --
4    MOSDBG    DET     --
5    CGWCon    DET     --
6    Config    DET     --
7    ROpCon    IDL    TTY1
8    ROpCon    RDY    TTY2 jlg@128.185.40.40
9    WEBCon    IDL    --
```

## 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 2-12 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 8-1 on page 8-5.

**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.

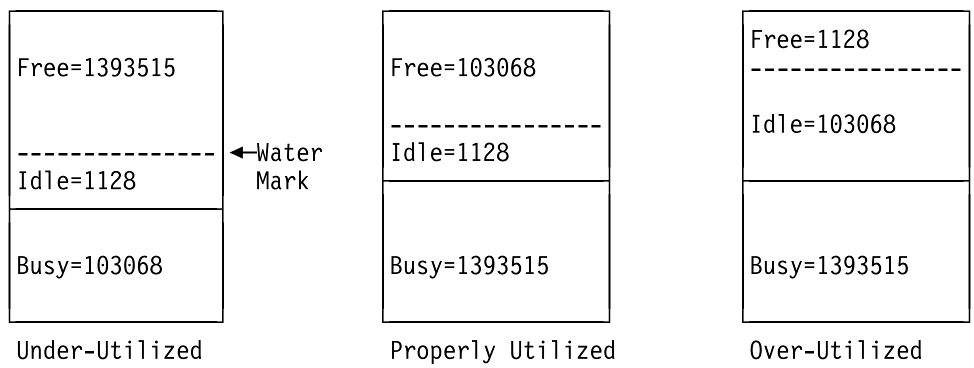



*Figure 8-1. Memory Utilization*

## 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.

**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 select to 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    COpCon    IOW    TTY0
2    Monitr    IDL     --
3    Tasker    RDY     --
4    MOSDDT    DET     --
5    CGWCon    IOW     --
6    Config    IOW    TTY1
7    ROpCon    IOW    TTY1 128.185.46.101
8    ROpCon    RDY    TTY2 128.185.46.104
9    WEBCon    IDL    --
```

**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.

**TTYn** 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 2-12 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:**

t**alk** *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 (*ip address*). The only optional parameter is the terminal type that you want to emulate.

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:**

te**lnet** *ip-address terminal-type*

**Example:** **`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 '^]'
```

When telneting 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 re-enter 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
*
```

# Chapter 9. The Configuration (CONFIG) Process and Commands (Talk 6)

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



## 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 entitled "Migrating to a New Code Level" in the Maintenance Guide 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 7, "The OPCON Process and Commands" on page 7-1).

**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 10-1 on page 10-1 for a list of the commands you can issue from the CONFIG process.

## Config-Only Mode

Config-Only mode is a way to back out of a bad configuration that is causing the router to crash during start-up. Use the Config-Only mode ***only*** to change devices or data links (that is, for unsupported devices) or to reduce memory use (for *no memory* crashes) such as routing table sizes, packet sizes, and receive buffer allocations.

**Note:** Config-Only is provided only for getting a subset of configuration commands when a config problem causes the router to panic, check, fail, or detect a bug. Do ***not*** use Config-Only mode for general router configuration; many of the device-related commands are disabled in Config-Only mode and some may cause a crash.

## Automatic Entry Into Config-Only Mode

Config-Only mode is entered when the router detects a problem during operation or during router initialization.

Any of the following situations will cause the router to enter into Config-Only mode:

- The software load does not match the device configuration. More particularly, an attempt is made to configure a device or data link that is unsupported by the software load.
- Deletion of all router interface information.

If the router entered into the configuration-only mode because an unsupported device has been configured:

- Change the device information to match the hardware installed in (and supported by) the router, or change the unsupported device to "null device."
- Enter the **Reload** command from the `Config (only)>` prompt.
- The router will automatically enter into OPCON (*).

## Manual Entry Into Config-Only Mode

To enter the Config-Only mode, take any one of the following actions:

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

During initial start-up, if no devices are configured the router comes up in Config-Only mode. If no protocols are configured the router comes up in Config-Only mode and automatically enters Quick Configuraton mode.

See Chapter 3, "Using MSS Server Firmware" on page 3-1 for more detail.

## 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.

**Attention:** 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.

Table 9-1 on page 9-3 lists what Quick Config supports.

Table 9-1. Quick Config Capabilities

| ATM Protocols | Bridging Protocols | Routing Protocols |
|---|---|---|
| LAN Emulation | STB, SRT,SRB | IP, IPX |

The 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:

- Blank or corrupted configuration memory, such as when one of the following situations occurs:
  - The router is configured for the first time.
  - Voltage fluctuations resulted in corruption of configuration memory.
  - The CPU board, which contains the configuration memory chip, was replaced in the router.
- 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 A-1.

## Manual Entry Into the Quick Config Mode

You might want to get to Quick Config manually to demonstrate the router's capabilities, reconfiguring on the fly to 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.

## 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 10-4.

## 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 when:

- 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.

- Adding router interfaces to new domains.

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

The following example shows how to configure and activate a new ATM LAN Emulation Client on which the IP protocol is configured. The ATM LAN Emulation Client and IP configurations are not shown.

```
* talk 6
Config> net 0
ATM User Configuration
ATM Config> le-client ATM LAN Emulation Clients Configuration
LE Client config> add token-ring Added Emulated LAN as interface 6
LE Client config> config 6
ATM LAN Emulation Client configuration
:
(Here you would configure the ATM LAN Emulation Client)
:
Token Ring Forum Compliant LEC Config> exit
LE Client config> exit
ATM Config> exit
Config> protocol ip
IP Conifg>
:
(Here you would configure IP on the ATM LAN Emulation Client)
:
IP Config> exit
* talk 5
write
ctrl-p
+ activate 6
Interface 6 activated successfully
```

## Restrictions for Spare Interfaces

The **activate** command cannot be used to bring a new interface online to the network under the following circumstances:

- 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 protocols on spare interfaces, but you cannot bring them online to the network using the **activate** command:

- MARS

**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 data-base

There are also limitations on certain functions. These limitations 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.

Bridging
: - 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).

# Chapter 10. Configuring 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 2-1 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 10-1.

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

*Table 10-1 (Page 1 of 2). 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 2-3. |
| 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. |
| Disable | Disables login from a remote console, system memory dumping and rebooting, or a specified interface. |
| Enable | Enables login from a remote console, enables modem use, |
| Event | Enters the Event Logging System configuration environment. |

| Table 10-1 (Page 2 of 2). CONFIG Command Summary | |
|---|---|
| **Command** | **Function** |
| 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. |
| Patch | Modifies the router's global configuration. |
| 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, location, and contact person. |
| System | Retrieves 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** device . . .

user . . .

**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 2-8 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 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 10-10.)

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 x(0-3) 0?
Adding CHARM ATM Adapter device in slot 0 port 1 as interface x
(where x is the interface number assigned)
```

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

When adding interfaces with more than one port, add one port at a time. Use the **add device** command twice to add both ports of a dual-port adapter.

**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.

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 10-2.

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

*Table 10-2. 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)dmin, (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 10-2).

## Boot

Use the **boot** command to enter the Boot CONFIG command environment. For Boot CONFIG information, see Chapter 11, “Using BOOT Config to Perform Change Management” on page 11-1.

**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 . . . |
| | user |

**Example:**

```
change device
Which configured slot would you like to change? (1, 2) [1]? 2
Which slot would you like to change to? (1-2)  [1]? 1
Changed slot 2 to slot 1 in 1 intf (port) record...
```

**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.)
- Swap slots of two existing interfaces. (Swap slot x and slot y in interface records with x or y.)
- 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.)

When the target slot is occupied:

1. If you select the “swap” option, the source and target slots are swapped in 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.

**Example - Change slot 2 on interface 0 to unoccupied slot 1:**

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

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

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

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

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

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

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

Configuration for slot 1 already exists. You can:
a - abort this operation
r - replace configuration
    (Interface configuration for slot 2 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 2.)
s

Swapped slot 2 with slot 1 in 1 port record...

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

#### 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
```

### 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.

**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])
```

## Clear

Use the **clear** command to delete the router's configuration information from non-volatile 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)
- bgp (Border Gateway Protocol)
- boot
- device
- dn (DECnet)
- els (Event Logging System Information)
- ip (IP)
- ipx (Novell IPX)
- ospf (OSPF routing protocol)
- snmp
- srb (Source Route Bridge)
- srly (SDLC Relay)
- stb (Spanning Tree Bridge)
- tcp/ip-host
- time (Time of day information)
- user
- vines (Banyan VINES)

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 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:**

| | |
|---|---|
| de**lete** | interface . . . |
| | user . . . |

**interface [*intfc#*]**
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 .

When 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.

**user** *user_name*
Removes user access to the router for the specified user.

## 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:**

| | |
|---|---|
| di**sable** | 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.
```

**CAUTION:**
**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**
Enables the dumping of system memory to the installed hard disk when a serious error occurs. 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, dump memory is aborted and the following message is displayed:

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

**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 15, “Using the Event Logging System (ELS)” on page 15-1 for information about ELS.

**Syntax:**

ev**ent**

## 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 IBM 8210 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 10-3 lists available feature numbers and names.

*Table 10-3. IBM 8210 Feature Numbers and Names*

| Feature Number | Feature Short Name | Accesses the following feature configuration process |
|---|---|---|
| 2 | MCF | MAC Filtering |
| 6 | QOS | Quality of Service |
| 7 | CMPRS | Data Compression |

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

devices

patches . . .

users . . .

vpd

**devices** 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.

**Example: `list devices`**

```
Ifc 0 CHARM ATM Adapter      Slot: 1  Port: 1
```

**configuration**

Displays configuration information about the router.

**Example: `list configuration`**

```
Hostname: acctg
Maximum packet size: [autoconfigured]
Maximum number of global buffers: [autoconfigured]
Number of spare interfaces: 0
Console baudrate:  9600 (Autobaud)
Console inactivity timer (minutes): 0
Physical console login: disabled
Modem Control Enabled, using CARRIER-WAIT type control
Contact person for this node: [none]
Location of this node: [none]

Configurable Protocols:
Num Name  Protocol
0   IP    DOD-IP
3   ARP   Address Resolution
7   IPX   NetWare IPX
11  SNMP  Simple Network Management Protocol
10  BGP   Border Gateway Protocol
12  OSPF  Open SPF-Based Routing Protocol
23  ASRT  Adaptive Source Routing Transparent Enhanced Bridge
24  HST   TCP/IP Host Services

Configurable Features:
Num Name  Feature
2   MCF   MAC Filtering
6   QOS   Quality of Service

27616 bytes of configuration memory free
```

**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
```

**vpd** Displays the hardware and software vital product data.

# Load

Use the **load** command to list, add, or delete optional software packages (for example, APPN).

**Syntax:**

**load** add *packagename*

delete *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.

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.

**delete package** *packagename*
Removes a software package to the software. The *packagename* is the name of the package of load modules you want to remove from the software.

**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. Whenever 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`.

## Patch

Use the **patch** command for modifying the router's global configuration. Patch variables are recorded in nonvolatile configuration memory and take effect immediately; you do not have to wait for the next restart of the router. This command should be used only for handling uncommon configurations. Anything that you commonly configure should still be handled by using the specific configuration commands. The following is a list of the current patch variables documented and supported for this release.

**Syntax:**

**patch** bgp-subnets
ethernet-security
ip-default-ttl
ip-mtu
more-lines
mosheap-lowmark
ospf-import-rate
ping-size
ping-ttl
rip-static-suppress

**bgp-subnets** *new value*
If you want the BGP speaker to advertise subnet routes to its neighbors, set *new value* to 1. The default is 0.

**dls-ignore-lfs** *new value*
When set to 1, DLSw ignores the "largest frame" size bits in source-routed frames when setting up a circuit. This avoids circuit setup problems with some older LAN products that do not set these bits correctly. The default is 0.

**ethernet-security** *new value*
When set to a non-zero value, zeros the padding that is applied to Ethernet packets whose data portion is less than the physical minimum of 60 bytes. This may be required for security reasons. Default: 0.

**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 *Multiprotocol Switched Services (MSS) Interface Configuration and Software User’s Guide*.) 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.

**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 *Multiprotocol Switched Services (MSS) Interface Configuration and Software User’s Guide*.)

**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 *Multiprotocol Switched Services (MSS) Interface Configuration and Software User’s Guide*.

**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.

## Protocol

Use the **protocol** command at the `Config>` prompt to enter the configuration environment for the protocol software installed in the router.

**Syntax:**

| | |
|---|---|
| pr**otocol** | [*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 OPCON 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:**

q**config**

**Note:** For complete information on using the Quick Config software provided with your router, see Appendix A, "Quick Configuration Reference" on page A-1.

## Set

Use the **set** command to configure various system-wide parameters.

**Syntax:**

| | |
|---|---|
| se**t** | contact-person . . . |
| | down-notify . . . |

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.

**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.

**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).

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 10-4 on page 10-18.

**Example:**

```
set prompt
What is the new MOS prompt [y]? AnyHost 99
AnyHost 99 Config>
```

*Table 10-4. 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:<br>`Config> set prompt`<br>`What is the new MOS prompt [y]? $n`<br>`hostname:: Config>` |
| $t | Displays the time. For example:<br>`Config> set prompt.`<br>`What is the new MOS prompt [y]? $t`<br>`02:51:08[GMT-300] Config>` |
| $d | Displays the current date-month-year. For example:<br>`Config> set prompt.`<br>`What is the new MOS prompt [y]? $d`<br>`26-Feb-1997 Config>` |
| $v | Displays the software VPD information in the following format:<br>`program-product-number Feature xxxx Vx.x PTFx RPQx` |
| $e | Erases one character *after* this combination within the user-defined prompt. |
| $h | Erases one character *before* this combination within the user-defined prompt. |
| $_ | Adds a carriage return to the user-defined prompt. |
| $$ | Displays the $. |

**Note:** You can combine these commands. For example:

```
Config> set prompt
What is the new MOS prompt [y]? $n::$d
hostname::26-Feb-1997 Config>
```

**receive-buffers** *interface# max#*

Adjusts the number of private receive buffers for most interfaces.

The range is 5 to 255.

*Table 10-5. Default and Maximum Settings for Interfaces*

| Interface | Default | Maximum |
|---|---|---|
| ATM | 80 | 80 |
| ETH | 40 | 100 |
| TKR | 40 | 100 |
| FDDI | 80 | 80 |

**spare-interfaces *n***

Defines ***n***, the number of spare interfaces, for this device. See "Configuring Spare Interfaces" on page 9-4 for additional information.

## System Memory Dump

Use the **system memory dump** command to retrieve the memory image file from the installed hard diskafter a serious error has occurred.

**Syntax:**

**system** retrieve *address filepath*

**retrieve** Uses TFTP to send the memory image to a remote location, with a destination TFTP file address, path, and file name supplied by the user.

If memory dumping is disabled, the function is aborted and the following message is displayed:

```
Image file transfer aborted:  function disabled
```

If the memory file is not present on the hard disk, or if the hard disk has been removed, the function is aborted and the following message is displayed.

```
Image file transfer aborted:  image file not found
```

```
Example: system retrieve
Destination IP address (0.0.0.0) 2.2.2.2
Fully qualified destination path/file name (tmp/dump.dat)
The memory image file is nnnnn bytes long.
Proceed? (Y/[N])
```

## Time

Use the **time** command to set the IBM 8210 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 IBM 8210 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 10-12.

**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:**

u**pdate** 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.

```
Updating configuration memory to V15.2 [X104]
```

# Write

Use the **write** command to save a configuration to the device before reloading.

**Syntax:**

w**rite**

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 11. 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)"

## Understanding Change Management

Change management is the handling of software and configuration data for an IBM 8210. This involves:

1. Moving code and configuration data to and from the IBM 8210
2. Moving code and configuration data on the IBM 8210 persistent storage device, which is currently a disk drive andflash memory
3. Selecting and activating specific combinations of software and configuration.

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

The IBM 8210 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 8210 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 8210's non-volatile configuration memory, image bank, and remote hosts.

TFTP allows you to:

- Get a configuration file from a server to an IBM 8210
- Put a configuration file from an IBM 8210 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 8210 acts as a client node by generating TFTP requests from the IBM 8210 console using the `Boot config>` process **tftp** command.

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. 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 12-1 for information on these commands.

# Chapter 12. 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 12-1 on page 12-2 summarizes the Change Management Configuration commands.

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

| Table 12-1. 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 2-3. |
| Add | Adds an optional description to a configuration file. |
| Copy | Copies boot files andconfiguration 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 8210 and remote servers. |
| Timedload | 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. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## 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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 01 Jan 1970 00:24 |
+------------------------+--------------------------------+-------------------+
  * - Last Used Config      L - Config File is Locked


Select the source bank:  (A, B, F): [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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 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 imagesto and from banks.

**Syntax:**

<u>co</u>**py** 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 |
| 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 00:01 |
| CONFIG 1 - AVAIL       |                                | 01 Jan 1970 00:14 |
| CONFIG 2 - AVAIL       |                                | 01 Jan 1970 00:01 |
| CONFIG 3 - AVAIL       |                                | 01 Jan 1970 00:37 |
| CONFIG 4 - ACTIVE  *   |                                | 01 Jan 1970 00:24 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 01 Jan 1970 00:01 |
| CONFIG 1 - AVAIL       |                                | 01 Jan 1970 00:14 |
| CONFIG 2 - AVAIL       |                                | 01 Jan 1970 00:01 |
| CONFIG 3 - AVAIL       |                                | 01 Jan 1970 00:37 |
| CONFIG 4 - ACTIVE  *   |                                | 01 Jan 1970 00:24 |
+------------------------+--------------------------------+-------------------+
  * - Last Used Config      L - Config File is Locked


Select the source bank:  (A, B, F): [A] b
Select the destination bank:  (A, B): [B] a
Copy SW load image from: bank B
                      to: bank A.


Operation completed successfully.
```

**Example:** `Boot config>`**`copy configuration`**

```
+------ 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 - AVAIL       |                                | 01 Jan 1970 01:39 |
| CONFIG 4 - AVAIL       |                                | 01 Jan 1970 01:52 |
+------ BankB -----------+--------- Description ----------+------ Date -------+
| IMAGE - ACTIVE         |                                | 01 Jan 1970 00:01 |
| CONFIG 1 - AVAIL       |                                | 01 Jan 1970 00:14 |
| CONFIG 2 - AVAIL       |                                | 01 Jan 1970 00:01 |
| CONFIG 3 - AVAIL       |                                | 01 Jan 1970 00:37 |
| CONFIG 4 - ACTIVE  *   |                                | 01 Jan 1970 00:24 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 01 Jan 1970 00:01 |
| CONFIG 1 - AVAIL       |                                | 01 Jan 1970 00:14 |
| CONFIG 2 - AVAIL       |                                | 01 Jan 1970 00:01 |
| CONFIG 3 - AVAIL       |                                | 01 Jan 1970 00:37 |
| CONFIG 4 - AVAIL       |                                | 01 Jan 1970 00:24 |
+------------------------+--------------------------------+-------------------+
  * - Last Used Config      L - Config File is Locked


Select the source bank:  (A, B, F): [A]
Select the source configuration:  (1, 2, 3, 4): [1]
Select the destination bank:  (A, B, F): [B]

Select the destination configuration:  (1, 2, 3, 4): [1]
Copy SW configuration from: bank A, configuration 1
                         to: bank B, configuration 1.
/hd0/sys0/CONFIG0 --> /hd0/sys1/CONFIG0

Operation completed successfully.
```

If the copy fails you may receive one of the following messages:

**Error: Active bank cannot be overwritten or erased.**
You attempted to copy a configuration into the bank currently in use by the IBM 8210.

**Error: File copy failed.**

This condition occurs when the copy operation fails for reasons other than copying to the active configuration. The most common cause is specifying the same source and destination configurations. When you list (see “List” on page 12-8) the configurations, CORRUPT appears next to the bank that is damaged.

## Describe

Use the **describe** command to display information about a stored image.

**Syntax:** describe

**Example:** `Boot config>` **`describe`**

```
+------------------------+------------------------+------------------------+
|         BANK A         |         BANK B         |         BANK F         |
| Product ID -   8210-MSS | Product ID -   8210-MSS | Product ID -   8210-MSS |
| Version   2.1          | Version   2.1          | Version   2.1          |
| Maint.    0 PTF       0 | Maint.    0 PTF       0 | Maint.    0 PTF       0 |
| Feat.  8707 RPQ       0 | Feat.  8707 RPQ       0 | Feat.  8707 RPQ       0 |
| Date        31 Dec 1996 | 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 halt at the firmware main menu, without running the router operational code. Disabling this function is similar to selecting “attended mode” from the firmware menu, and is useful for accessing the firmware when you are remotely dialed-in to the router console through a modem. 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 firmware main menus. Enabling this function is similar to selecting "unattended mode" from the firmware menus, and is the default operational mode.

**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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 01 Jan 1970 00:24 |
+------------------------+--------------------------------+-------------------+
  * - Last Used Config      L - Config File is Locked


Select the bank to erase:  (A, B, F): [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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 01 Jan 1970 00:24 |
+------------------------+--------------------------------+-------------------+
  * - Last Used Config      L - Config File is Locked


Select the source bank:  (A, B, F): [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        |                                | 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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 01 Jan 1970 00:24 |
+------------------------+--------------------------------+-------------------+
  * - 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 along 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          |                                | 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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 01 Jan 1970 00:24 |
+------------------------+--------------------------------+-----------------+
  * - 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 following are the possible file status descriptors:

**ACTIVE** The file is currently loaded and is running on the 8210

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

**CORRUPT**
The file was damaged or not loaded into the 8210 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 8210.

## Lock

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

**Syntax:**

lo**ck**

**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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 01 Jan 1970 00:24 |
+------------------------+--------------------------------+-------------------+
  * - Last Used Config      L - Config File is Locked

Auto-boot mode is enabled.  Fast-boot mode is disabled.Select the source bank:  (A, B, F): [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         |                                |                   |
| 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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                |                   |
| 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 - AVAIL       |                                | 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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 01 Jan 1970 00:24 |
+------------------------+--------------------------------+-------------------+
  * - Last Used Config      L - Config File is Locked


Select the source bank:  (A, B, F): [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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 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 8210 and remote servers.

**Note:** When you unzip a Release 2 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 single *image*

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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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/8210load/nce.img
Select the destination bank:  (A, B, F): [A] a
  TFTP SW load image
  get:   /usr/8210load/nce.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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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/8210load/
Select the destination bank:  (A, B, F): [A] a
  TFTP SW load image
  get:   /usr/8210load/LML.ld
  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.A 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.

**Syntax:**

| | |
|---|---|
| <u>ti</u>**medload** | <u>a</u>ctivate |
| | <u>d</u>eactivate |
| | <u>v</u>iew |

**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 12-11 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

+------ 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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 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'
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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 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:**

un**lock**

**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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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 - AVAIL       |                                | 01 Jan 1970 00:24 |
+------------------------+--------------------------------+-------------------+
  * - Last Used Config      L - Config File is Locked


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

Operation completed successfully.
Boot config>list
+------ BankA -----------+--------- Description ----------+------ Date -------+
| IMAGE - NONE           |                                |                   |
| 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       |
| 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 |
+------ BankF -----------+--------- Description ----------+------ Date -------+
| IMAGE - AVAIL          |                                | 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.
```

**Note:** Note that bank A config 4 is no longer marked with an “L.”

# Chapter 13. 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 13-1 on page 13-2.

To use the GWCON commands, access the GWCON process by entering **talk 5** and enter the GWCON commands at the (+) prompt.

*Table 13-1. 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 2-3. |
| 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 off line. |
| 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. |
| Protocol | Enters the command environment of the specified protocol. |
| Queue | Displays buffer statistics for a specified interface. |
| 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 9-4 for more information.

**Syntax:**

**activate** *interface#*

## Buffer

Use the **buffer** command to display information about packet buffers assigned to each interface.

**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 ]

**Example:**

```
buffer
               Input  Buffers:       Buffer sizes:
Nt  Interface  Req  Alloc  Low Curr  Hdr  Wrap  Data  Trail Total   Bytes Alloc



0   ATM/0       20    20     7    0  109   92    2052    7   2260   45200
```

**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#*

## 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**

**Example:**

```
configuration

Nways 8210 Multiprotocol Switching Server


Host name: [not configured]
Version: 2.0

Num Name  Protocol
0   IP    DOD-IP
3   ARP   Address Resolution
11  SNMP  Simple Network Management Protocol
12  OSPF  Open SPF-Based Routing Protocol
23  ASRT  Adaptive Source Routing Transparent Enhanced Bridge

Num Name  Feature
2   MCF   MAC Filtering
6   QOS   Quality of Service

1 Networks:
Net Interface  MAC/Data-Link         Hardware         State
0   ATM/0      ATM                   CHARM ATM        Up
```

- The first line gives the product name.
- The second line indicates whether a host name is configured.
- The third 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.

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.
- 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 network manager initiates a self-test of the interface through SNMP.

**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.

## Disable

Use the **disable** command to take a network interface off-line, making the interface unavailable. This command immediately disables the interface. You are not prompted to confirm, and no verification message displays. If you disable an interface with this command, it remains disabled until you use the GWCON **test** command or an OPCON **reload** command to enable it.

Enter the interface, or net number as part of the command. To obtain the interface number, use the GWCON **configuration** command.

**Syntax:**

**disable** *interface#*

## Error

Use the **error** command to display error statistics for the network. This command provides a group of error counters.

**Syntax:**

**error**

**Example:**

```
error

                  Input   Input      Input      Input     Output  Output
Nt  Interface  Discards  Errors  Unk Proto  Flow Drop   Discards  Errors



0   ATM/0             0       0         0          0          0       0
```

**Nt** Network interface number associated with the software.

**Interface** Type of interface.

**Input Discards**
Number of inbound packets which were discarded even though no errors 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 15, "Using the Event Logging System (ELS)" on page 15-1 for information about the Event Logging System and its commands. Use the **exit** command to return to the GWCON process.

**Syntax:**

e**vent**

## Feature

Use the **feature** command to access console commands for specific IBM 8210 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 10-3 on page 10-9 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:**

f**eature** *feature#* or *feature-short-name*

## Interface

Use the **interface** command to display statistical information about the network interfaces (for example, FDDI,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:**

i**nterface** [*interface#*]

**Example: interface**

```
                                       Self-Test  Self-Test  Maintenance
Nt  Interface  Slot-Port  Port Name     Passed     Failed       Failed
0   ATM/0         Slot:1     Port:1          1          0            0
```

**Note:** The display varies depending on the device.

**Nt** Global interface number.

**Interface** Interface name.

**Slot-Port** Slot number and port number of the interface.

**Port Name**
Port number, if applicable on the slot.

**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
                  Total  Reserve    Never      Perm     Temp     Prev
                                    Alloc     Alloc    Alloc    Alloc

Heap memory     5463895   201824  5065383    328344   375856    22656

Number of global buffers:  Total = 294, Free = 287, Fair = 57, Low = 58
Global buff size:  Data = 4478, Header = 128, Wrap = 92, Trailer = 19
Total = 4700
```

**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 *Free* is less than *Low*, then buffers will not be placed on any queue that has more than the *Fair* 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. This command obtains the console prompt for the specified interface. From the prompt, you can display statistical information, such as the LAN Emulation Clients for ATM networks.

**Syntax:**

net**work** *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 13-3 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 0
ATM+
```

In the example, the ATM+ prompt is displayed. You can then view information about the ATM interface by entering the ATM operating commands.

After identifying the interface number of the interface you want to monitor, for interface-specific information, see the 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:

- ATM
- Token-Ring LECs
- Ethernet LECs
- ISDN

## 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 2-7 for instructions on accessing `Config>`. To return to GWCON, enter **exit**.

See the corresponding monitoring chapter in this manual or in the *Multiprotocol Switched Services (MSS) Configuring Protocols and Features* 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#*

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
```

```
queue
              Input Queue      Output Queue
Nt Interface  Alloc Low Curr    Fair Curr
0  ATM/0         30  10   30      30    1
```

**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.

## Statistics

Use the **statistics** command to display statistical information about the network software, such as the configuration of the networks in the router.

**Syntax:**

s**tatistics** *interface#*

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
               Unicast  Multicast      Bytes    Packets      Bytes
 Nt Interface  Pkts Rcv   Pkts Rcv   Received      Trans      Trans
 0  ATM/0           479          0      19730        479      20292
```

**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 ATM/0...
```

When testing completes or fails, or when GWCON times out (after 30 seconds), the following possible messages are displayed:

```
Testing net 0 ATM/0 ...successful
   Testing net 0 ATM/0 ...failed
  Testing net 0 ATM/0 ...still testing
   Network is already undergoing test, attempting restart
```

Some interfaces may take more than 30 seconds before testing is done.

## 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**

# Chapter 14. The Messaging (MONITR - Talk 2) Process

This chapter explains how to collect and display messages. (Refer to Chapter 15, "Using the Event Logging System (ELS)" on page 15-1 for information about ELS and message formats. Refer also to the *IBM 8210 Multiprotocol Switched Services Server 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 15. 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?

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 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 or not the router has a problem and basically 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 necessary to temporarily view messages other than what 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 8210 Multiprotocol Switched Services Server 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 take 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 15-1 shows the message contents.

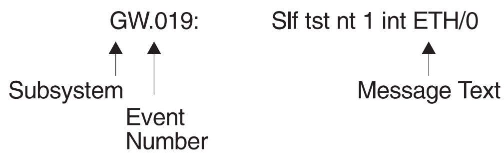



*Figure 15-1. Message Generated by an Event*

The information illustrated in Figure 15-1 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 15-1, **GW** identifies the subsystem through which this event occurred.

Other examples of subsystems include IP, TKR, and ATM. 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 15-1, **19** 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, 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 seting of the logging level. Table 15-1 on page 15-4 lists the logging levels and types.

*Table 15-1. 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 |

In Table 15-1, ERROR, INFO, TRACE, STANDARD, and ALL are aggregates of other logging level types. STANDARD is the recommended default.

The logging level setting affects the operation of the following commands:

- **Display subsystem**
- **Nodisplay subsystem**
- **Trap subsystem**
- **Notrap 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 15-1 on page 15-3, `Slf 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 15-2 on page 15-5 describes the error or packet completion codes. Packet completion codes indicate the disposition of the packets that arrive at the router.

*Table 15-2. Packet Completion Codes (Error Codes)*

| Code | Meaning |
|---|---|
| 0 | Packet successfully queued for output |
| 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 described in this chapter, 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, take the following steps:

- Know what you want to see 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.
- Use the *IBM 8210 Multiprotocol Switched Services Server Event Logging System Messages Guide* to determine which messages you are seeing are 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.

## 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 16, “Configuring and Monitoring the Event Logging System (ELS)” on page 16-1.

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.

## 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 IBM 8210. When ELS is configured appropriately, an SNMP trap will be generated each time the selected event occurs. For more information about SNMP, see *Multiprotocol Switched Services (MSS) Configuring Protocols and Features*.

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 will need to reboot to activate these changes.

2. Enable your network management station to receive and properly display the enterprise-specific traps.

Follow the steps above for trapping groups, subsystems, and events.

## Using ELS to Troubleshoot a Problem

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.

When trying to troubleshoot a particular problem, display those messages that relate to the problem. For example, when 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 those up in the 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.

```
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 *Multiprotocol Switched Ser-*

*vices (MSS) Configuring Protocols and Features* 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.

# Chapter 16. 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 16-12
- "ELS Monitoring Commands" on page 16-13

For more information on the Event Logging System and how to interpret ELS event messages, refer to Chapter 15, "Using the Event Logging System (ELS)" on page 15-1.

## Accessing the ELS Configuration Environment

The ELS configuration environment is characterized by the `ELS config>` prompt. Commands entered at this prompt are described Chapter 16, "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 16-1 on page 16-2 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 16-1. 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 2-3. |
| Add | Adds an event to an existing group or creates a new group. |
| Clear | Clears all ELS configuration information. |
| Default | Resets the display or trap setting of an event, group, or subsystem. |
| Delete | Deletes an event number from an existing group or deletes an entire group. |
| Display | Enables message display on the console monitor. |
| List | Lists information on ELS settings and messages. |
| Nodisplay | Disables message display on the console. |
| Notrace | Controls disablement of packet trace events. |
| Notrap | Keeps messages from being sent out in SNMP traps. |
| Set | Sets the pin parameter, the timestamp feature, and ATM packet tracing 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 2-3. |

## 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)
```

## 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:**

| | |
|---|---|
| def**ault** | 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:**

| | |
|---|---|
| del**ete** | *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:**

| | |
|---|---|
| di**splay** | 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:**

```
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. The following is a list of subsystems that are supported on the router. To find out which subsystems are on your router, type **list subsystems**.

**Note:** Although ELS supports all of these subsystems, not all devices support all subsystems. See *ELS Messages* for the most current list of supported subsystems.

| Subsystem | Description |
|---|---|
| **AI** | Auto-device Install |
| **All** | All subsystems |

**Note:** Do not display all subsystems for extended periods of time when the router is forwarding live protocol traffic because this causes the router to spend an excessive amount of time communicating with the monitoring. Never display all subsystems when you are communicating with the router through a remote monitoring. This causes the router to spend most of its time communicating with the remote monitoring.

| | |
|---|---|
| **AP2** | AppleTalk Phase 2 |
| **ARP** | Address Resolution Protocol |
| **APPN** | Advanced Peer-to-Peer Networking |
| **ATM** | Asynchronous Transfer Mode |
| **BAN** | Boundary Access Node |
| **BGP** | Border Gateway Protocol |
| **BR** | Bridging/Routing |
| **BRS** | Bandwidth Reservation |
| **BTP** | BOOTP relay agent |
| **CLNP** | ISO 8473 - CLNP |
| **COMP** | Data Compression |
| **DLS** | Data Link Switching |
| **DNAV** | DNA Phase V |
| **DVM** | DVMRP Multicast Routing Protocol |
| **ENCR** | Data Encryption |
| **ESIS** | ISO 9542 - ESIS Protocol |
| **ETH** | Ethernet handler |
| **EZ** | EasyStart |
| **FLT** | Filter library |
| **FRL** | Frame Relay |
| **GW** | Router base and network library |
| **ICMP** | Internet Control Message Protocol |
| **ILMI** | Interim Local Management Interface |
| **IP** | Internet Protocol |
| **IPPN** | IP Protocol Net |
| **IPX** | Internetwork Packet Exchange Protocol |
| **ISDN** | Integrated-services Digital Network |
| **ISIS** | ISO 10589 - ISIS Protocol |
| **ILEC** | ATM IBM LAN Emulation Client |
| **ILMI** | ATM Interim Local Management Interface |
| **LCS** | Logical Channel Station |
| **LEC** | ATM LAN Emulation Client |
| **LECS** | LAN Emulation Configuration Server |
| **LES** | LAN Emulation Server |

| | |
|---|---|
| **LLC** | Logical Link Control |
| **LSA** | Link Services Architecture |
| **LSI** | LAN Switch Integration |
| **LNM** | LAN Network Manager |
| **MCF** | MAC Filtering |
| **MPC** | Multi-Path Channel |
| **MSPF** | OSPF Multicast extensions |
| **NBS** | NetBIOS Support Subsystem |
| **NOT** | Non-supported Protocol Forwarder |
| **OSPF** | Open SPF-based Routing Protocol |
| **PPP** | Point-to-Point Protocol |
| **RIP** | IP Routing Information Protocol |
| **R2MP** | AppleTalk Phase 2 Routing Table Management Protocol |
| **SAAL** | Signaling ATM Adaptation Layer |
| **SDLC** | IBM SDLC |
| **SL** | Serial Line Handler |
| **SNMP** | Simple Network Management Protocol |
| **SRLY** | SDLC Relay |
| **SRT** | Source Routing Transparent Bridge |
| **STP** | Spanning Tree Protocol |
| **SVC** | Switched Virtual Connection |
| **TCP** | Transport Control Protocol |
| **TFTP** | Trivial File Transfer Protocol |
| **TKR** | Token Ring Handler |
| **UDP** | User Datagram Protocol |
| **VIN** | Banyan VINES |
| **VLAN** | Dynamic Protocol Filtering |
| **V25B** | CCITT/ITU V.25bis |
| **WRS** | WAN Restoral/Reroute |
| **XN** | XNS/IPX/DDS common processing |
| **XNS** | Xerox Networking Systems Protocol |
| **X25** | X.25 Protocols |
| **X251** | X.25 Physical Layer |
| **X252** | X.25 Frame Layer |
| **X253** | X.25 Packet Layer |
| **XTP** | X.25 Transport Protocol |
| **ZIP2** | AppleTalk Phase 2 Zone Information Protocol |

## List

Use the **list** command to get updated information regarding ELS settings and listings of selected messages.

**Syntax:**

| | |
|---|---|
| **list** | all |
| | groups |
| | pin |
| | status |
| | subsystem . . . |
| | subsystems all |
| | trace-status |

**all** Lists information from all the **list** categories.

**groups** Lists the user-defined group names and contents.

**pin** Lists the current number of ELS event messages sent in SNMP traps (per second).

**status** Lists the subsystems, groups, and events that have been modified by the **display**, **nodisplay**, **trap**, and **notrap**, **trace**, and **notrace** commands.

**subsystem** Lists names, events, and descriptions of all subsystems.

(Example output from a **list subsystem** command can be found beginning on page 16-16.)

**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 a̲ll** Lists all events in all subsystems.

**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** e̲vent. . .

g̲roup . . .

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.

## Notrace

Disables packet trace for the specified event/range/subsystem/group.

**Syntax:**

notrac**e** 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*

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.

## Set

Use the **set** command to set the maximum number of traps per second, to set the timestamp feature, or to set tracing options for ATM devices.

**Syntax:**

| | |
|---|---|
| **set** | pin . . . |
| | 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.)

**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 for ATM devices. When tracing options are configured from the monitoring monitoring, the changes take effect immediately, and 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.

**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, ≥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.)

**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:**

| | |
|---|---|
| trac**e** | 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.

**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.

## 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 16, “Configuring and Monitoring the Event Logging System (ELS)” on page 16-1.

To enter the ELS monitoring environment from OPCON:

1. Enter the **talk 5** command.

   ```
   * talk 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 16-2. 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 2-3. |
| 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. |
| List | Lists information on ELS settings and messages. |
| Nodisplay | Disables message display on the console. |
| 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. |
| 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 work-station 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 2-3. |

## 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.

**Syntax:**

| | |
|---|---|
| **clear** | event . . . |
| | group . . . |
| | subsystem . . . |

**event** *subsystem. event#*
Resets the count of events to zero for displaying, trapping, tracing or remote logging of the specified event (*subsystem.event#*).

**group** *group.name*
Resets the count of events to zero for displaying, trapping, tracing or remote logging of the specified group (*group.name*).

**subsystem** *subsystem.name*
Resets the count of events to zero for displaying, trapping, tracing or remote logging of the specified subsystem (*subsystem.name*).

## Display

Use the display command to enable the message display on the monitoring monitor for specific events.

**Syntax:**

| | |
|---|---|
| **display** | event . . . |
| | group . . . |
| | range . . . |
| | subsystem . . . |

**event** *subsystem.event#*
Displays messages for 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:**

```
display range gw 19 22
```

Displays events gw.19, gw.20, gw.21, and gw.22.

**subsystem** *subsystem.name*
Displays any messages associated with the specified subsystem (*logging level*). If you do not specify a logging level, all messages for that subsystem are turned on.

## Files Trace TFTP

Use the **files trace tftp** command to retrieve trace files from the subdirectory associated with:

- 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).

## List

Use the list command to get updated information regarding ELS settings and to get listings of selected messages.

**Syntax:**

**list** all
active . . .
event . . .
groups . . .
pin
subsystems . . .
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
```

**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
```

**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
```

**subsystem** *subsystem.name*
Lists event names, the total number of events that have occurred, and their descriptions.

**Note:** Although ELS supports all of these subsystems, not all devices support all subsystems. See *ELS Messages* for the most current list of supported subsystems.

**Example:**

```
list subsystem

Name      Events  Description

ALL               All subsystems
GW         101    Router base and network library
FLT          7    Filter Library
BRS          5    Bandwidth  Reservation
ARP        142    Address Resolution Protocol
IP         100    Internet Protocol
ICMP        21    Internet Control Message Protocol
TCP         57    TCP
UDP          6    User Datagram Protocol
BTP         13    BOOTP relay agent
RIP         22    IP Routing Information Protocol
OSPF        73    Open SPF-Based Routing Protocol
MSPF        17    OSPF Multicast extensions
TFTP        29    TFTP Protocol
SNMP        28    Simple Network Management Protocol
DVM         21    DVMRP Multicast Routing Protocol

XN          21    XNS/IPX/DDS common processing
IPX        110    Internetwork Packet Exchange Protocol
CLNP        58    ISO 8473 - CLNP
ESIS        24    ISO 9542 - ESIS Protocol
ISIS        58    ISO 10589 - ISIS Protocol

AP2         70    AppleTalk Phase 2
ZIP2        51    AppleTalk Phase 2 Zone Information Protocol
R2MP        38    AppleTalk Phase 2 Routing Table Management Protocol
VIN         79    Banyan VINES
SRT         94    Source Routing Transparent Bridge
STP         32    Spanning Tree Protocol
BR          30    Bridge/Routing
SRLY        28    SDLC Relay
ETH         47    Ethernet Handler
SL          35    Serial Line Handler
TKR         45    Token Ring Handler
X25         53    X.25 Protocols
FDDI        27    FDDI Handler
SDLC        95    IBM SDLC
FRL         97    Frame Relay
PPP        186    Point-to-Point
X251        16    X.25-Physical-Layer
X252        34    X.25-Frame-Layer
X253        42    X.25-Packet-Layer
ISDN        43    Integrated Services Digital Network
IPPN         4    IP Protocol Net
WRS         33    WAN Restoral
LNM         60    LNM
LLC        168    Logical Link Control
BGP         74    Border Gateway Protocol
MCF          9    MAC Filtering

V25B        28    CCITT/ITU V.25bis

COMP        26    Data Compression Engines
NBS         50    NetBIOS Support Subsystem
ATM        216    Asynchronous Transfer Mode
LEC        174    ATM LAN Emulation Client
APPN        28    Advanced Peer-to-Peer Networking
ILMI        23    ATM Interim Local Management Interface
SAAL        26    ATM Signalling ATM Adaptation Layer
SVC         26    ATM Signalling
LES        361    LAN Emulation Services
LECS       145    LAN Emulation Configuration Server
EVLOG        1    EventLog() error logging system
NOT         15    Forwarder messages not loaded
NHRP       211    Next Hop Resolution Protocol
XTP         58    X.25 Transport
VLAN        29    Dynamic Protocol Filtering
```

```
LCS       22    LCS Handler
LSA       61    LSA Handler
MPC       30    MPC Handler
SCSP      34    Server Cache Synchronization Protocol
ALLC      36    ATM LLC (RFC1483)
NDR       38    Network Dispatcher Router Feature
MLP       93    Multilink-PPP
SEC       30    Security Protocols
ENCR       4    Data Encryption Engines
PM         6    Presence Manager
DGW        9    Default Gateway
QLLC      54    QLLC-Packet-LayerName  Events  Description
VLAN      20    Virtual LAN
```

**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
```

**subsystems 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 ATM 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
------------------------ 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 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:**

nod**isplay**    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*).

## Notrace

Use the **notrace** command to stop display of selected trace events at the monitoring.

**Syntax:**

notrac**e**    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.

**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 atm error

notrace subsystem atm
```

## 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.

**Syntax:**

p**acket-trace**

Use the **Exit** command when you are finished using Packet Trace.

For complete command descriptions, see "Packet-trace Monitoring Commands" on page 16-29.

## 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:**

remov**e**

## 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:**

res**tore**

## 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:**

ret**rieve**

## 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.)

**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:**

**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 monitoring, 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

**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, ≥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
```

**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 |
| ESIS | 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 |
| LNM | 70 | 60 | 3137 | 0 | 0 |
| LLC | 170 | 168 | 9840 | 0 | 0 |
| BGP | 80 | 74 | 2477 | 0 | 0 |
| MCF | 15 | 9 | 244 | 0 | 0 |
| V25B | 30 | 28 | 1058 | 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 16-29.

**Syntax:**

trac**e** 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_numbe*r 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 16-3. 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 2-3. |
| 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. |
| Set | Configures tracing options. |
| Subsystems | Activates tracing for the ATM subsystems, or displays a summary. |
| Trace-status | Displays information on the status of ATM 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 2-3. |

## 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 16-22.

## Subsystems

Use the **subsystems** command to activate tracing for the ATMsubsystems or display a summary.

**Syntax:**

| | |
|---|---|
| **subsystems** | atm |
| | lec |
| | ilec |
| | lecs |
| | les-bus |
| | 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 lecs
LECS Environment
on | off | list [list]? on
LECS modified
LECS modified
Tracing event LECS.128: control frames
(To trace a subset of LEC's, use the SET TRACE VALUE and
 SET TRACE MASK commands while using the LECS monitoring.)
```

**Example:**

```
subsystems les-bus
LES-BUS Environment
  (  1) ELAN0
  (  2) ELANE
Choice of LES/BUS [1]? 2
on | off | list [list]? on
LES/BUS: 'ELANE' : parameter successfully set
LES/BUS: 'ELANE' : parameter successfully set
Trace which types of frames (data, control, both) [both]? data
Tracing event LES.257: data frames
(To trace a subset of LEC's, use the SET TRACE VALUE and
SET TRACE MASK commands while WORK'ing with the LES-BUS.)
```

### Example:

```
subsystems les-bus
LES-BUS Environment
  (  1) ELAN0
  (  2) ELANE
Choice of LES/BUS [1]? 2
on | off | list [list]?
Packet trace is ON for ALL LEC's using this LES
LES DATA tracing is on
```

### Example:

```
subsystems les-bus
LES-BUS Environment
  (  1) ELAN0
  (  2) ELANE
Choice of LES/BUS [1]?
on | off | list [list]? on
LES/BUS: 'ELANE' : parameter successfully set
LES/BUS: 'ELANE' : parameter successfully set
Trace which types of frames (data, control, both) [both]? control
Tracing event LES.256: control frames
(To trace a subset of LEC's, use the SET TRACE VALUE and
SET TRACE MASK commands while WORK'ing with the LES-BUS.)
```

### Example:

```
subsystem summary
Subsystems Being Traced

ATM        net number = 0, VPI Range:     0 -     0
                           VCI Range:    16 -    16
LEC        net number = 1
LECS
LESBUS     elan name = ELAN0
LESBUS     elan name = ELANE
```

### Example:

```
subsystem les-bus
LES-BUS Environment
      (  1) ELAN0
      (  2) ELANE
Choice of LES/BUS [1]?
on | off | list [list]? off
LES/BUS: 'ELAN0' : parameter successfully set
LES/BUS: 'ELAN0' : parameter successfully set
```

### Example:

```
subsystem les-bus
LES-BUS Environment
      (  1) ELAN0
      (  2) ELANE
Choice of LES/BUS [1]?
on | off | list [list]? off
LES/BUS: 'ELAN0' : parameter successfully set
LES/BUS: 'ELANE' : parameter successfully set
notracing event LES.256: control frames
notracing event LES.257: data frames
```

## 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
```

## 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 16-29.

**Syntax:**

**view**

- current
- first
- jump
- last
- next
- prev
- search *hexstring*
- exit

# Chapter 17. 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) 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 17-2.

## 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
- 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

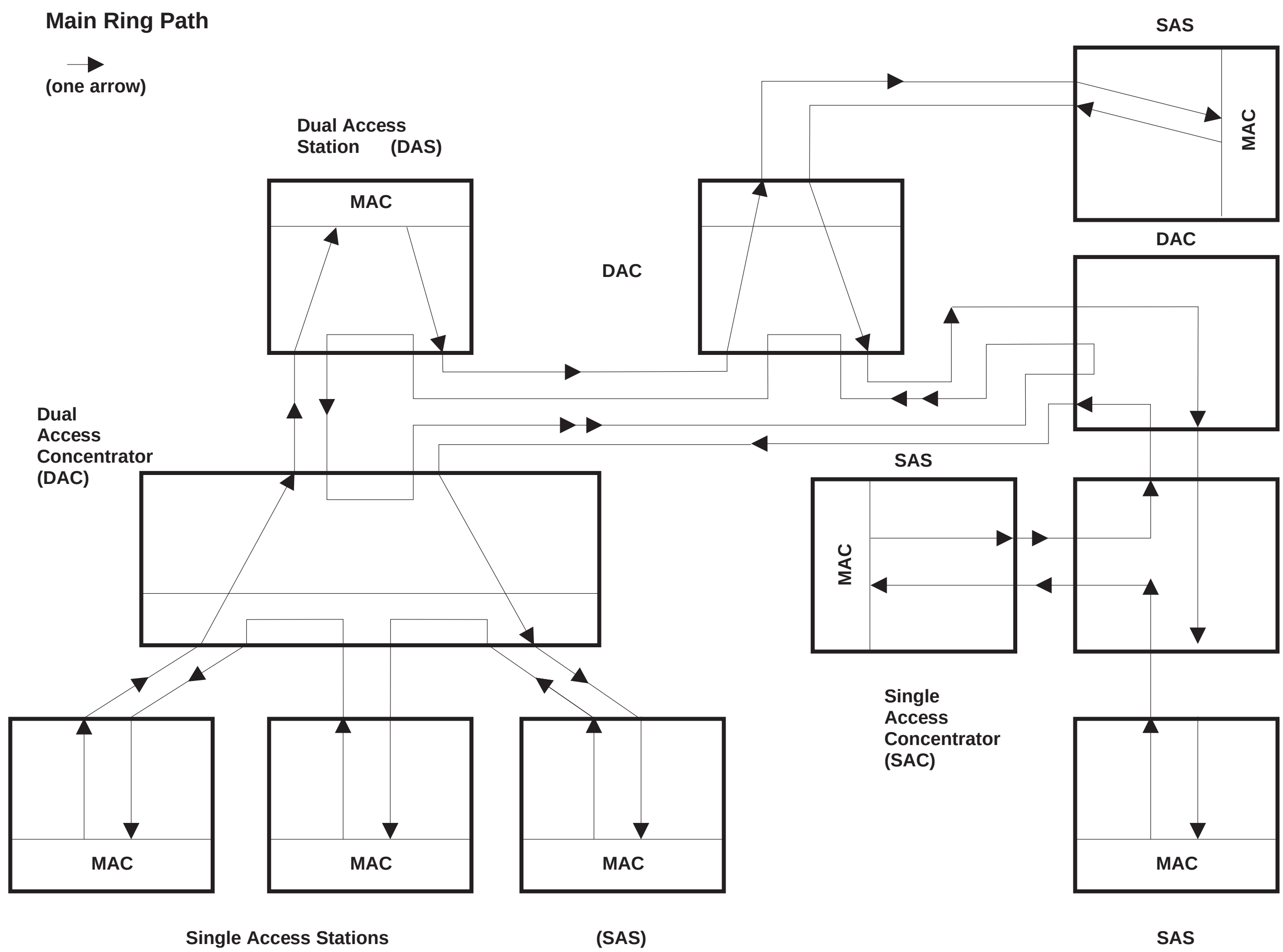



*Figure 17-1. FDDI Network Diagram. This diagram shows Single Access Stations (SAS), Dual Access Stations (DAS), Single Access Concentrators (SAC), and Dual Access Concentrators (DAC) in one Main Ring Path of an FDDI network.*

# Chapter 18. Configuring and Monitoring FDDI

This chapter describe 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 18-3
- "FDDI Monitoring Commands" on page 18-4

## 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 18-1. Enter the commands from the `FDDI Config>` prompt.

*Table 18-1. 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 2-3. |
| 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 2-3. |

## 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 18-2. 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 2-3. |
| List | Displays the FDDI adapter information |
| LLC | Displays the LLC monitoring 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 2-3. |

## 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 filtr 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 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, Losts: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

**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 connectionbetween 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 dected in error.

**Losts** 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.

# ATM and LAN Emulation

# Chapter 19. Overview of LAN Emulation

**Note:** See the glossary for definitions of the acronyms and terms used in this chapter.

The server 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 work-stations. Physical and logical views of a simple LAN emulation example are illustrated in 19-1.

## Simple LAN Emulation Network

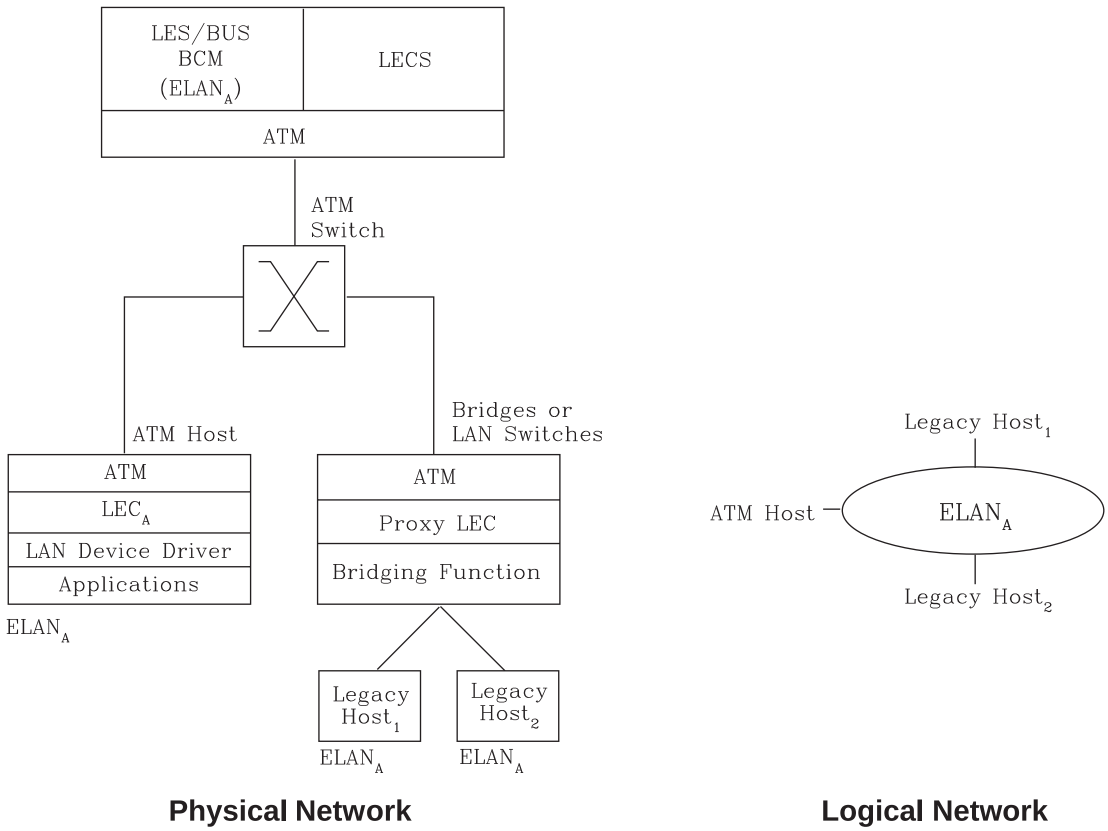



*Figure 19-1. Physical and Logical Views of a Simple LAN Emulation Network*

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.

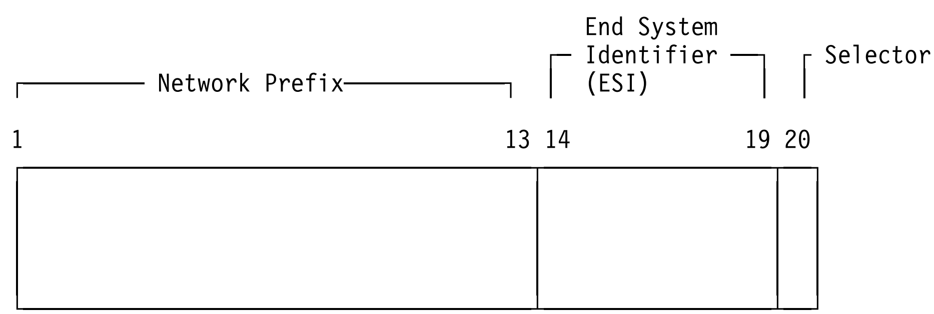
**Broadcast and Unknown Server (BUS)**
A LAN emulation service component responsible for the delivery of multicast and unknown unicast frames.

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 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.

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 server.

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 19-3
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 19-3, 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 server 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 server 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 server.

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 server 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 server 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

   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.

## Sample Situations for Use of the LECS Assignment Policies

The following section offers examples of various LECS assignment policies.

### ATM Address Policy

The LECS permits two types of ATM address policy values. The first type is a variable length ATM address prefix. For example, the policy value (3999999999999900000102, LES_A) means that all LE clients whose ATM address begins with 3999999999999900000102 should be assigned to LES_A.

The second type of ATM address policy value is an ESI and Selector of an ATM address. For example, the policy value (10002345003281, LES_A) means that the LE client with an ESI of 100023450032 and a selector of 81 should be assigned to LES A.

When given the ATM address of an LE client, the LECS searches first for a matching ESI and selector. If no match is returned, the LECS searches for the ATM address prefix policy value with the longest matching prefix. Thus, for example, the above policy value (399999999999990000, LES_B).

ATM address ESI and selector policy values can be used to assign clients to LESs in a manner independent of the LE clients physical location (the ESI and selector is defined locally to the client). ATM address prefixes are the only policy values which indicate any geographic information.

### LAN Destination Policy

LE clients can be assigned to LESs based upon a MAC address or a route descriptor. Because a LAN destination uniquely identifies an LE client in a manner that is independent of geographic location, this policy is useful in ensuring that the LE client is assigned to the correct ELAN regardless of its physical location, for example, retaining the ELAN memberships of a workstation when it is moved from one switch to another.

### ELAN Name Policy

ELAN names are perhaps the most flexible of the assignment criteria. Some of the ways that ELAN name policy values can be used are:

- Use the actual name of the ELAN

  If LES_A serves Elan 1, then create the policy value (Elan 1, LES_A). LE clients specifying Elan 1 in configuration requests will then be assigned to LES_A.

- Use aliases for the ELAN

  For example, all LE clients belonging to members of the Accounting Department could be configured to use the ELAN name *Accounting*, while those belonging to the Engineering Department could use the ELAN name *Engineering*. Depending upon the number of LE clients on the ELANs, these names could be directed to the same ELAN by configuring these policy values:

  ```
  (Accounting,  LES_A)
  (Engineering, LES_A)
  ```

  or to different ELANs by configuring these policy values:

  ```
  (Accounting,  LES_A)
  (Engineering, LES_B)
  ```

  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.
- 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 server 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 19-2; 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 19-11.

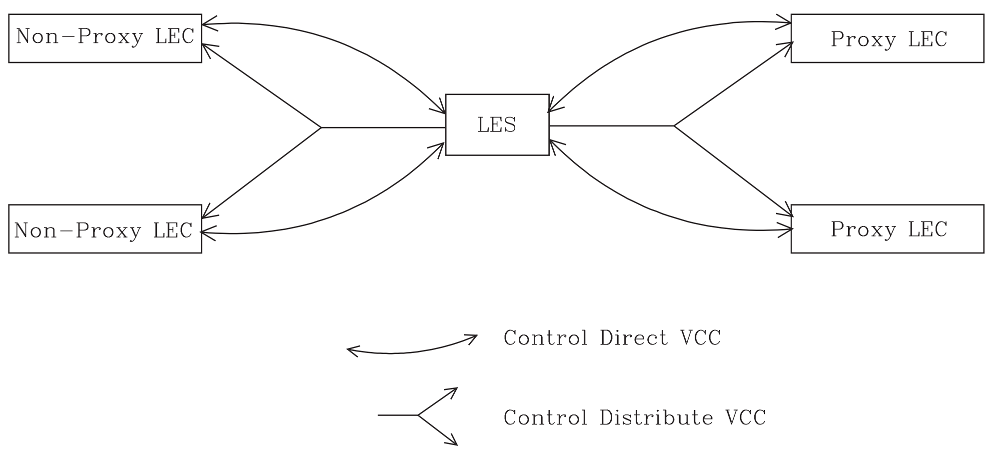



*Figure 19-2. Default Connections Between LE Clients and the LES*

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 19-3 on page 19-12 shows partitioned Multicast Forward VCCs.

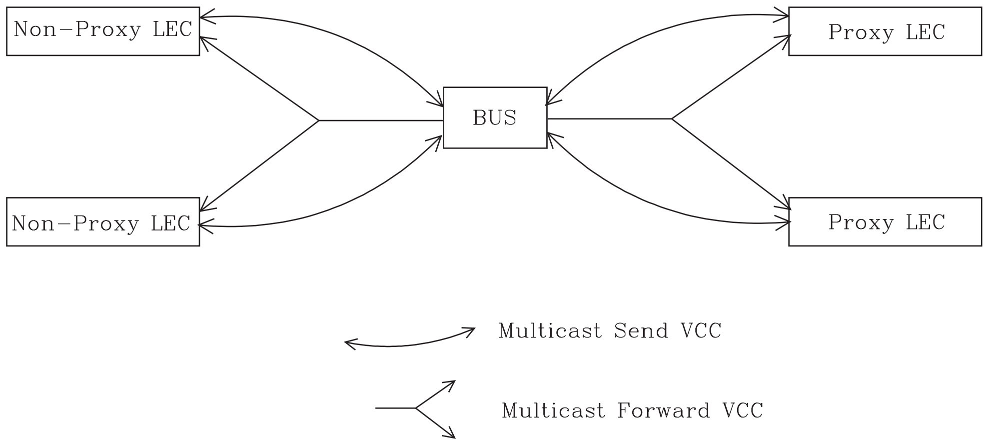



*Figure 19-3. Default Connection Between LE Clients (LECs) and BUS*

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 server 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 server 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 server Extensions for LAN Emulation

IBM has made value-add extensions to ATM Forum LAN Emulation available on the server. 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.

- 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 BetBIOS 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.

**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 server offers an answer in the interim. Figure 19-4 provides a framework for describing the MSS redundancy solution. See the chapter entitled “Configuring”

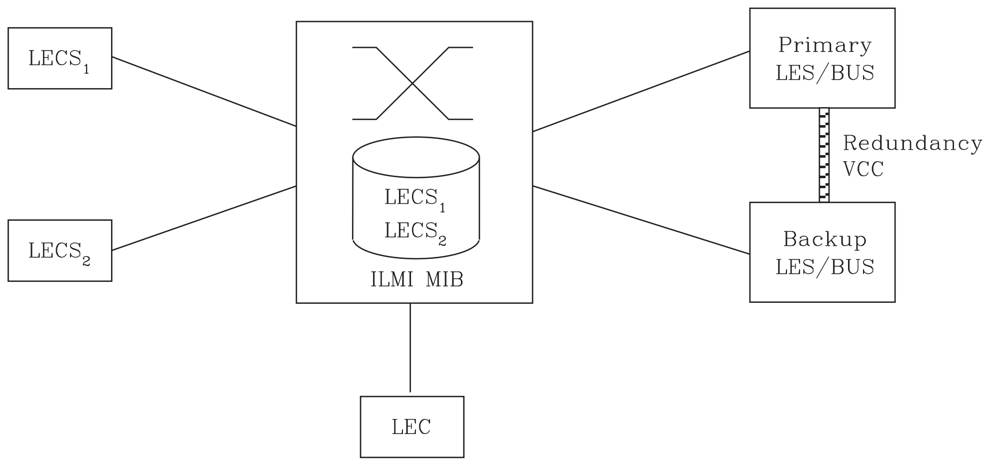



*Figure 19-4. LAN Emulation Redundancy*

Each LES/BUS may be independently configured for redundancy (the default is no 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. For example, LECS 1 and the backup LES/BUS in Figure 19-4 on page 19-16 could be on MSS Server 1, while LECS 2 and the primary LES/BUS could be on MSS Server 2.

Additionally, note that servers need not be dedicated to backup functions, because a single server can host backup LES/BUSs for some ELANs and primary LES/BUSs for other ELANs.

## 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 server. If the LECS is located on the same server, a local interface is used to confirm requests to join without transmitting requests onto the ATM network.

With the LECS interface, the server 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:

1. At the LECS, use ATM addresses to assign clients to the LES. See “Overview of the LECS Function” on page 19-5 for more information.
2. Activate the LECS Interface on the server.
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.

## BUS Monitor

The BUS Monitor provides a way to pinpoint end users who may be over-utilizing the BUS. When enabled, the BUS Monitor periodically samples the traffic sent to the BUS on a particular ELAN. At the end of each sample interval, the BUS Monitor identifies the top users of the BUS by their source MAC addresses, LE client ATM addresses, and the number of sampled frames each of them has sent to the BUS. You can configure the following parameters for the BUS monitor:

- The number of MAC addresses (hosts) to record as top users
- The number of seconds in each sample interval
- The sample rate. The sample rate consists of the fraction of all the frames received that the sample consists of, for example, 1 out of every 100 frames, 1 out of every 10 frames, or every frame.
- The number of minutes between sample intervals

## SuperELAN

SuperELAN is essentially the precursor to LAN Emulation Network to Network (LNNI) specification currently being addressed by the ATM Forum LAN Emulation standards committee. SuperELAN provides distributed LE services for version 1.0 emulated LANs.

A SuperELAN is a collection of emulated LANs. A client on any of the SuperELAN member emulated LANs can set up a data direct VCC to any other client on the SuperELAN. In essence, a SuperELAN emulates a standard ELAN, distributing the LE services among the member ELANs. The reliability and performance of the LE services increases with the number of ELANs. Resource utilization becomes less centralized, allowing a SuperELAN to be much larger than a standard ELAN.

Distributing LE services is accomplished by logically linking together individual ELANs. When ELANs are linked together in a SuperELAN, certain LAN Emulation control frames (such as LE ARP requests and LE ARP responses) and data frames are forwarded between the member ELANs. By forwarding certain LE control frames, clients are able to locate a target client on another ELAN and establish a data direct VCC to it.

Data Direct VCCs between ELANs also utilize the switched fabric of the ATM network. Although each LE server still exhibits a concentration of utilization, no single LE server serves the entire SuperELAN, and network utilization is distributed among the constituent LE servers. Thus, SuperELAN LE Services can serve larger numbers of clients.

Because a SuperELAN is made up of multiple ELANs, reliability is improved. If one LE server fails, other LE servers within the SuperELAN are not affected. Only the inter-ELAN data-direct VCCs to clients in the failed ELAN are affected. In addition, clients that were joined to the failed ELAN can be configured to join one of the other SuperELAN LE services by requesting another LES address from the LECS.

The propagation of broadcast and unknown frames is a major concern within a SuperELAN network. Both types of frames are forwarded to every member ELAN except the ELAN from which the frames were received. This forwarding uses bandwidth on every segment of the network, and, in the case of broadcast frames, causes an interruption at every station.

A SuperELAN is equipped with two additional functions to combat the effects of these frames.

Bridging Broadcast Manager (BBCM) can transform many broadcast frames into unicast frames, thus lessening their effects on network performance. BBCM snoops on packets to learn bindings between layer 3 and layer 2 network addresses. Future broadcast packets to any learned layer 3 address can be transformed into unicast packets and forwarded by the bridge as any other unicast packet. If the transformed unicast address is in the bridge database, then the packet can be forwarded to its destination segment. The packet will not cause an interruption at every station, nor will it utilize bandwidth on every network segment.

Dynamic Protocol Filtering (DPF) also snoops on packets. It learns the different protocols being received on every bridge port. Packets for a particular protocol are not forwarded over ports that are not actively using that protocol. Although many bridges permit filtering based on protocol, DPF performs this filtering automatically based on current traffic.

Refer to the chapter entitled “Bridging Features” in the *Multiprotocol Switched Services (MSS) Configuring Protocols and Features* for more information about BBCM and DPF.

SuperELAN, aided by Bridging Broadcast Manager and dynamic protocol filtering, combine to provide a reliable, distributed, emulated LAN with strong controls on the propagation of broadcast and unknown frames.

## SuperELAN II

SuperELAN II is the enhanced successor to SuperELAN. SuperELAN II supports the following additional new functions:

- Source-Route ATM Token Ring Topologies
- Multiple SuperELANs in a single device
- Independent operation from existing ASRT bridging function

SuperELAN II is based on a source-route aware transparent LAN Emulation bridge technology. LAN Emulation control frames are bridged as described in

"SuperELAN" on page 19-18, and data frames are bridged using the new SuperELAN II bridge path while the data direct VCC is being established. All data frames forwarded between ELANs in the SuperELAN use the transparent MAC and/or Route Descriptor cache to forward non-broadcast unicast traffic. All broadcast frames are treated like Spanning Tree Explorer frames and are forwarded onto every ELAN in SuperELAN Spanning Tree forwarding state.

Each SuperELAN maintains independent MAC, LE Control Frame, BBCM, VLAN, and Route Descriptor (Token Ring only) forwarding caches. Multiple SuperELANs can be bridged together using the ASRT bridging function (This is especially useful for interconnecting Ethernet and Token Ring SuperELANs using SR-TB).

Distributed SuperELANs can be constructed using multiple devices.

The existing SuperELAN support under the ASRT bridging function is still supported. Refer to the chapter entitled "Bridging Features" in the *Multiprotocol Switched Services (MSS) Configuring Protocols and Features* for more information.

BBCM, Dynamic Protocol Filtering VLANs, and MAC filters are all supported in SuperELAN II. Static bridging filters like SAP and or NetBIOS name filters, manual Spanning Tree port control, and IP Host bridge support are not currently supported.

SuperELAN users should review their current network configuration prior to migrating the MSS configuration to SuperELAN II to insure that SuperELAN II meets their network requirements. See "Migration to SuperELAN II" on page 20-6.

## Key Configuration Parameters for LAN Emulation

This section briefly describes the required configuration parameters of the server 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.

2. **LES/BUS**:

   The required parameters for a LES/BUS are the ELAN name, the ELAN type, and the ESI (which you select from a list that includes the burned-in MAC address and any locally-administered values defined for the ATM interface). Defaults are supplied for other parameters.

   The maximum frame size default is 1516 bytes for Ethernet ELANs and 4544 bytes for Token-Ring ELANs. LE clients will not be allowed to join the ELAN if their maximum frame size is less than the maximum frame size of the ELAN; LE clients that have a larger maximum frame size will be allowed to join the ELAN, but will use the maximum frame size of the ELAN as a result of join-time negotiation with the LES.

3. **LECS**:

At a minimum, you must select the LECS ESI and configure a default ELAN assignment policy. See “Overview of the LECS Function” on page 19-5 for more information.

# Chapter 20. 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 20-2
- "ATM Virtual Interface Concepts" on page 20-13

## 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

   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 21-15 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 SuperELAN II Configuration Concepts

The concept of SuperELANs is discussed in the chapter entitled “Bridging Features” in the *Multiprotocol Switched Services (MSS) Configuring Protocols and Features*. Reasons for using SuperELANs for building large ATM LAN Emulation networks can be grouped into two categories:

- Improved ATM LAN Emulation network performance
- Improved ATM LAN Emulation network reliability

Using a SuperELAN to combine multiple ELANs with fewer clients instead of placing all clients on one large ELAN can:

1. Improve VCC setup times since clients can be distributed across multiple LES/BUSes in different switches
2. Reduce the impact of failure of one LES/BUS on network connectivity, since clients in the other ELANs remain active
3. If bridging, improve the inter-ELAN data traffic transmission speed since inter-ELAN data traffic is transmitted at hardware switching speed along a direct path because the software necessary to perform bridging is no longer in the middle of the client-to-client communication.

With the appropriate network design utilizing multiple ATM switches, LES/BUSes, LECSs, and SuperELANs, a high performance redundant ATM LAN Emulation network can be configured to provide reliable high bandwidth communication.

### Configuring a SuperELAN II

Once the LES/BUSes have been configured for each ELAN (LES/BUSes are not required to be located in the same device as the SuperELAN. See Chapter 25, “Using LAN Emulation Services” on page 25-1 for information about configuring LES/BUSes.),

1. Use the SE-SERVICES **add** command to add a SuperELAN.
2. Use the **work** command to select the SuperELAN just added.
3. Add each ELAN to the SuperELAN using the **add elan to superelan** command.

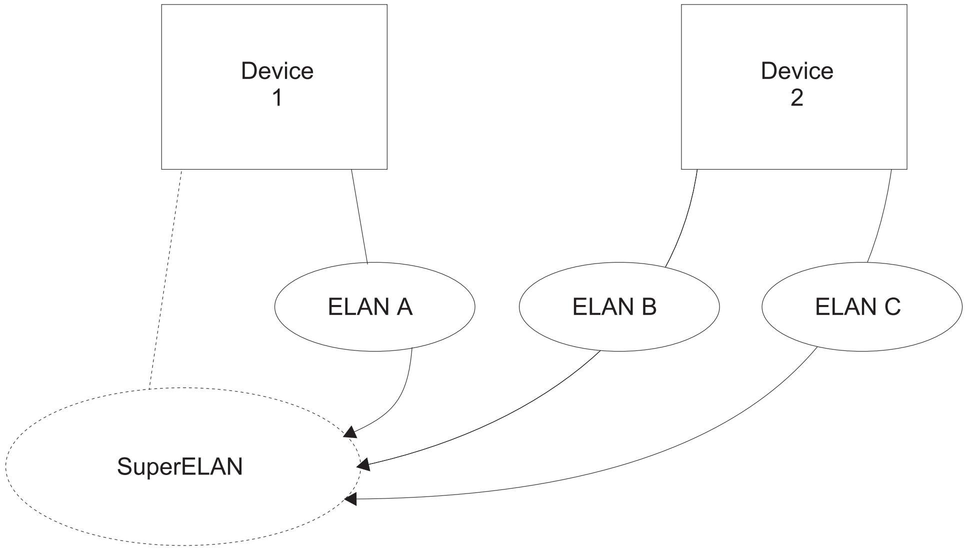



*Figure 20-1. Adding ELANs to Form a SuperELAN*

The **add elan to superelan** command will present a list of locally configured ELANs and an option to add an remotely configured ELAN. Only those ELANs allowed to participate in the SuperELAN will be displayed.

ELANs may not be displayed because:

a. ELAN type does not match the SuperELAN type, either Ethernet or token-ring
b. ELAN frame size does not match the SuperELAN frame size
c. ELAN is on an ATM interface with a different network ID than that of the SuperELAN
d. ELAN is currently configured in another SuperELAN

Remote ELAN configurations must conform to the above four conditions for proper SuperELAN operation.

4. Use the **broadcast-manager**, **set**, and **vlan** commands to tune the SuperELAN.

   Cache parameters, broadcast management, VLAN enablement, and MAC filters may be configured to enhance the performance of the SuperELAN. See the chapter entitled “Using and Configuring MAC Filtering” in *Configuring Protocols and Features* for information about configuring MAC filters.

## SuperELAN II Spanning Tree

Each SuperELAN runs an independent modified-802.1d spanning tree. This insures that there are no SuperELAN loops in the network and that each ELAN receives at most one copy of a unknown unicast, broadcast frame, or LE Control frame. Bridges running a true 802.1d or the Token Ring bridging spanning tree do not participate in the SuperELAN spanning tree nor does the SuperELAN participate in bridging spanning trees. This means that from a bridging spanning tree perspective, the SuperELAN appears as a single network segment. As shown in Figure 20-2 on page 20-4, bridges connected to different ELANs in a SuperELAN and also connected to the same legacy network, either directly or through another bridge, are considered to be in parallel.

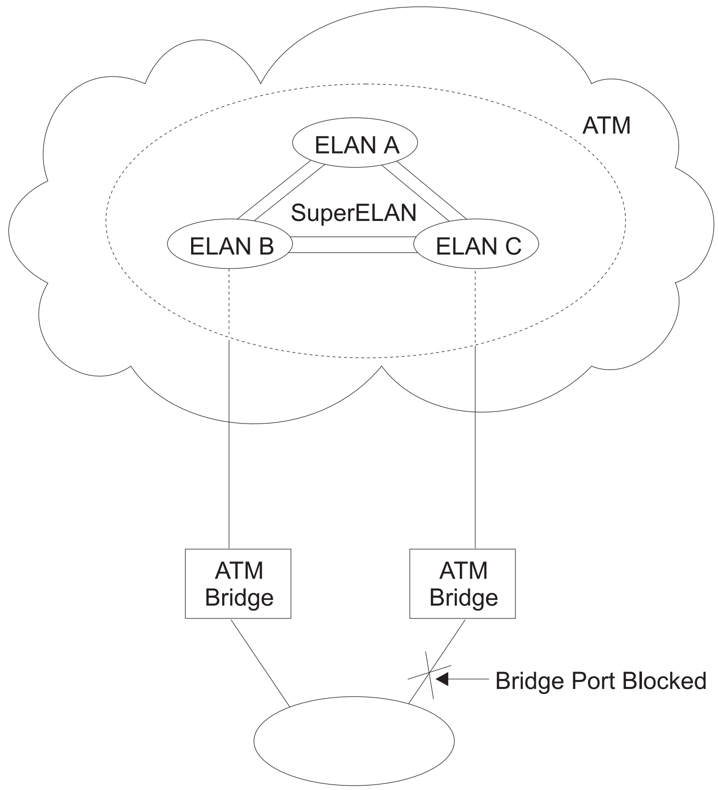



*Figure 20-2. Parallel SuperELANs*

Unlike the 802.1d Spanning Tree Protocol (STP) frames, the destination MAC address of the SuperELAN II STP frames is the all 1's broadcast address instead of the bridge functional address. Therefore, other non-SuperELAN bridges connected to the SuperELAN will forward these STP frames onto other LANs and ELANs. Although harmless, it may be useful to reduce this extraneous traffic by filtering these SuperELAN II STP frames in the other bridges. This can be accomplished by adding a SNAP filter for SNAP header `10005A-80D7` in the other bridges.

## Redundant SuperELANs

Redundant SuperELANs provide inter-ELAN connectivity in the event one or more devices fail. Redundant SuperELANs can be constructed using multiple devices. In Figure 20-3 on page 20-5, a second SuperELAN is added to the second device with the same SuperELAN ID as the first device. Both SuperELANs (which may have different SuperELAN names) contain ELAN A, ELAN B, and ELAN C. One possible SuperELAN spanning tree scenario is shown in Figure 20-4 on page 20-5. If device 1 fails, the SuperELAN forwarding paths 2b and 2c will move to forwarding state from blocked state. Clients joined to ELAN A should return to the LECS and be assigned to either ELAN B or ELAN C. SuperELAN paths 1a, 1b, and 1c will cease to exist. Clients on the SuperELAN may see a short disruption in communication while the SE spanning tree converges, depending on which ELAN they joined and to which clients they were communicating at the time of the failure.

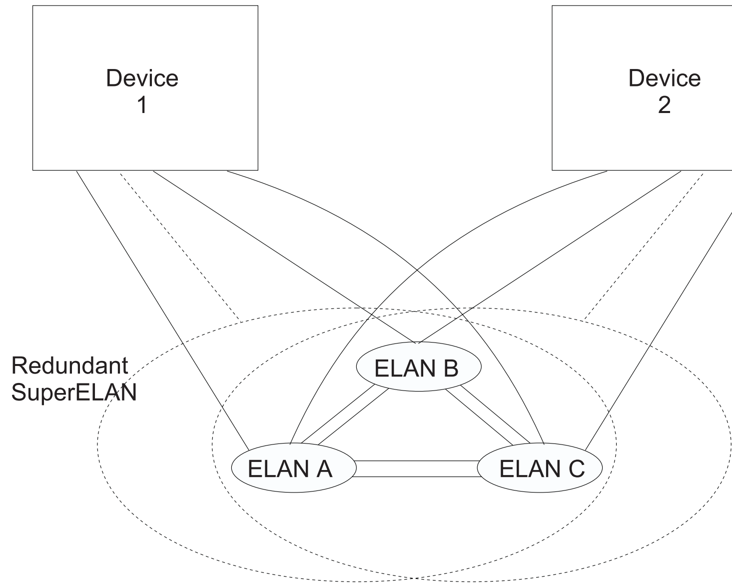



*Figure 20-3. Redundant SuperELAN*

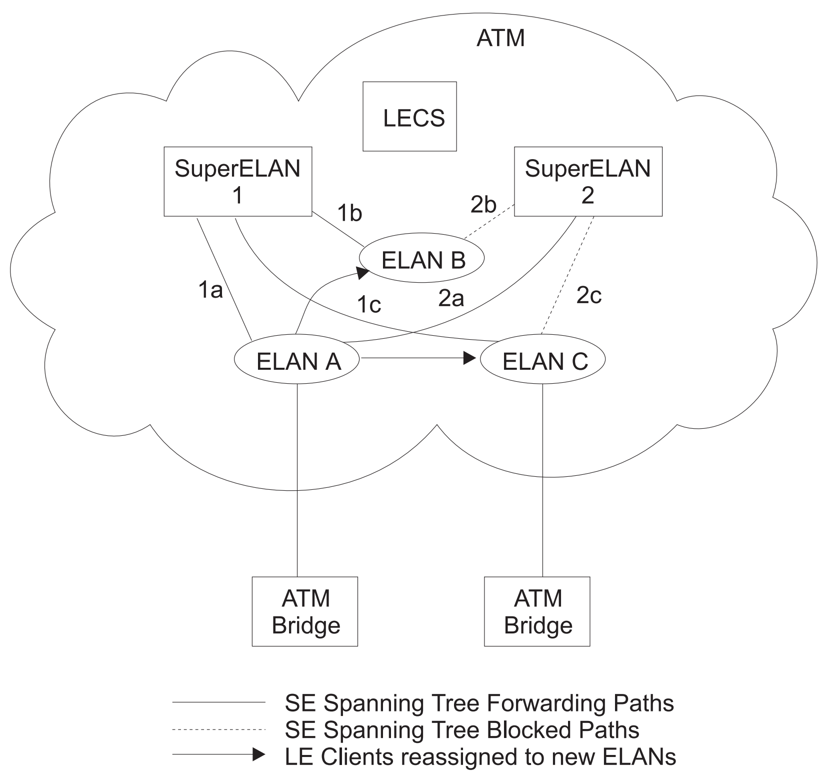



*Figure 20-4. SuperELAN II Spanning Tree*

## Token Ring SuperELANs

Since the SuperELAN concept is based on grouping ELANs to form a single larger super ELAN, Token Ring SuperELANs treat the collection of ELANs as one Token Ring segment. All bridges connected to the SuperELAN should define the SuperELAN segment as the same ring number.

The SuperELAN ring number is not configured but is learned. Once learned, specifically routed frames can be forwarded to the correct ELAN by looking up the next hop in the SuperELAN route descriptor cache. All routes and spanning tree explorer frames are transmitted to every ELAN in forwarding state (provided broadcast manager or VLAN filters have not processed the frame).

## Configuring Routing Protocols on SuperELAN II Interfaces

The following routing protocols are supported on the SuperELAN II interfaces:

- IP
- IPX
- AppleTalk
- Banyan Vines

Layer-2 protocols like APPN and ASRT bridging, are not supported on SuperELAN II interfaces. If connectivity to a SuperELAN using Layer 2 protocols is needed, these protocols should be configured on non-SuperELAN II LECs and the LECs should be configured to 'join' the SuperELAN (any ELAN in the SuperELAN).

## Migration to SuperELAN II

Migration from ASRT SuperELAN to SuperELAN II is provided via the **migrate** command under `SE Services>` configuration command prompt.

Once a configuration is migrated from ASRT SuperELAN to SuperELAN II, there is no automated reverse migration. Although ASRT SuperELAN and SuperELAN II can coexist within an ATM network, they can not coexist on the same device.

# Sample SuperELAN II Configuration

```
Console granted to this interface
Config (only)>net 0
ATM user configuration
ATM Config>inter
ATM interface configuration
ATM Interface Config>add esi   1
ESI in 00.00.00.00.00.00 form []? 000011111111
ATM Interface Config>ex
ATM Config>le-s
LAN Emulation Services user configuration
LE Services config>les 1   2
New ELAN Name (ELANxx) []? tok1
LES-BUS configuration
LES-BUS config for ELAN 'tok1'>add
Turn on Standard Event Logging for LES [yes]
Select ELAN type
        (1) Token Ring
        (2) Ethernet

Enter Selection:  [1]?
Select ESI
        (1) Use burned in ESI
        (2) 00.00.11.11.11.11

Enter Selection:  [1]? 2

Selector x00 is generally reserved for use by the LECS,
Selector x01 is generally reserved for use by the LECS Interface.

Enter selector (in hex) [2]?
Selection "Add LES-BUS" Complete
LES-BUS config for ELAN 'tok1'>set lecid   3
Lower bound of LECID range (in hex) [1]? 100
Upper bound of LECID range (in hex) [FEFF]? 199
New LECID Range: 0x0100 through 0x0199
LES-BUS config for ELAN 'tok1'>ex
```

```
LE Services config>les 1
New ELAN Name (ELANxx) []? tok2
LES-BUS configuration
LES-BUS config for ELAN 'tok2'>add
Select ELAN type
        (1) Token Ring
        (2) Ethernet

Enter Selection:  [1]?
Select ESI
        (1) Use burned in ESI
        (2) 00.00.11.11.11.11

Enter Selection:  [1]? 2

Selector x00 is generally reserved for use by the LECS,
Selector x01 is generally reserved for use by the LECS Interface.

Enter selector (in hex) [3]?
Selection "Add LES-BUS" Complete
LES-BUS config for ELAN 'tok2'>set lecid
Lower bound of LECID range (in hex) [1]? 200
Upper bound of LECID range (in hex) [FEFF]? 299
New LECID Range: 0x0200 through 0x0299
LES-BUS config for ELAN 'tok2'>ex

LE Services config>les 1
New ELAN Name (ELANxx) []? tok3
LES-BUS configuration
LES-BUS config for ELAN 'tok3'>add
Select ELAN type
        (1) Token Ring
        (2) Ethernet

Enter Selection:  [1]?
Select ESI
        (1) Use burned in ESI
        (2) 00.00.11.11.11.11

Enter Selection:  [1]? 2

Selector x00 is generally reserved for use by the LECS,
Selector x01 is generally reserved for use by the LECS Interface.

Enter selector (in hex) [4]?
Selection "Add LES-BUS" Complete
LES-BUS config for ELAN 'tok3'>set lecid
Lower bound of LECID range (in hex) [1]? 300
Upper bound of LECID range (in hex) [FEFF]? 399
New LECID Range: 0x0300 through 0x0399

LES-BUS config for ELAN 'tok3'>ex

LE Services config>ex
```

```
ATM Config>se
SuperELAN Services User Configuration
SE Services config>add     4
SuperELAN Name []? super_tok
SuperELAN ID [0]? 88
  (  1) Ethernet
  (  2) Token-Ring
Type of SuperELAN [2]?
  (  1) 1516
  (  2) 4544
  (  3) 9234
  (  4) 18190
Maximum Frame Size of SuperELAN [2]?
SuperELAN 'super_tok' added.

SE Services config>work      5
  (  1) super_tok
  (  2) << Exit (no selection) >>
SuperELAN Name [1]?
SuperELAN 'super_tok' selected for detailed configuration.
Selected SuperELAN 'super_tok'>add     6
  (  1) << All ELANs >>
  (  2) tok1
  (  3) tok2
  (  4) tok3
  (  5) << Remote ELAN >>
  (  6) << Exit (no selection) >>
ELAN Name [1]? 1
ELAN 'tok1' added to SuperELAN 'super_tok'.
ELAN 'tok2' added to SuperELAN 'super_tok'.
ELAN 'tok3' added to SuperELAN 'super_tok'.
```

```
Selected SuperELAN 'super_tok'>list    7
------ SuperELAN Configuration -------
SuperELAN Name:          super_tok
Type:                    Token Ring
Mode:                    Enabled
Associated ATM Net       0
Frame Size:              4544
SuperELAN ID:            88

------- ELAN Cache Parameters --------
MAC Filter Cache Age:    300
MAC Filter Cache Size:   1000
RD Filter Cache Age:     1800

------ Spanning Tree Parameters ------
SuperELAN Address:       000000000000
Max Age:                 20
Hello Time:              2
Forward Delay:           15
Priority:                32768

----- Packet Tracing Parameters ------
Packet Tracing:          Disabled
Trace Dest Addr Mask:    000000000000
Trace Dest Addr Value:   000000000000
Trace Source Addr Mask:  000000000000
Trace Source Addr Value: 000000000000

----- VLAN Configuration Summary -----
                  (Enabled/Configured)
IP VLANs:                0/0
IPX VLANs:               0/0
NetBios VLANs:           0/0
Sliding Window VLANs:    0/0
Mac Address VLANs:       0/0

-------- Broadcast Management --------
IP:                      Enabled
NetBIOS Dupl. Filter:    Disabled
NetBIOS Route Caching:   Disabled
```

```
Selected SuperELAN 'super_tok'>elans      8
SuperELAN Name:          super_tok

Mode E=Enabled/D=Disabled
| SuperELAN Port Number
|   |   MSS Server Interface Number
|   |     |  ELAN Services Location
|   |     |     |    Spanning Tree Priority
|   |     |     |      |  Spanning Tree Path Cost
|   |     |     |      |    |
v   v     v     v      v    v    ELAN Name
- ----- ----- ------  --- -----  --------------------------------
E     1     1  Local  128 32768  tok1
E     2     2  Local  128 32768  tok2
E     3     3  Local  128 32768  tok3


Selected SuperELAN 'super_tok'>br       9
Enter Bridge Broadcast Manager Protocol:  IP or NetBIOS  [IP]?

IP Bridge Broadcast Manager User Configuration

IP B-BCM 'super_tok' config>ena        10
IP Bridge Broadcast Manager is   ENABLED

IP B-BCM 'super_tok' config>ex

Selected SuperELAN 'super_tok'>vlan      11

VLAN filter configuration
VLAN config>add sliding-window          12
Enter filter base (MAC or INFO) [MAC]?
Enter window filter offset (0-255) [0]? 6
Enter compare value in hex (1-10 bytes) []? 10005A000000
Enter compare mask in hex (6 bytes) [ffffffffffff]? 7fffff000000
Configure This VLAN on Specific Bridge Ports? [No]:
Age (expiration in minutes,0=infinity) [5000]?
Track Active Mac Addresses on this VLAN? [No]: y
Enable This Filter? [Yes]:
VLAN Name (Required, 32 chars max) []? IBM Mac Addresses
VLAN 'IBM Mac Addresses' (Sliding Window) successfully added
```

```
VLAN config>list sliding all              13

   --------------- SLIDING WINDOW VLANS ----------------

   Compare Value               = 0x10005A000000
   Compare Mask                = 0x7FFFFF000000
   Offset Length and Type      = 6 (MAC)
   Port  1 (Interface  1)      = Auto-Detect and Include
   Port  2 (Interface  2)      = Auto-Detect and Include
   Port  3 (Interface  3)      = Auto-Detect and Include
   Age (expiration in minutes) = 5000
   Tracking of Mac Addresses   = Enabled
   VLAN Filter State           = Enabled
   VLAN Name                   = IBM Mac Addresses
VLAN config>add mac-address               14
Configure This VLAN on Specific Bridge Ports? [No]:
Age (expiration in minutes,0=infinity) [5000]?
Track Active Mac Addresses on this VLAN? [No]:
Enable This Filter? [Yes]:
VLAN Name (Required, 32 chars max) []? Finance Dept
VLAN 'Finance Dept' (MAC Address) successfully added
VLAN config>add address                   15

Choice of Mac Address VLAN:
       VLAN Name
       =========
   (1) Finance Dept
Enter Selection [1]?
Enter New Mac Address in Hex: []? 40005A000001
New MAC Address For VLAN 'Finance Dept' successfully added
VLAN config>add address

Choice of Mac Address VLAN:
       VLAN Name
       =========
   (1) Finance Dept
Enter Selection [1]?
Enter New Mac Address in Hex: []? 40005A000002
New MAC Address For VLAN 'Finance Dept' successfully added
VLAN config>add address

Choice of Mac Address VLAN:
       VLAN Name
       =========
   (1) Finance Dept
Enter Selection [1]?
Enter New Mac Address in Hex: []? 40005A000003
New MAC Address For VLAN 'Finance Dept' successfully added
```

```
VLAN config>list mac by              16

Choice of Mac Address VLAN:
       VLAN Name
       =========
   (1) Finance Dept
Enter Selection [1]?

   ---------------- MAC ADDRESS VLAN -------------------

   Mac Address #1             = 40.00.5A.00.00.01
   Mac Address #2             = 40.00.5A.00.00.02
   Mac Address #3             = 40.00.5A.00.00.03
   Port  1 (Interface  1)     = Auto-Detect and Include
   Port  2 (Interface  2)     = Auto-Detect and Include
   Port  3 (Interface  3)     = Auto-Detect and Include
   Age (expiration in minutes) = 5000
   Tracking of Mac Addresses   = Disabled
   VLAN Filter State           = Enabled
   VLAN Name                   = Finance Dept
VLAN config>ex
Selected SuperELAN 'super_tok'>ex

SE Services config>list       17
Number of configured SuperELANS: 1

Mode E=Enabled/D=Disabled                                       BCM
| ATM Interface Net Number                                      IP
|   |  Type E=Ethernet/T=Token Ring                             | NetBIOS
|   |   |                                                       | |
v   v   v SuperELAN Name                  ID    #ELANs #VLANs v v
- ----- - ------------------------------- ----- ------ ------ - -
E     0 T                       super_tok    88      3      2 Y N
```

**1** Add ESI to ATM Interface
**2** Add all LES/BUSes that will be included in the SuperELAN
**3** Set LEC ID range for each ELAN so that all LEC IDs in the SuperELAN will be unique
**4** Add SuperELAN
**5** Work on the SuperELAN
**6** Add ELANs to the SuperELAN
**7** List the SuperELAN configuration
**8** Show the configured ELANs in the SuperELAN
**9** Move to the BCM menu
**10** Add IP Broadcast Management to the SuperELAN
**11** Move to the VLAN menu
**12** Add Sliding-Window VLAN to SuperELAN
**13** List the Sliding-Window VLAN configuration
**14** Add MAC-Address VLAN to SuperELAN
**15** Add MAC Addresses to MAC-Address VLAN
**16** List the MAC-Address VLAN
**17** List summary of SuperELAN configuration

## 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 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 re-assembly 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.

**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 21. 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

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 7, “The OPCON Process and Commands” on page 7-1.) 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.

   If ATM is not specified as an interface, enter the **add device atm** command.

   ```
   Config> add dev atm
   Device Slot x(0-3) 0?
   Adding CHARM ATM Adapter device in slot 0 port 1 as interface xx
   (where xx is the interface number assigned)
   ```

   **Note:** You can define two ATM interfaces on an IBM 8210 Multiprotocol Switched Services Server but only one on a IBM Nways Multiprotocol Switched Services (MSS) Server Module for an 8260/8265.

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

   ```
   Config> network 0
   ATM Config>
   ```

   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 21-1. 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 2-3. |
| INTERFACE | Displays the `ATM Interface Config>` prompt from which you can list, change, or configure the ATM Interface.<br>• Add an ESI.<br>• List the current configuration or list ESIs.<br>• Remove an ESI.<br>• Set parameters of the ATM network.<br>• Enable or disable an ESI.<br>• Exit |
| LE-SERVICES | Displays the `LE Services Config>` prompt from which you can list, change, or configure LAN Emulation Services as described in Chapter 25, "Using LAN Emulation Services" on page 25-1 .<br>• LECS displays the `LECS Config>` prompt from which you can configure a LAN Emulation Configuration Server.<br>• LES-BUS displays the `LES-BUS config for ELAN 'x'>` prompt from which you can configure a LAN Emulation Server — Broadcast and Unknown Server (LES-BUS).<br>• List all LES-BUS names.<br>• SECURITY (LES/LECS INTERFACE TO VALIDATE JOINS) displays the `LECS Interface Config>` prompt from which you can list, change, or configure security between the LECS and LES-BUS pairs. |
| SE-SERVICES | Displays the `SE Services Config>` prompt from which you can list, change, or configure SuperElan Services. |
| 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 23, "Using LAN Emulation Clients" on page 23-1.<br>• Add a LAN Emulation Client (LEC) for a token-ring or Ethernet emulated LAN.<br>• Configure a LEC by network #. This command displays the `LE Config>` prompt, from which you can configure a specific LAN Emulation Client (LEC).<br>• List LAN Emulation Clients (LECs).<br>• 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 21-8 |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## 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 21-2. 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 2-3. |
| 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 21-4. |
| 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 2-3. |

## 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 a 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 21-5.

**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
```

**ESIs** Lists the ESIs in the ATM configuration.

**Example:** **`list esi`**

```
ATM INTERFACE> list esi

        ESI                 Enabled
------------------------    -------
000000000009                   YES
000000000100                   YES
```

## 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 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, LES/BUS, LECS, LECS Interface, 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 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.

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, CIP clients,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
```

**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

**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:**

en**able** 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:** d**isable** esi *esi-address*

esi *esi-address*

Address of End Sytem 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 21-3. 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 2-3. |
| 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 2-3. |

## 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 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 7, "The OPCON Process and Commands" on page 7-1.) 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 21-4. 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 2-3. |
| 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 21-11. |
| LE-SERVICES | Displays the `LE Services+` prompt from which you can monitor LAN Emulation Services as described in Chapter 26, “Configuring and Monitoring LAN Emulation Services” on page 26-1. |
| SE-SERVICES | Displays the `SE Services+` prompt from which you can monitor SuperELAN Services as described in “Accessing SE-Services Monitoring Process” on page 22-16. |
| 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 2-3. |

## Interface

Displays the `ATM Interface+` prompt, described in “ATM Interface Monitoring Commands (ATM INTERFACE+ Prompt).”

**Syntax:**

**interface**

## LE-Services

Displays the `LE Services+` prompt. Refer to Chapter 26, “Configuring and Monitoring LAN Emulation Services” on page 26-1.

**Syntax:**

**le-services**

## ATM-LLC

Displays the `ATM-LLC+` prompt, described in “ATM-LLC Monitoring Commands” on page 21-15.

**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 21-5. 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 2-3. |
| List | Lists ATM addresses and VCCs. |
| Trace | Starts/Stops packet tracing on a specified VPI/VCI 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 2-3. |

## 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
----------------------------------------  -------------------------------------
39999999999999900009999020000041347391804  LEC 1 'eth1'
39999999999999900009999020000041347391802  LES/BUS 'eth1'
```

**all** Lists all of the following:

- Addresses
- 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:**

```
ATM Interface+ list vccs
                       VCCs
 VPI  VCI   Hndl   Type    FrmXmt     FrmRcv     ByteXmt    ByteRcv
 --- ----- ----- ------- ---------- ---------- ---------- ----------
   0   142    17    P-MP         0          0          0          0
 Name = BUS Mcast Fwd on 'eth1'

   0   143    19    P-MP         0          0          0          0
 Name = LEC 1 (LECID 0001) Mcast Fwd 'eth1'

   0   138    13  B0-139         1          0         62          0
 Name = LEC 1 (LECID 0001) Mcast Send 'eth1'

   0   139    16  B0-138         0          1          0         62
 Name = BUS Mcast Send LECID 0001 on 'eth1'

   0   134     9    P-MP         0          0          0          0
 Name = LES Cntrl Dist on 'eth1'

   0   135    11    P-MP         0          0          0          0
 Name = LEC 1 (LECID 0001) Cntrl Dist 'eth1'

   0   130     5     P-P         2          2        216        216
 Name = LEC 1 (LECID 0001) Cntrl Dir 'eth1'

   0   131     7     P-P         2          2        216        216
 Name = LES Cntrl Dir LECID 0001 on 'eth1'

   0     5     1    SAAL      2592       2592      27380      27036
 Name = SAAL

   0    16     2    ILMI       545        544      23646      35030
 Name = ILMI

VCC Totals: 4 point-to-point, 4 point-to-multipoint
ATM Interface+
```

*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 16-29.

**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
```

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: [ABCDEFGHIJKLMNOPQRSTUVWXYZ123456]?
```

**stop** Stops the wrap procedure and displays final wrap statistics.

## ATM-LLC Monitoring Commands

This section explains the commands for monitoring ATM LLC multiplexing.

Enter the commands at the `ATM-LLC+` prompt.

*Table 21-6. 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 2-3. |
| List | Lists various options |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## 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” for additional information.

# Chapter 22. SuperELAN Services

This chapter describes the SuperELAN Services configuring and monitoring commands and includes the following sections:



## Accessing the SuperELAN II Configuration Process

From the `ATM Config>` prompt of a selected real ATM interface, use the **se-services** command to access the `SE Services config>` prompt for SuperELAN configuration command mode.

You can also access the `SE Services config>` prompt for SuperELAN configuration command mode by issuing the **protocol se** command from the `Config>` prompt.

## SuperELAN II Configuration Commands

This section summarizes the SuperELAN configuration commands. Enter the commands at the `SE Services config>` prompt.

*Table 22-1. SuperELAN 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 2-3. |
| ADD | Adds a SuperELAN. |
| DELETE | Deletes a SuperELAN configuration. |
| LIST | Lists the current configured SuperELANs. |
| MIGRATE | Migrates older ASRT SuperELAN configurations to the current SuperELAN II operational release code level. |
| RENAME | Renames a SuperELAN. |
| WORK with SuperELAN | Allows you to work with the SuperELAN configuration. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## Add

Use the **add** command to add a SuperELAN. A new Super ELAN is added to the corresponding ATM real interface (the `ATM>` configuration menu from which this SuperELAN configuration menu is accessed).

Even though a SuperELAN is directly associated with a single ATM Adapter, a SuperELAN can span multiple ATM Adapters provided the *ATM Adapter network ID* for all ATM Adapters on which the SuperELAN resides have the same value. The *ATM Adapter network ID* is a configurable parameter which identifies the ATM network to which the ATM adapter is attached. Therefore, if two ATM Adapter interfaces are configured with different ATM network IDs, a SuperELAN can not be configured to span both ATM interfaces since short-cut VCCs could not be established between ELANs on the two ATM networks.

**Syntax:**

**add**

**Example:**

```
SE Services config>add
SuperELAN Name [] super_test_elan
SuperELAN ID [1] 6
  (  1) Ethernet
  (  2) Token-Ring
Type of SuperELAN [2]
  (  1) 1516
  (  2) 4544
  (  3) 9234
  (  4) 18190
Maximum Frame Size of SuperELAN [2]
SuperELAN 'super_test_elan' added.
```

# Delete

Use the **Delete** command to delete a SuperELAN. If you do not specify an SuperELAN index number, a list of configured SuperELANs will be displayed. You can select from the list the SuperELAN you want to delete.

**Syntax:**

**delete** *superelan#*

**Example:**

```
SE Services config>del
  (  1) << All ELANs >>
  (  2) super_eth
  (  3) << Exit (no selection) >>
SuperELAN Name [1] 3
No action taken.
```

# List

Use the **list** command to list all configured SuperELANs defined on all real ATM interfaces.

**Syntax:**

**list**

**Example:**

```
SE Services config>list
Mode E=Enabled/D=Disabled                                      BCM
| ATM Interface Net Number                                     IP
|   |  Type E=Ethernet/T=Token Ring              Proxy LE ARP    | NetBIOS
|   |   |                                        |               | |
v   v   v SuperELAN Name                   ID    v #ELANs #VLANs v v
- ----- - ------------------------------- ----- - ------ ------ - -
E     0 T                       super_tok    88 N      3      0 N N
E     1 E                       super_eth    77 N      3      2 Y N
```

## Migrate

Use the **migrate** command to migrate an existing ASRT SuperELAN configuration to the current SuperELAN II operational release code level.

The previously available SuperELAN I was based on the MSS Server ASRT bridge. The new SuperELAN II runs independently of the MSS Server ASRT bridge. MSS Server 2.0.1 supports SuperELAN I as well as SuperELAN II. However, the MSS Server can be configured as SuperELAN I or SuperELAN II, but not both. A migration utility is provided from the MSS Server console to migrate a SuperELAN I configuration to SuperELAN II.

**Note:** The **migrate** utility is only available from the MSS Server console and the web interface. It is not available from the MSS Server Configuration Program. If you plan to use the Configuration Program to manage MSS Server configurations:

1. Migrate the SuperELAN I configuration using the **migrate** command as described in this section
2. Retrieve the updated configuration from the MSS Server using the Configuration Program and save it as a `cdb` file.

Migration to SuperELAN II is provided via the command under the SuperELAN configuration menu. The **migrate** command will scan the ASRT bridge configuration records and migrate any ports which are enabled for SuperELAN I. You will be prompted to enter additional SuperELAN information for each ASRT port that can be migrated to SuperELAN II.

Prior to invoking the **migrate** command, you should:

1. Backup the original configuration
2. Have the following information available for each current ASRT port enabled for SuperELAN I:
   a. The ELAN which the ASRT port LEC joins
   b. The location of the ELAN relative to this MSS Server( the ELAN's LES/BUS is in this local MSS Server or in a remote MSS Server .

To migrate the existing configuration:

1. At the * prompt, enter **talk 6**.
2. At the `Config>` prompt, enter **net 0**. (if 0 is the ATM interface)
3. At the `ATM Config>` prompt, type **se-services**.
4. At the `SE Services Config>` prompt, type **migrate**.

After migration is complete, the migrated ASRT configuration records are updated and new SuperELAN records are added. Migrated changes will become effective after the new configuration is saved and the MSS Server is restarted.

Use the **migrate** command to migrate an existing ASRT SuperELAN configuration to the current SuperELAN II operational release code level.

The **migrate** command can only be invoked when an ASRT SuperELAN configuration is present. Once migrated to SuperELAN II, there is no migration path back to the ASRT SuperELAN configuration.

**Syntax:**

**migrate**

**Example:**

```
* talk 6
Config> net 0
ATM Config> se-services
SE Services Config> migrate
SuperELAN ID:22     SuperELAN Name: []? star backbone
SuperELAN will be added to ATM Interface Number []?
  ASRT Port:1    Ifc:1     Is Port's LEC joined to Remote ELAN? [No]:
  ELAN Name (if Local must match LES/BUS Name): []? chicago
  ASRT Port:2    Ifc:2     Is Port's LEC joined to Remote ELAN? [No]:
  ELAN Name (if Local must match LES/BUS Name):[]  tulsa
  ASRT Port:3    Ifc:3     Is Port's LEC joined to Remote ELAN? [No]: yes
  ELAN Name (if Local must match LES/BUS Name): []? baltimore

Migrate ASRT SuperELAN ID 22 to SuperELAN II 'star backbone'
  ASRT Port: 1    Interface: 1    Remote ELAN: No   ELAN Name: chicago
  ASRT Port: 2    Interface: 2    Remote ELAN: No   ELAN Name: tulsa
  ASRT Port: 3    Interface: 3    Remote ELAN: Yes  ELAN Name: baltimore

The above ASRT ports will be migrated, do you want to continue? [Yes]:
Adding SuperELAN star backbone, ID=22
SuperELAN 'star backbone' added.
ELAN 'chicago' added to SuperELAN 'star backbone'
ELAN 'tulsa' added to SuperELAN 'star backbone'
ELAN 'baltimore' added to SuperELAN 'star backbone'
Migration complete.
Please write config and reboot for migration to take effect.

SE Services Config>list
Number of configured SuperELANS: 1

Mode E=Enabled/D=Disabled                                       BCM
  ATM Interface Net Number                                     IP
     Type E=Ethernet/T=Token Ring            Proxy LE ARP       NetBIOS

v  v  v SuperELAN Name                   ID    v #ELANs #VLANs v v
- --- - ------------------------------- ----- - ------ ------ - -
E   0 E                  star backbone    22 N      3      0 N N
SE Services Config> w
  (  1) star backbone
  (  2) << Exit (no selection) >>
SuperELAN Name [1]?
SuperELAN 'star backbone' selected for detailed configuration.

SuperELAN 'star backbone' Config> elan
SuperELAN Name:          star backbone

Mode E=Enabled/D=Disabled
  SuperELAN Port Number
        MSS Server Interface Number
             ELAN Services Location
                     Spanning Tree Priority
                          Spanning Tree Path Cost

v   v     v     v      v    v    ELAN Name
- ----- ----- ------  --- -----  --------------------------------
E     1     1  Local  128 32768  chicago
E     2     2  Local  128 32768  tulsa
E     3     3 Remote  128 32768  baltimore
```

## Rename

Use the **rename** command to rename a SuperELAN.

**Syntax:**

**rename**

**Example:**

```
SE Services config>rename
  (  1) super_eth
  (  2) super_test_elan
  (  3) << Exit (no selection) >>
ELAN Name [1] 2
ELAN Name [super_test_elan] super_tok
Renamed ELAN 'super_test_elan' to 'super_tok'
```

## Work with SuperELAN

Use the **Work with SuperELAN** command to select a SuperELAN for detailed configuration. Use this command to access the `Selected SuperELAN 'x'>` prompt so that you can provide detailed configuration of SuperELAN x.

**Syntax:**

**work** *superelan#*

**Example:**

```
  SE Services config> work
  (  1) super_eth
  (  2) super_tok
  (  3) << Exit (no selection) >>
ELAN Name [1] 2
ELAN 'super_tok' selected for detailed configuration.
```

# Selected SuperELAN Configuration

This section describes the selected SuperELAN detailed configuration commands. Enter the commands at the `Selected SuperELAN 'x'>` prompt.

| *Table 22-2. Selected SuperELAN 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 2-3. |
| ADD ELAN to SuperELAN | Adds an ELAN to a SuperELAN. |
| BROADCAST-MANAGER | Enters the Broadcast Manager configuration menu. |
| DELETE ELAN from SuperELAN | Deletes an ELAN from a Super ELAN configuration. |
| DISABLE SuperELAN | Disables a Super ELAN configuration. |
| ELANs | Lists an ELAN configuration on the selected SuperELAN. |
| ENABLE SuperELAN | Enables a Super ELAN configuration. |
| LIST | Lists the current configured SuperELAN. |
| SET | Sets the value of configuration parameters associated with the selected ELAN. |
| TRACE | Allows tracing of packets for a SuperELAN. |
| VLANS | Enters the VLANS configuration menu. |
| WORK with ELAN | Allows you to work with the selected ELAN configuration. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

# Add ELAN to SuperELAN

Use the **ADD ELAN to SuperELAN** command to add an ELAN to the selected SuperELAN.

Both local and remote ELANs may be added. Local ELANs represent LES/BUSes defined in the same device as the SuperELAN. Remote ELANs represent LES/BUSes defined in other devices.

**Syntax:**

**add**

**Example:**

```
Selected SuperELAN 'setest'>add

  (  1) << All ELANs >>
  (  2)  eth1
  (  3)  eth2
  (  4)  eth4
  (  5) << Remote Ethernet ELAN >>
  (  6) << Exit (no selection) >>
ELAN Name [1]? 5
Remote ELAN Name []? ext ethernet elan
Connect to remote ELAN via LECS? [Yes]: no
Remote ELAN LES Address []? 3999999999999900009999020044444455555502
ELAN 'ext ethernet elan' added to SuperELAN 'super_eth'
```

The listed ELANs are locally defined and are eligible to be added to a SuperELAN. Selecting << *All ELANs* >> adds all listed ELANs to the selected SuperELAN. Selecting <<*Remote ELAN* >> allows you to add a remotely defined ELAN configuration to the selected SuperELAN.

## Broadcast-Manager

Use the **broadcast-manager** command to access the `BBCM >` configuration prompt. Refer to the chapter entitled “Configuring Bridging” in the Multiprotocol Switched Services (MSS) Configuring Protocols and Features for additional information.

## Delete ELAN from SuperELAN

Use the **Delete ELAN from SuperELAN** command to delete an ELAN from a SuperELAN configuration. All ELANs in the selected SuperELAN will be listed and you can select from that list the ELAN you want to delete.

**Syntax:**

<u>de</u>**lete** *n*

**Example:**

```
Selected ELAN 'super_tok'>delete
  (  1) << All ELANs >>
  (  2) tok1
  (  3) tok2
  (  4) tok3
  (  5) << External ELAN >>
  (  6) << Exit (no selection) >>
ELAN Name [1] 2
ELAN 'tok1' deleted from to ELAN 'super_tok'.
```

## Disable

Use the **disable** command to disable the selected SuperELAN.

Once the SuperELAN is started, it can be enabled from the `talk 5` monitoring menu by issuing the **enable** command from the `Selected SuperELAN 'x'` prompt. See “Enable” on page 22-19 for more information.

**Syntax:**

<u>di</u>**sable**

**Example:**

```
Selected SuperELAN 'super_eth'>disable
SuperElan 'super_eth' is disabled.
```

## ELANs

Use the **elans** command to list the configured ELANs on the selected SuperELAN.

**Syntax:**

<u>el</u>**ans**

**Example:**

```
Selected SuperELAN 'super_eth'>elans
SuperELAN Name:          super_eth

Mode E=Enabled/D=Disabled
| SuperELAN Port Number
|   |   MSS Server Interface Number
|   |     |  ELAN Services Location
|   |     |     |    spanning tree Priority
|   |     |     |      |  spanning tree Path Cost
|   |     |     |      |    |
v   v     v     v      v    v    ELAN Name
- ----- ----- ------  --- -----  --------------------------------
E     1     5  Local  128 32768  eth1
E     2     6  Local  128 32768  eth2
E     3     7  Local  128 32768  eth3
```

## Enable

Use the **enable** command to enable the selected SuperELAN.

**Syntax:**

en**able**

**Example:**

```
Selected SuperELAN 'super_eth'>enable
SuperElan 'super_eth' is enabled.
```

## List

Use the **list** command to list a configured SuperELAN.

**Syntax:**

l**ist**

**Example:** `list`

```
------ SuperELAN Configuration -------
SuperELAN Name:         super_eth
Type:                   Ethernet
Mode:                   Enabled
Associated ATM Net      0
Frame Size:             1516
SuperELAN ID:           3

-------- ELAN Cache Parameters -------
MAC Filter Cache Age:   300
RD Filter Cache Age:    1800  1
Maximum MAC Cache Size: 1000

------ spanning tree Parameters ------
SuperELAN Address:      000000000000
Max Age:                20
Hello Time:             2
Forward Delay:          15
Priority:               32768

----- Packet Tracing Parameters ------
Packet Tracing:          Disabled
Trace Dest Addr Mask:    000000000000
Trace Dest Addr Value:   000000000000
Trace Source Addr Mask:  000000000000
Trace Source Addr Value: 000000000000

----- VLAN Configuration Summary -----
                   Enabled/Configured
IP VLANs:                1/1
IPX VLANs:               0/0
NetBios VLANs:           0/0
Sliding Window VLANs:    1/1
Mac Address VLANs:       0/0

-------- Broadcast Management --------
IP:                      Enabled
NetBIOS Dupl. Filter:    Disabled
NetBIOS Route Caching:   Disabled
```

**Note:**

**1** This field does not appear for Ethernet SuperELANs.

## Set

Use the **set** command to set ELAN parameters on the selected SuperELAN.

**Syntax:**

| | |
|---|---|
| **set** | address |
| | cache age |
| | cache size |
| | duplicate-mac tracking |
| | frame |
| | proxy-le-arp |
| | spanning |
| | super-elan-id |

**Example:**

```
Selected SuperELAN 'super_eth'>set ?
ADDRESS of SuperELAN spanning tree Node
CACHE
DUPLICATE-MAC Tracking
FRAME Size
PROXY-LE-ARP
SPANNING Tree Parameters
SUPER-ELAN ID
```

The following parameters can be specified with the **set** command:

**address** Identifies the SE spanning tree address used for constructing the SuperELAN spanning tree.

**Default Value**: the lowest MAC address for all ELAN interfaces in the SuperELAN

**cache** This parameter sets the MAC cache age and size. For a Token-ring SuperELAN, this parameter also sets the route-descriptor cache age.

**Example:**

```
Selected SuperELAN 'super_tok'>set cache ?
AGE
SIZE
Selected SuperELAN 'super_tok'>set cache age
MAC Filter Cache Age (60-3600 seconds) [300]? 400
RD Filter Cache Age (600-65535 seconds) [1800]? 900
Cache Age parameters set for SuperELAN 'super_tok'.
```

**duplicate-mac**

This parameter allows duplicate MAC addresses to be used with port-based VLANs.

If enabled, a single MAC address may be associated with multiple ports in the SuperELAN bridge. It is recommended that this option be disabled. If enabled, you should configure Port-based VLANs to ensure that only a single copy of any MAC address is visible to any station. Extreme caution is required in the network design because duplicate MAC addresses are not generally supported in bridged environments.

**Example:**

```
Selected SuperELAN 'super_tok'>set duplicate-mac ?
ON
OFF
```

**frame** Sets the SuperELAN frame size. Only ELANs matching the SuperELAN frame size can be configured in the SuperELAN.

**spanning tree parameters**

Sets the SuperELAN spanning tree parameters:

**Priority** Indicates the SuperELAN short-cut bridge spanning tree priority. A lower value will increase the likelihood of a SuperELAN short-cut bridge becoming the root. This value is prefixed to the SuperELAN spanning tree MAC Address to form a SuperELAN short-cut bridge ID.

**Valid Values**: 0 - 65535

**Max age** The age at which the current spanning tree configuration is considered too old. A value that is too small may cause the spanning tree to unnecessarily reconfigure. A value too large will increase the time it takes for the spanning tree to converge once an outage is detected.

**Valid Values**: 6 - 40

**Hello Time**

The interval of time, in seconds, between the generation of spanning tree configuration messages generated by the root. Lower values increase the spanning tree robustness, but increase the network traffic overhead.

**Valid Values**: 1 - 10

**Forward Delay**

The delay, in seconds, that the SuperELAN bridge waits before transitioning to the next port state. The forward delay should be large enough to allow all SuperELAN bridges in the SuperELAN to disable ports in the new topology prior to this short-cut bridge forwarding data frames. Values too low may cause temporary loops in the SuperELAN. Values too large may lengthen network partitions after the spanning tree has converged. The default value of 15 indicates that the short-cut bridge will begin forwarding frames 30 seconds after the spanning tree has converged: 15 seconds in listening state and 15 seconds in learning state.

**Valid Values**: 4 - 30

**Default Value**: 15

**proxy-le-arp**

Indicates the operational status of the SuperELAN Proxy LE ARP support. If disabled, all LE ARP requests will be forwarded onto all ELANs in the SuperELAN. If enabled, the SuperELAN will attempt to resolve the LE ARP Request first and send a LE ARP Response before flooding the LE ARP request onto all ELANs in the SuperELAN. Enabling Proxy LE ARP support uses additional memory store the learned MAC to ATM mapping, but reduces the amount of LE ARP traffic for each ELAN in the SuperELAN.

**Example:**

```
Selected SuperELAN 'super_tok'>set proxy-le-arp ?
ON
OFF
```

**SuperELAN id**

Sets the identifier associated with this SuperELAN.

Unlike the SuperELAN implementation under the `ASRT Config>` command prompt, the SuperELAN ID is used to construct redundant SuperELANs that span multiple devices. The SuperELAN ID is included as part of the spanning tree Topology frames and has external significance.

**Valid Values**: 1 - 65279

## Trace

The **trace** command, used with the ELS packet tracing facility, controls packet tracing configuration for the SuperELAN. Issuing the **trace on** command enables the selected SuperELAN for packet tracing. The default for packet tracing is *off*. See “Packet-trace Monitoring Commands” on page 16-29 for additional information.

Setting the *Destination Address Value*, *Destination Address Mask*, *Source Address Value*, and *Source Address Mask* provides a mechanism for limiting the tracing of frames sent or received by the SuperELAN bridge. Frames passing the MAC address trace filter will be forwarded to ELS to be traced. A frame is considered traceable if:

> *destination MAC Address* of the frame ANDed with *destination address trace mask* equals the *destination address trace value*
>
> AND
>
> *source MAC Address* of the frame ANDed with *source address trace mask* equals the *source address trace value*

For example, the following trace address settings will trace any frame received or transmitted to any ELAN in the SuperELAN that has a destination address of 0x000012120021 and was originated from any device with a MAC address beginning with 0x10005A.

```
Trace Dest Address Mask     = FFFFFFFFFFFF
Trace Dest Address Value    = 000012120021
Trace Source Address Mask = FFFFFF000000
Trace Source Address Value = 10005A000000
```

**Note:** The trace mask and value settings do not effect the tracing of bridge LAN Emulation control frames.

**Syntax: trace** on

off

address

**Example:**

```
Selected SuperELAN 'super_eth'>trace on
Packet Tracing enabled for SuperELAN 'super_eth'.
```

## Work with ELAN

Use the **work with ELAN** command to get to the `Selected ELAN 'x'>` prompt. At this prompt, you can provide detailed ELAN configuration parameters for this ELAN in the selected SuperELAN

**Syntax:**

**work with ELAN** *elan#*

**Example:**

```
Selected ELAN 'super_tok'> work
  (  1) tok1
  (  2) tok2
  (  3) tok3
  (  4) << Exit (no selection) >>
ELAN Name [1] 2
ELAN 'tok2' selected for detailed configuration

Selected ELAN 'tok2'>
```

See “Selected ELAN Configuration” on page 22-13 for information about commands available at the `Selected ELAN 'x'>` prompt.

## VLANs

Use the **vlans** command to access the `SuperELAN 'x'VLAN config>` configuration prompt. Refer to the chapter entitled "Configuring Bridging" in the Multiprotocol Switched Services (MSS) Configuring Protocols and Features for additional information.

**Syntax:**

**vlans**

## Selected ELAN Configuration

This section summarizes the selected SuperELAN detailed configuration commands. Enter the commands at the `Selected ELAN 'x'>` prompt.

*Table 22-3. Selected ELAN 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 2-3. |
| DISABLE | Disables an ELAN. |
| ENABLE | Enables an ELAN from a Super ELAN configuration. |
| LIST | Lists the current configured ELAN. |
| LE-CLIENT Configuration | Points to the LE-CLIENT configuration menu. |
| LES-BUS Configuration | Points to the LES-BUS configuration menu. |
| SPANNING TREE PORT | Sets spanning tree port parameters. |
| TRACE | Controls packet tracing for the ELAN. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Disable

Use the **Disable** command to disable an ELAN. Disabling the ELAN prevents clients of the disabled ELAN from setting up short-cut Data Direct VCCs with clients on other ELANs in the SuperELAN. It does not prevent clients in the disabled ELAN from communicating with clients in other ELANs if routing has been enabled on the disabled SuperELAN interface. Also, it does not prevent clients on the disabled ELAN from setting up Data Direct VCCs among themselves.

**Syntax:**

**disable** *elan#*

**Example:**

```
 Selected ELAN 'super_tok'>disable
  (  1) << All ELANs >>
  (  2) tok1
  (  3) tok2
  (  4) tok3
  (  5) << Remote ELAN >>
  (  6) << Exit (no selection) >>
ELAN Name [1]:2
ELAN 'tok1' disabled
```

## Enable

Use the **Enable** command to enable an ELAN on a SuperELAN configuration.

**Syntax:**

**enable** *elan#*

**Example:**

```
Selected ELAN 'super_tok'>enable
  (  1) << All ELANs >>
  (  2) tok1
  (  3) tok2
  (  4) tok3
  (  5) << Remote ELAN >>
  (  6) << Exit (no selection) >>
ELAN Name [1]2
ELAN 'tok1' enabled
```

## LE-Client Configuration

Use the **le-client** command to move directly to the ATM LAN Emulation client configuration menu for the SuperELAN interface associated with the selected ELAN. See Chapter 23, “Using LAN Emulation Clients” on page 23-1 for additional information.

**Syntax:**

**le-client**

## LES-BUS Configuration

Use the **les-bus** command to move directly to the LES-BUS configuration menu for the selected ELAN. See Chapter 25, “Using LAN Emulation Services” on page 25-1 for additional information.

This menu item is visible only for *locally* configured LAN Emulation Services.

**Syntax:**

**les-bus**

## List

Use the **list** command to list configured ELANs.

**Syntax:**

**list**

**Example:**

```
Selected ELAN 'tok4'>list
-------- ELAN Configuration ----------
ELAN Name:               ext ethernet elan
Type:                    Token Ring
Mode:                    Enabled
Frame Size:              4544
SuperELAN ID:            35
Port Number:             1
LANE Service Location:   Remote

------ spanning tree Parameters ------
ELAN Port Priority:      128
Path Cost:               32768

-------- Interface Parameters --------
ATM Physical Interface:  0
LEC Interface Number:    1
LECS Auto Configuration: No
LE Server ATM address:   39.99.99.99.99.99.99.00.00.99.99.02.00.44.44.44.55.55.
55.02
```

## Spanning Tree Port Parameters

Use the **spanning tree port** command to set spanning tree port parameters for the selected ELAN.

**Syntax:**

**spanning tree port** port priority

path cost

**Example:**

```
Selected ELAN 'tok2'>span
ELAN Port Priority (0-255) [128] 5
ELAN Path Cost (0-65535)  [32768] 27777
SuperELAN spanning tree parameters set for ELAN 'tok2'.
```

**ELAN port priority**

A one-octet value which influences which ELAN is used when two or more ELANs are connected to the same network segment in a loop. A lower value represents a higher priority.

**Valid Values**: 0 - 255

**ELAN path cost**

The cost added to the root path cost in the spanning tree configuration message received on this ELAN in order to determine the path cost to get to the root SuperELAN bridge through this ELAN.

Using a small value for this parameter increases the probability that this ELAN will be close to the root SuperELAN short-cut bridge, and thus asked to carry more broadcast unknown-unicast traffic and LE control traffic.

**Valid Values**: 0 - 65535

## Trace

The **Trace** command enables packet tracing for the selected ELAN in the SuperELAN. When used with the Packet Tracing subsystem in ELS, all frames received and transmitted for this ELAN are traced. Destination and Source MAC Address filters are provided to help limit the number of traced data frames. These trace filters are configured using the SuperELAN TRACE ADDRESS command and are applied to all ELANs in the SuperELAN. See “Packet-trace Monitoring Commands” on page 16-29 for more information.

**Syntax:**

| | |
|---|---|
| **trace** | on |
| | off |

**Example:**

```
Selected ELAN 'tok1'>trace ?
ON
OFF

Selected ELAN 'tok1'>trace on
Packet tracing enabled for ELAN port 'tok1' on SuperElan 'super_test_elan'.
```

## Accessing SE-Services Monitoring Process

Displays the `SE Services+` prompt.

This prompt can also be accessed using the **protocol se** command from the + prompt. See “SE Services Monitoring Commands.”

## SE Services Monitoring Commands

*Table 22-4. SE Services 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 2-3. |
| CREATE | Dynamically creates and starts a newly configured superELAN without rebooting the device. |
| LIST | Displays information about the current configuration. |
| WORK with SuperELAN | Displays the `Selected SuperELAN 'x'` prompt from which you can monitor SuperELAN Services. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## Create

Use the **Create** command to create a new SuperELAN.

**Syntax:**

| | |
|---|---|
| **create** | *superelan name* |

**SuperELAN name**
Specifies the name of the SuperELAN to be created.

**Note:** The SuperELAN must not be currently running and must have an associated SRAM record. One spare interface per ELAN in the SuperELAN must be available. See “Configuring Spare Interfaces” on page 9-4 for information about spare interfaces.

**Example:**

```
SE Services console>create
SuperELAN Name []? super_eth
SuperELAN interface 5 activated successfully.
SuperELAN interface 6 activated successfully.
SuperELAN interface 7 activated successfully.

SuperELAN 'super_eth' started.
```

## List

Use the **list** command to display SuperELANs.

**Syntax:**

**list**

**Example:**

```
SE Services console>list
Number of SuperELANS: 2                                      BCM
Mode E=Enabled/D=Disabled                  Proxy LE ARP      IP
| Type E=Ethernet/T=Token-Ring              |                 | NetBIOS
| |                                         |  ELANs   VLANs  | |
v v SuperELAN Name                    ID   v Act/Cfg Act/Cfg v v     Up-time
- - ------------------------------- ----- - ------- ------- - - -----------
E T                        super_tok    88 Y 2/  3   1/  1   Y N 00.00.27.72
E E                        super_eth    77 N 3/  3   2/  2   N N 00.00.27.73
```

## Work with SuperELAN

Use the **Work with SuperELAN** command to access the `Selected SuperELAN 'superelan name'>` prompt for detailed monitoring.

**Syntax:**

**work** *superelan#*

**Example:**

```
SE Services console>work
  (  1) setest
  (  2) super_eth
  (  3) << Exit (no selection) >>
SuperELAN Name [1]?  2
SuperELAN 'super_eth' selected for detailed console montoring.
```

See “Selected SuperELAN Monitoring Commands”for information about the commands that are available after issuing the **work** command:

## Selected SuperELAN Monitoring Commands

The following commands are available at the `Selected SuperELAN 'superelan name'>` monitoring prompt:

*Table 22-5. Selected SuperELAN monitoring command Summary*

| Command | Function |
|---|---|
| BROADCAST-MANAGER | See the chapter entitled “Monitoring Bridging” in the Multi-protocol Switched Services (MSS) Configuring Protocols and Features for information. |
| CLEAR counters | Resets counters. |
| CREATE | Creates an ELAN. |
| ENABLE | Enables the selected SuperELAN. |
| DISABLE | Disables the selected SuperELAN. |
| DISPLAY Counters | Displays counters of all ELANs in the SuperELAN. |
| ELANs | Lists ELANs in the SuperELAN. |
| FLUSH | Flushes the data on the LE control frame cache. |
| LIST | Displays the configured SuperELANs. |
| RESTART | Restarts a disabled SuperELAN. |
| SET | Sets SuperELAN cache age and size. |
| SHOW cache | Displays the data on the LE control frame cache. |
| TRACE | Enables packet tracing for the selected SuperELAN. |
| WORK with ELAN | Displays the `Selected ELAN 'elan name'>` prompt from which you can monitor ELAN Services. |
| VLANs | See the chapter entitled “Monitoring Bridging” in the Multi-protocol Switched Services (MSS) Configuring Protocols and Features for information. |
| Exit | Exits the SE Services monitoring process and returns to the `SE Services+` monitoring prompt. |

## Broadcast Manager

Use the **Broadcast-Manager** command to access the Bridge Broadcast Manager monitoring prompt. Refer to the chapter entitled “Monitoring Bridging” in the Multi-protocol Switched Services (MSS) Configuring Protocols and Features for additional information.

## Clear

Use the **clear** command to reset counters for all ELANs in the SuperELAN.

**Syntax:**

<u>cl</u>**ear**

## Create

Use the **create** command to create and start a new ELAN. The ELAN must have been previously configured for the selected SuperELAN under `talk 6` and the ELAN can not be currently active. There must be at least one available spare interface for the ELAN. Use the **CONFIGURATION** command from the + prompt to determine the number of available spare interfaces.

**Syntax:**

<u>cr</u>**eate** *elan name*

**Example:**

```
SE Services console>create
ELAN Name []? eth4
ELAN interface 8 activated successfully.

ELAN 'eth4' started.
```

## Disable

Use the **disable** command to disable the selected SuperELAN.

Disabling the SuperELAN prevents new inter-ELAN shortcut VCCs from being established between ELANs. It does not prevent clients from setting up data direct VCCs within an ELAN and it does not disconnect inter-ELAN data direct VCCs already established.

Disabling the SuperELAN moves all spanning tree ELAN states to *Configured*. See “ELANs” for a description.

**Syntax:**

disa**ble**

**Example:**

```
Selected SuperELAN 'super_eth'>disable
SuperELAN 'super_eth' disabled.
```

## Display

Use the **Display** command to display counter information for all ELANs in the SuperELAN.

**Syntax:**

disp**lay**

See “Display” on page 22-25 for an example of the **display** command.

## Enable

Use the **enable** command to enable the specified SuperELAN. Enabling the SupeELAN moves all spanning tree states to *listening* state. See “ELANs” for a description.

**Syntax:**

en**able**

**Example:**

```
Selected SuperELAN 'super_eth'>enable
SuperELAN 'super_eth' enabled.
```

## ELANs

Use the **ELANs** command to display information about all the ELANs in the specified SuperELAN.

**Syntax:**

el**ans**

**Example:**

```
Selected SuperELAN 'super_eth'>elans
SuperELAN Name: super_eth
Number of ELANS: 3             Routing
Interface Number               IP        Port Number (Dec)
  |    L=Local/R=Remote ELAN   |IPX       |    Port Priority (Hex)
  |    | E=Enabled/D=Disabled  | |AT      |    |
  |    | |                     | | |BV    |    |
  |    | |                     | | | |    |    |
  |    | |                     | | | |    |    |    Last STP  Time Since
  v    v v ELAN Name           v v v v    v    v    Status    State Change
----- - - ---------------------------  ---- --  ----------- ------------
    4 L E      eth1            x x . .      1 80  Forwarding  00.01.42.00
    5 L E      eth2            x x . .      2 80  Forwarding  00.01.42.04
    6 L E      eth3            . . x .      3 80  Forwarding  00.01.42.08
```

ELAN status values:

**Forwarding**
SuperELAN is forwarding LE control and data frames to this ELAN

**Learning** SuperELAN is receiving data frames for the purpose of caching MAC addresses and Route Descriptors, but no frames are being sent to this ELAN

**Listening** SuperELAN is listening for SE Spanning Tree frames to determine if this ELAN should proceed to the Learning state or Block itself

**Blocked** No frames are being sent or received since another short-cut SuperELAN path exists with higher priority to this ELAN

**Configured**
ELAN interface is configured within the SuperELAN but is not participating in the SE Spanning Tree and is not receiving or forwarding frames. Most likely the ELAN has been disabled

**NetDown** LAN Emulation interface is down, usually indicates that the LEC has not successfully joined the ELAN

**Configuring**
ELAN interface is initializing and will enter the Listening state (if enabled) or Configured state (if disabled) after initialization is complete

**NotSetup** ELAN interface is not defined

# Flush

Use the **flush** command to clear the control and/or data cache for all ELANs in the SuperELAN.

**Syntax:**

**flush**

**Example:**

```
Selected SuperELAN 'super_eth'>flush ?
CONTROL Frame Forwarding Cache
DATA Frame Forwarding Cache


Selected SuperELAN 'super_eth'>flush control
Control Frame Forwarding Cache flushed for SuperELAN 'super_eth'.
```

## List

Use the **List** command to display the status of the selected SuperELAN.

**Syntax:**

**list**

**Example:**

```
Selected SuperELAN 'super_eth'>list
------ SuperELAN Configuration -------
SuperELAN Name:              super_eth
Type:                        Ethernet
Mode:                        Enabled
ID:                          44
Frame Size:                  1516

--------- ELAN Cache Status ----------
Proxy LE ARP Support:        Disabled
Duplicate MAC Tracking:      Disabled
Learned ring segment (hex):  0
MAC Cache Age:               300
MAC Cache Size:              1000
Dynamic MAC Entries Count:   5

-------- Spanning Tree Status --------
Bridge Priority-ID:          32768-000413473679
Designated Root Priority-ID: 32768-000413473679
Root Port:                   Self
Max Age:                     20
Hello Time:                  2
Forward Delay:               15
Topology Change Detected:    No
Topology Change:             No

------- Packet Tracing Status --------

Packet Tracing:              Disabled
Trace Dest Address Mask:     000000000000
Trace Dest Address Value:    000000000000
Trace Source Address Mask:   000000000000
Trace Source Address Mask:   000000000000

----- VLAN Configuration Summary -----
                   Enabled/Configured
IP VLANs:                1/1
IPX VLANs:               0/0
NetBios VLANs:           0/0
Sliding Window VLANs:    1/1
Mac Address VLANs:       0/0
Port-based VLANs:        0/0

-------- Broadcast Management --------
IP:                      Enabled
NetBIOS Dupl. Filter:    Disabled
NetBIOS Route Caching:   Disabled
```

## Restart

Use the **restart** command to restart the SuperELAN. Restarting the SuperELAN causes the configuration record parameters to be used upon restart, instead of just enabling the ELAN, which restarts the ELAN with current runtime parameters. The SuperELAN must be disabled prior to issuing the **restart** command.

**Syntax:**

**restart**

## Set Cache

Use the **set cache** command to dynamically set the data cache characteristics for the selected SuperELAN.

The cache age value determines the amount of time in seconds a newly added entry will remain in the cache without being revalidated.

The cache size limits the number of MAC addresses cached to prevent excessive heap usage.

**Note:** Route descriptor cache entries are not bound by any configurable cache limit.

Once the cache is full, the next new MAC entry added will cause the oldest MAC entry to be deleted from the cache.

**Syntax:**

**set cache** *age*

*size*

*duplicate-mac-tracking*

*proxy-le-arp*

**Example:**

```
Selected SuperELAN 'super_eth'>set cache ?
AGE
SIZE
DUPLICATE-MAC-Tracking
PROXY-LE-ARP

Selected SuperELAN 'super_eth'>set cache size
MAC Filter Cache Size (1-10000) [1000]? 2000
Cache Size parameter updated for SuperELAN 'super_eth'.
```

## Show

Use the **show** command to display data or control frame cache for all ELANs in the selected SuperELAN.

**Syntax:** **show** *control*

*data*

*duplicate-mac*
*dynamic-mac*
*registered-mac*
*route-descriptor* **1**

**1** This menu item does not appear for Ethernet SuperELANs.

**Example:**

```
Selected SuperELAN 'super_eth'>show ?
CONTROL Frame Forwarding Cache
DATA Frame Forwarding Cache

Selected SuperELAN 'super_eth'>show data dyn

ELAN Name                        Count MAC Address   TTL
-------------------------------- ----- ------------ ----
                            eth1     1 000044891323  240
                            eth2     2 000064432998  120
                                       000099213011  300
                            eth3     0
```

## Trace

Use the **trace** command to start packet tracing for the selected SuperELAN. When used with the Packet Tracing subsystem in ELS, all frames received and transmitted onto this SuperELAN are traced. Destination and Source MAC Address filters are provided to help limit the number of traced data frames. Trace filters are configured using the SuperELAN **TRACE ADDRESS** command and are applied to ELANs in the SuperELAN. See “Packet-trace Monitoring Commands” on page 16-29 for more information.

**Syntax:**

**trace** on

off

address

**Example:**

```
Selected SuperELAN 'super_eth'>trace ?
ON
OFF
ADDRESS

Selected SuperELAN 'super_eth'>trace addr
Enter dest MAC addr trace mask in xx.xx.xx.xx.xx.xx form [00.00.00.00.00.00]?
ffffffffffff
Enter dest MAC addr trace value in xx.xx.xx.xx.xx.xx form [00.00.00.00.00.00]?
00005a000001
Enter source MAC addr trace mask in xx.xx.xx.xx.xx.xx [00.00.00.00.00.00]?
ffffffffffff
Enter source MAC addr trace value in xx.xx.xx.xx.xx.xx [00.00.00.00.00.00]?
00005a000002
Address trace parameters updated for SuperELAN 'super_eth'.
```

Configuring the MAC mask and values as shown will allow only frames with a destination MAC address of 00005a000001 and a source MAC address of 00005a000002 to be traced. Filtering does not effect tracing of LE Control frames forwarded between SuperELAN ports.

## Work with ELAN

Use the **work with ELAN** command to get to the `Selected ELAN 'elan name'>` monitoring prompt. At this prompt, you can monitor detailed ELAN parameters for the selected ELAN on the SuperELAN.

**Syntax:**

**work with ELAN** *elan#*

**Example:**

```
Selected SuperELAN 'super_tok'>work
  (  1) eth1
  (  2) eth2
  (  3) eth3
  (  4) << Exit (no selection) >>
ELAN Name [1] 2
ELAN 'eth2' selected for detailed console monitoring

Selected ELAN 'tok2'>
```

See “Selected ELAN Monitoring Commands” for information about the commands available after you issue the **work** command.

## VLANs

Use the **vlans** command to access the `SuperELAN 'x' VLANs>` monitoring prompt. At this point, you can configure and monitor VLANs on this SuperELAN. Refer to the chapter entitled “Monitoring Bridging” in the Multiprotocol Switched Services (MSS) Configuring Protocols and Features for additional information.

**Syntax:**

**vlans**

# Selected ELAN Monitoring Commands

This section summarizes the selected ELAN detailed monitoring commands for a selected SuperELAN. Enter the commands at the `Selected ELAN 'x'>` prompt.

**Note:** Many of the commands at this prompt level perform the same action as the corresponding command at the `Selected SuperELAN 'x'>` command prompt level. The difference is that the action at this command prompt level is directed to an ELAN rather than a SuperELAN.

*Table 22-6. Selected ELAN 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 2-3. |
| CLEAR | Clears counters for selected ELAN. |
| DISABLE | Disables an ELAN. |
| DISPLAY | Lists the current configured ELAN counters. |
| ENABLE | Enables an ELAN. |
| FLUSH | Flushes the control or data cache associated with the ELAN. |
| LEC | Points to the LE-CLIENT monitoring menu. |
| LES-BUS | Points to the LES-BUS monitoring menu. |
| LIST | Lists the current configured ELAN. |
| RESTART | Restarts the ELAN using configuration parameters. |
| SHOW | Displays LE control or data cache MAC and Route Descriptor entries. |
| TRACE | Configures tracing for selected ELAN. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## Disable

Use the **Disable** command to disable an ELAN. Disabling the ELAN prevents clients of the disabled ELAN from setting up short-cut Data Direct VCCs with clients on other ELANs in the SuperELAN. It does not prevent clients in the disabled ELAN from communicating with clients in other ELANs if routing has been enabled on any of the SuperELAN interfaces. Also, disabling the ELAN does not prevent clients on the disabled ELAN from setting up Data Direct VCCs among themselves.

**Syntax:**

disa**ble** *elan#*

**Example:**

```
 Selected ELAN 'the2'>disable
  (  1) << All ELANs >>
  (  2) eth1
  (  3) eth2
  (  4) eth3
  (  5) << External ELAN >>
  (  6) << Exit (no selection) >>
ELAN Name [1]: 3
ELAN 'eth2' disabled
```

## Display

Use the **Display** command to display counters for the selected ELAN.

**Syntax:**

disp**lay**

**Example:**

```
 Selected ELAN 'eth2'>display
 SuperELAN: super_eth
 -------------------------------------------------------------------------------
 ELAN: eth2
 ---------------------------------------.---------------------------------------
 Data Packet Counters                   | LE Control Frame Counters
 ---------------------------------------|---------------------------------------
 Pkts received . . . . . . .          0 | LE Control Frame received .         0
 Pkts transmitted. . . . . .          0 | LE Control Frame xmitted. .         0
*Pkts disc, src addr filt. .          0 | LE Ctl disc, rcv port !fwd.         0
 Pkts disc, dest addr filt .          0 | LE Ctl disc, xmit port !fwd         0
*Pkts disc, protocol filt. .          0 | ARP Requests received . . .         0
 Pkts disc, rcv port !fwd. .          0 | ARP Requests transmitted. .         0
 Pkts disc, rcv port no bufs          0 | ARP Requests disc, error. .         0
 Pkts disc, rcv port q over.          0 | ARP Requests filt . . . . .         0
 Pkts disc, xmit port !fwd .          0 | ARP Replies received. . . .         0
 Pkts disc, xmit error . . .          0 | ARP Replies transmitted . .         0
 Pkts disc, frame too big. .          0 | ARP Replies disc, error . .         0
 Pkts disc, rif seg mismatch          0 | NARP Requests received. . .         0
*Pkts disc, rif seg dup. . .          0 | NARP Requests transmitted .         0
 Pkts routed, not SEed . . .          0 | Flush Requests received . .         0
                                        | Flush Requests transmitted.         0
 BPDUs received  . . . . . .          0 | Flush Replies received. . .         0
 BPDUs disc, rcv port q over          0 | Flush Replies transmitted .         0
                                        | LE Ctl disc, ctl frm q over         0
```

* These counters are currently not maintained and will always be set to 0.

## Enable

Use the **Enable** command to enable the selected ELAN.

**Syntax:**

**enable** *elan#*

**Example:**

```
Selected ELAN 'super_tok'>enable
  (  1) << All ELANs >>
  (  2) tok1
  (  3) tok2
  (  4) tok3
  (  5) << External ELAN >>
  (  6) << Exit (no selection) >>
ELAN Name [1] 2
ELAN 'tok1' enabled
```

## Flush

Use the **Flush** command to clear the control and/or data cache for the selected ELAN.

**Syntax:**

**flush** control

data

**Example:**

```
Selected ELAN 'eth2'>flush ?
CONTROL Frame Forwarding Cache
DATA Frame Forwarding Cache


Selected ELAN 'eth2'>flush data
Data Frame Forwarding Cache flushed for ELAN 'eth2'.
```

## LEC

Use the **lec** command to jump directly to the ATM LAN Emulation client monitoring menu for the SuperELAN interface associated with the selected ELAN. See Chapter 23, “Using LAN Emulation Clients” on page 23-1 for additional information.

**Syntax:**

lec

**Example:**

```
Selected ELAN 'eth2'>lec
ATM Emulated LAN Console
LEC+
```

## LES-BUS

Use the **les-bus** command to jump directly to the LES-BUS monitoring menu for the selected ELAN. See Chapter 25, “Using LAN Emulation Services” on page 25-1 for additional information.

This menu item is visible only for locally configured LAN Emulation Services.

**Syntax:**

les**-bus**

**Example:**

```
Selected ELAN 'eth2'>les
EXISTING LES-BUS 'eth2'+
```

## List

Use the **list** command to list configuration for the selected ELAN.

**Syntax:**

lis**t**

**Example:**

```
Selected ELAN 'tok4'>list
--------- ELAN Configuration ---------
ELAN Name:                         eth2
Status:                            Enabled
Location:                          Local
Interface Number:                  5
Port Number:                       2
Packet Tracing:                    Disabled

-------- Spanning Tree Status --------
STP State:                         Forwarding
Time Since Last STP State Change:  00.00.39.67
Spanning Tree Priority:            128
Path Cost:                         32768
Designated Root:                   000413473679
Root Cost:                         0
Designated Bridge:                 000413473679
Designated Port:                   2
```

## Restart

Use the **restart** command to restart the ELAN using the configuration parameters. The ELAN must be disabled prior to issuing this command.

**Syntax:**

r**estart**

**Example:**

```
Selected ELAN 'eth1'>restart
Restarting ELAN 'eth1'.
```

## Show

Use the **Show** command to display the data and control frame cache for the selected ELAN.

**Syntax:**

sh**ow** *control*

*data*

*dynamic-mac*
*registered-mac*
*route-descriptor* **1**

**1** This menu item does not appear for Ethernet SuperELANs.

**Example:**

```
Selected ELAN 'eth2'>show ?
CONTROL Frame Forwarding Cache
DATA Frame Forwarding Cache

Selected ELAN 'eth2'>show data ?
DYNAMIC-MAC
REGISTERED-MAC

ELAN Name                        Count MAC Address   TTL
-------------------------------- ----- ------------ ----
                            eth2     2 000064432998  120
                                       000099213011  300
```

## Trace

The **Trace** command enables packet tracing for the selected ELAN in the SuperELAN. When used with the Packet Tracing subsystem in ELS, all frames received and transmitted onto this ELAN are traced. Destination and Source MAC Address filters are provided to help limit the number of traced data frames. These trace filters are configured using the **TRACE ADDRESS** command and are applied to all ELANs in the SuperELAN. See “Packet-trace Monitoring Commands” on page 16-29 for more information.

**Syntax:**

**trace** off

on

**Example:**

```
Selected ELAN 'eth2'>trace ?
ON
OFF

Selected ELAN 'eth2'>trace on
Packet tracing enabled for ELAN port 'eth2' on SuperElan 'super_test_elan'.
```

# Chapter 23. Using LAN Emulation Clients

This chapter describes LAN Emulation Clients (LECs). It includes the following sections:

- "LAN Emulation Client Overview"

## LAN Emulation Client Overview

As a pioneer of ATM technology, IBM defined one of the early LAN Emulation architectures. The ATM Forum LAN Emulation Specification diverged from IBM's architecture in a number of ways. IBM, like several other vendors, now has products that implement two different LAN Emulation architectures: earlier products implement the IBM LAN Emulation Architecture, while more recently developed products implement the ATM Forum LAN Emulation Specification. The MSS Server implements LE Clients for both architectures, but LE Servers for ATM Forum LAN Emulation only.

Although ATM Forum LAN Emulation is the strategic direction for multivendor interoperability, customers that have installed products implementing the IBM LAN Emulation Architecture must also be supported. These customers will generally fall into one of the following two categories:

1. Those who wish to continue using IBM LAN Emulation, which offers some technical advantages relative to the ATM Forum LAN Emulation
2. Those who wish to migrate to ATM Forum LAN Emulation.

The 8210 can provide routing and bridging services that support any combination of ATM Forum or IBM LAN Emulation clients. From routing and bridging perspectives, IBM LECs are functionally equivalent to ATM Forum LECs; both provide emulated Ethernet and Token-Ring interfaces with operational characteristics of real interfaces. Configure a LEC to be either of these types:

- Ethernet
  - ATM Forum-Compliant
  - IBM
- Token-Ring
  - ATM Forum-Compliant
  - IBM

LECs are equivalent to "ports" or "interfaces" on traditional routers and bridges. The router bridges and routes traffic between ports by receiving and transmitting traffic through its LECs.

There are two levels to the configuration menus for LE Clients:

1. `LE Client Config>` permits you to view the set of LE Clients on a particular ATM interface, to add or remove LECs from this set, or to enter into a more detailed configuration environment for any member of this set (see LEC commands in the following). The commands for this prompt level are described in "Configuring LAN Emulation Clients" on page 24-1.

2. `Token-Ring-Forum Compliant LEC Config>`, `Token-Ring-IBM LEC Config>`, `Ethernet Forum Compliant LEC Config>`, or `Ethernet-IBM LEC Config>` permits you to configure all parameters for a particular LE Client. The commands available at this level are described in "Configuring an ATM Forum-Compliant LE Client" on page 24-3 and "Configuring an IBM LE Client" on page 24-18.

# Chapter 24. 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

This section explains the commands for viewing, changing, using the set of LE Clients on a particular ATM interface.

Enter the commands at the `LE Client Config>` prompt under the `ATM Config>` prompt, as described in “ATM Configuration Commands” on page 21-2.

To get to the `LE Client Config>` prompt, enter **le-c** at the ATM Config> prompt as described in “ATM Configuration Commands” on page 21-2.

*Table 24-1. 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 2-3. |
| Add | Adds a LEC for the following types of Emulated LANs architectures:<br>• Ethernet<br>– ATM Forum-Compliant<br>– IBM<br>• Token-Ring<br>– ATM Forum-Compliant<br>– IBM |
| Config | Gets you to the `LEC Config>` prompt, from which you can configure a specific LAN Emulation Client as described in:<br>• “Configuring an ATM Forum-Compliant LE Client” on page 24-3<br>• “Configuring an IBM LE Client” on page 24-18 |
| List | Lists the LECs |
| Remove | Removes a LEC. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## Add

Use the **add** command to add an ATM Forum-compliant or IBM LEC for a Token-Ring or Ethernet emulated LAN.

**Syntax:**

| | |
|---|---|
| **add** | ethernet forum |
| | ethernet ibm |
| | token-ring forum |
| | token-ring ibm |

**token-ring forum**
Token ring ATM Forum compliant LEC.

**Example:**

```
LE Client Config> add token-ring forum
Added device as interface 3
```

**token-ring ibm**
Token ring IBM LEC.

**Example:**

```
LE Client Config> add token-ring ibm
Added device as interface 3
```

**ethernet forum**
Ethernet Forum-Compliant LEC.

**Example:**

```
LE Client Config> add ethernet forum
Added device as interface 2
```

**ethernet ibm**
Ethernet IBM LEC.

**Example:**

```
LE Client Config> add ethernet ibm
Added device as interface 1
```

## Config

Use the **config** command to get you to the `LEC Config>` prompt, from which you can configure the details of a specific LAN Emulation Client. Refer to "Configuring an ATM Forum-Compliant LE Client" on page 24-3 or "Configuring an IBM LE Client" on page 24-18.

**Syntax:**

| | |
|---|---|
| **config** | interface# |

**interface#**
An integer number assigned by the router when the LEC was added to the configuration. Use the **list** command to determine the interface number assigned to the LEC.

**Example:**

```
LE Client Config> config 3
```

## List

Use the **list** command to list the LAN emulation clients.

**Syntax:**

**list**

**Example:**

```
LE Client Config> list
                 ATM Emulated LANs
-------------------------------------------------------
  ATM interface number = 0
  LEC interface number = 1
  Emulated LAN type    = Token Ring Forum Compliant
  Emulated LAN name    =
```

## Remove

Use the **remove** command to remove a LEC.

**Syntax:**

**remove** interface#

**interface#**
You must specify the interface number that was assigned when the LEC was added to the configuration. Use the **list** command to determine the interface number assigned to the LEC.

# 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 24-2 (Page 1 of 2). 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 2-3. |
| ARP-Configuration | Allows you to configure the LE-ARP configuration for the ATM Forum-compliant client |
| Frame | Sets the NetWare IPX encapsulation type. |
| 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. |

| Table 24-2 (Page 2 of 2). LAN Emulation Client Configuration Commands Summary | |
|---|---|
| Command | Function |
| 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 `elan-x LEC QoS Config>` prompt from which you can configure Quality of Service as described in "LE Client QoS Configuration Commands" on page 28-7. |
| Set | Sets the LAN Emulation Client parameters. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## 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 24-3. 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 2-3. |
| 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. |
| Remove | Removes an ARP cache entry. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

### 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 []? 390f000000000000000000000000123456789098
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 []? 390f000000000000000000001234567890988888
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 24-4. 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 2-3. |
| Set | Sets QOS parameter values. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

***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 Chapter 27, "Using Quality of Service (QoS)" on page 27-1 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*

## Frame

Use the **frame** command to set the NetWare IPX encapsulation type. The command options differ depending on the type of LEC (Token-Ring or Ethernet). For Token-Ring LECs, enter one of the following:

| Option | Description | Syntax |
|---|---|---|
| Token-Ring using MSB | Uses the standard 802.2 IPX header with the noncanonical Token-Ring address bit ordering (MSB). | frame token-ring msb |
| Token-Ring using LSB | Uses the 802.2 IPX header with the canonical address bit ordering (LSB). | frame token-ring lsb |
| Token-Ring with 802.2 SNAP using MSB | Uses the 802.2 format with a SNAP header and noncanonical address bit ordering. This encapsulation is used primarily in bridging environments. | frame token-ring_snap msb |
| Token-Ring with 802.2 SNAP using LSB | Uses the 802.2 format with a SNAP header and canonical address bit ordering. | frame token-ring_snap lsb |
| Ethernet 2.0 | Uses Ethernet version 2.0 protocol 81-37. | frame ethernet_II |
| Ethernet 802.2 | Uses Ethernet 802.3 with 802.2 SA E0. | frame ethernet_8022 |
| Ethernet 802.3 | Uses Ethernet 802.3 without any 802.2 header. | frame ethernet_802.3 |
| Ethernet SNAP | Uses 802.3, 802.2 with SNAP PID 00-00-00-81-37. | frame ethernet_SNAP |

**Syntax:**

**frame** *ipx-encapsulation type*

Note: The frame command cannot be used in the network configuration process to set the IPX encapsulation unless the interface has been configured with IPX.

The IPX encapsulation can also be set in the IPX configuration environment. Refer to the Multiprotocol Switched Services (MSS) Configuring Protocols and Features chapter on Configuring IPX for details.

**Example:**

```
frame token_ring msb
```

## 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:**

r**if-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.

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:**

s**ource-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 **E**thernet or **I**EEE-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" on page 28-7.

**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.

**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. This value must be Yes for the client to use a redundant IBM MSS Server LES.

**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 24-13.

**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.

**Default Value:**
4 seconds

**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 seconds

**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 seconds

**Example:**

```
LEC Config> set flush-timeout 3
```

**forward-delay**
Sets the forward delay. Entries in the LE ARP cache must be periodically reverified. 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 reverification traffic.

**Valid Values:**
An integer number of seconds in the range of 4 to 30.

**Default Value:**
15 seconds

**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 21-6.

**Valid Values:**

1516

4544

9234

18190

**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 24-11.

**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.00.00.00.00.00.00.00.00.00.01.10.00.5A.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 24-10.

- 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.00.00.00.00.00.00.00.00.00.01.10.00.5A.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.

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 in 24-11.

**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 ≤ ***reconfig-delay-max***.

**Valid Values:**
1 - the value of ***reconfig-delay-max***

**Default Value:**
1

**reconfig-delay-max**
This parameter sets the maximum delay time when LEC returns to the initial state. This value must be ≥ ***reconfig-delay-min***.

**Valid Values:**
1 - 10

**Default Value:**
5

**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:**
An integer number in the range of 0 to 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 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
```

## Configuring an IBM LE Client

This section summarizes and then explains the commands for configuring an IBM LAN Emulation Client.

Enter the appropriate commands at either the `Ethernet-IBM LEC Config>` prompt or the `Token-Ring-IBM LEC Config>` prompt. Commands in the following table apply to both types of LECs except where indicated.

*Table 24-5. IBM 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 2-3. |
| Frame | Sets the NetWare IPX encapsulation type. |
| 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. |
| Set | Sets the IBM LAN Emulation Client parameters. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

### Frame

Use the **frame** command to set the NetWare IPX encapsulation type. The command options differ depending on the type of LEC (Ethernet or Token-Ring) For Token-Ring LECs, enter one of the following:

| Option | Description | Syntax |
|---|---|---|
| Token-Ring using MSB | Uses the standard 802.2 IPX header with the noncanonical Token-Ring address bit ordering (MSB). | frame token-ring msb |
| Token-Ring using LSB | Uses the 802.2 IPX header with the canonical address bit ordering (LSB). | frame token-ring lsb |
| Token-Ring with 802.2 SNAP using MSB | Uses the 802.2 format with a SNAP header and noncanonical address bit ordering. This encapsulation is used primarily in bridging environments. | frame token-ring_snap msb |
| Token-Ring with 802.2 SNAP using LSB | Uses the 802.2 format with a SNAP header and canonical address bit ordering. | frame token-ring_snap lsb |
| Ethernet 2.0 | Uses Ethernet version 2.0 protocol 81-37. | frame ethernet_II |
| Ethernet 802.2 | Uses Ethernet 802.3 with 802.2 SA E0. | frame ethernet_8022 |
| Ethernet 802.3 | Uses Ethernet 802.3 without any 802.2 header. | frame ethernet_802.3 |
| Ethernet SNAP | Uses 802.3, 802.2 with SNAP PID 00-00-00-81-37. | frame ethernet_SNAP |

**Syntax:**

**frame** *ipx-encapsulation-type*

Note: The frame command cannot be used in the network configuration process to set the IPX encapsulation unless the interface has been configured with IPX.

The IPX encapsulation can also be set in the IPX configuration environment. Refer to the Multiprotocol Switched Services (MSS) Configuring Protocols and Features chapter on Configuring IPX for details.

**Example:** `frame token_ring msb`

## RIF-Timer (for Token-Ring-IBM 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.

**Syntax:**

**rif-timer**

**Example:** `rif-timer 100`

## Source-routing (for Token-Ring-IBM 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.

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-IBM 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 **E**thernet or **I**EEE-803.3.

**Syntax:**

**IP-encapsulation** *type*

**Example:** `IP-encapsulation E`

## List

Use the **list** command to list the LE client configuration.

**Syntax: list**

## Set

Use the **set** command to set IBM LE Client parameters.

**Syntax: set** backward-peakrate

esi-address

frame-size

forward-peakrate

keep-alive-count

les-atm-address

mac-address

mac-cache-size

mac-cache-aging-period

rd-cache-size

rd-cache-aging-period

registration interval

retry-count

selector

trace

**backward-peakrate**

This parameter specifies the maximum data rate (backward peak rate), in Kbps, of the ATM device for all LAN emulation connections.

Specify an integer from 1 to the maximum data rate of the ATM device.

Default: line rate in Kbps

**Example:**

```
LEC Config> set backward-peakrate 155000
```

**esi-address**

Sets the ESI portion of the client's ATM address.

**Valid Values:**
Any 12 hexadecimal digits.

**Default Value:**
Burned-in ESI

**Example:**

```
token ring lec config>set esi
Select ESI
   (1) Use burned in ESI
   (2) 11.22.33.44.55.66

Enter selection [1]?
```

**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 21-6. The specified maximum frame size includes any Layer 2 header information. All transparently bridged LANs must have the same maximum frame size.

**Valid Values:**
1024 - 17843

**Default Value:**
If the ELAN type is token ring, the default is 4551. If the ELAN type is Ethernet, the default is 1523.

**forward-peakrate**

This parameter specifies the maximum data rate (forward peak rate), in Kbps, of the ATM device for all LAN emulation connections.

Specify a decimal integer between 1 and the maximum data rate of the ATM device.

Default: data rate in Kbps

**Example:**

```
Ethernet IBM LEC Config> set forward-peakrate 155000
```

**keep-alive-count**

Specifies the number of times that the LEC sends a registration message without requiring a response from the LES.

**Valid Values:** 5 to 50

**Default Value:** 10

**Example:**

```
Ethernet IBM LEC Config> set keep-alive-count 20
```

**les-atm-address**

Sets the LES ATM address.

Specify the ATM address of the LES. *

**Note:** This command should be entered on one command line. It is shown here on two lines because of spacing.

**Example:**

```
Ethernet IBM LEC Config> set les-atm-address
      39.84.0F.00.00.00.00.00.00.00.00.00.01.10.00.5A.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.

**Valid Values:**
Any valid MAC address.

**Default Value:**
none

**Example:**

```
Ethernet IBM LEC Config> set mac-address
  Use adapter address for MAC? [No]
  MAC address []: 10.00.5a.00.00.01
```

**mac-cache-size**

Specifies the maximum number of MAC entries that the LEC caches.

**Valid Values:** 5 to 1024.

**Default Value:** 32

**Example:**

```
Ethernet IBM LEC Config> set mac-cache-size 48
```

**mac-cache-aging-period**

Specifies the amount of time (in seconds) after which MAC addresses are aged out of the cache, if not refreshed.

**Valid Values:** 1 to 300

**Default Value:** 60

**Example:**

```
Ethernet IBM LEC Config> set mac-cache-aging-period 120
```

**rd-cache-size**
Specifies the maximum number of route descriptor entries that the LEC caches.

**Valid Values:** 5 to 1024

**Default Value:** 32

**Example:**

```
Ethernet IBM LEC Config> set rd-cache-size 48
```

**rd-cache-aging-count**
Specifies the amount of time (in seconds) after which entries are aged out of the route descriptor cache, if not refreshed.

**Valid Values:** 1 to 300

**Default Value:** 60

**Example:**

```
Ethernet IBM LEC Config> set rd-cache-aging-period 120
```

**registration-interval**
Specifies the frequency (in seconds) that the LEC sends registration messages to the LES.

**Valid Values:** 30 to 240

**Default Value:** 60

**Example:**

```
Ethernet IBM LEC Config> set registration-interval 75
```

**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.

**Valid Values:**
An integer number in the range of 2 to 10.

**Default Value:**
3

**Example:**

```
Ethernet IBM 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** Sets packet trace for the LEC.

**Valid Values:**
Enable or Disable

**Default Value:**
Disable

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).

**Example:**

```
Token Ring LEC config>set trace
Trace packets on the LEC? [No]?yes
```

## 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 7, “The OPCON Process and Commands” on page 7-1.) 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 24-6 on page 24-25 shows the commands.

*Table 24-6. 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 2-3. |
| List | Lists:<br>• LEC Address Resolution Table (ARP)<br>• LEC configuration<br>• Data Direct VCC information<br>• LEC statistics<br>• VCC table. |
| MIB | Displays LEC MIB objects including:<br>• LEC MIB Configuration Table<br>• LEC MAC ARP Table<br>• LEC Route Descriptor Table<br>• LEC MIB Server VCC Tables<br>• LEC MIB Statistics Table<br>• 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" on page 28-15. |
| Trace | Sets packet tracing on or off. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## 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
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

                               Xmit  BUS   Arp
                       Conn   Queue Frame Retry Aging
 MAC Address     Remote Handle Depth Count Count Timer  Destination ATM Ad
                                                                    dress
 -----------------------------------------------------------------------
 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:**

```
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           = 00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   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:**

```
 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           = 39.84.07.00.00.00.00.00.00.00.00.00.00.01.10.00.5A.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
```

See “Set” on page 24-8 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    39.99.99.99.99.99.99.00.00.99.99.30.02.
                                         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

super-elan-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      = 155000000
 lecMulticastSendPeakRate     = 155000000
 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

**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

**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.
   ATM Address of LECS          = 00.00.00.00.00.00.00.00.00.00.00.00.00.00
   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.
   ATM Address of LES           = 00.00.00.00.00.00.00.00.00.00.00.00.01.10.00.5A.00.DE.AD.02
   lecProxyClient               = False                Is LES acting like a
                                                       proxy ?
```

**super-elan**

**Example:**

```
LEC+ mib super-elan
```

## 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” on page 28-15.

**Syntax:**

**qos-information**

# Chapter 25. Using LAN Emulation Services

This chapter describes how to use LAN Emulation Services for an Emulated LAN (ELAN).

## About LAN Emulation Services

LAN Emulation (LE) protocols allow ATM networks to appear as local area networks such as Ethernet or Token-Ring. An emulated LAN (ELAN) provides flexibility in handling moves, adds, and changes to your network topology. A client's association with an ELAN is logical and is independent of physical location. Consequently, reconfiguration is not required when a station is physically moved, provided the station's ELAN *membership* is retained. A station can be a member of multiple ELANs. Wiring modifications are not required when a station is moved from one ELAN to another.

An ELAN is a collection of LAN Emulation Clients (LECs) that are coordinated by LAN Emulation (LE) Services. There are three standard LE Services components that provide services for your ELANs:

- LE Server (LES)
- Broadcast and Unknown Server (BUS)
- LE Configuration Server (LECS)

This chapter describes configuration of the LES, BUS, and LECS components. For a description of LAN Emulation Client (LEC, not to be confused with LECS), refer to Chapter 23, "Using LAN Emulation Clients" on page 23-1.

The MSS Server has an additional LE Services component that provides a value-added security feature to LE Services. For additional detail on this security feature and on the overall LAN Emulation environment, refer to the *Multiprotocol Switched Services (MSS) Configuration and Operations Guide*.

# Chapter 26. Configuring and Monitoring LAN Emulation Services

This chapter describes how to configure and control operational LE services. Chapter 25, “Using LAN Emulation Services” on page 25-1 described the use of LE services. These commands can be used to modify the static memory of the router, and the changes would not take effect until the router is restarted.

There are many components to the LE Services monitoring environment. There is a component for the LECS, for the LES-LECS Security interface, and for each individual LES-BUS.

From the top-level LE Services console, you can enter into a monitoring environment for any particular component, or you can create a new LES-BUS component.

This chapter includes the following sections:



Individual LE Service components can be stopped, modified, or restarted without restarting the entire router.

## Accessing the LAN Emulation Services Environment

To get to the LE-services environment, enter the **le-services** command at the `ATM config>` prompt:

```
ATM config> le-services
LAN Emulation Services user configuration
LE Services config>
```

To start the configuration process, enter the following commands at the `LE Services config>` prompt:

*Table 26-1. LAN EMULATION Services 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 2-3. |
| Lecs | Enters the LECS Configuration environment. For additional information, see "Configuration Commands for a LECS" on page 26-15. |
| Les-bus | Enters the LES-BUS Configuration environment for a particular ELAN. For additional information, see "Configuration Commands for a LES-BUS" on page 26-4. |
| List | Lists all LES-BUSs that you have configured. |
| Rename | Changes the name of the LES-BUS. |
| Security | Enters the LES-LECS Security Interface Configuration environment. For additional information, see "Configuration Commands for Security for ELANs" on page 26-38. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

**Note:** For a description of addressing requirements in this environment, see "How to Enter Addresses" on page 20-1.

## Lecs

Type the **lecs** command at the `LE Services config>` prompt to enter the LECS Configuration environment. The LECS Configuration environment is characterized by the `LECS config>` prompt.

**Syntax:**

lecs

**Example:**

```
LE Services config> lecs
LAN Emulation Configuration Server configuration
LECS config>
```

For additional information, see "Configuration Commands for a LECS" on page 26-15.

## Les-bus

Type the **les-bus** command at the `LE Services config>` prompt to enter the LES-BUS Configuration environment for a particular LES-BUS. A selection list will appear, or you can use the **list** command to display all of the currently configured LES-BUSs. The LES-BUS Configuration environment is characterized by the `LES-BUS Config for ELAN 'n'>` prompt.

**Syntax:**

les-**bus** elan-name
item-number

**elan-name**
Name of the ELAN

**item-number**
Item number from selection list

**Example: les-bus**

```
LE Services config>les-bus
  (  1) <<< New LES/BUS >>>
  (  2) Test Ethernet Elan
  (  3) Test Token Ring Elan
Choice of LES/BUS [1]? 3
LES-BUS configuration
LES-BUS config for ELAN 'Test Token Ring Elan'>
```

**Example: les-bus** *elan-name*

```
LE Services config>les-bus Test Token Ring Elan
LES-BUS configuration
LES-BUS config for ELAN 'Test Token Ring Elan'>
```

**Example: les-bus** *item-number*

```
LE Services config>les-bus 3
LES-BUS configuration
LES-BUS config for ELAN 'Test Token Ring Elan'>
```

For additional information, see “Configuration Commands for a LES-BUS” on page 26-4.

## List

Enter the **list** command to display a list of all the ELANs that are served by LES-BUSs configured on the MSS Server.

**Syntax:**

**list**

**Example:**

```
LE Services config> list
List of Configured LES-BUS(s)

ELAN Type  (E=Ethernet/802.3, T=Token Ring/802.5)
| Interface #
| | Enabled                                             Max.
| | |                                                   Frame   Redundancy
| | | ELAN Name                       LES ESI       Sel  Size    Role
- - - ------------------------------- ------------  ---  -----   ----------
E 0 Y Test Ethernet Elan              400082104001  x02   4544   (disabled)
T 0 Y Test Token Ring Elan            400082104001  x03   4544   (disabled)
```

## Rename

Enter the **rename** command to change the name of a LES-BUS.

**Note:** If you rename a LES-BUS, simply restarting the LES-BUS from the LES-BUS Console will not reflect the newly configured name. To rename an operational LES-BUS, you must either reload, or use the LES-BUS Console command **delete**, then the LAN Emulation Services Console command **create**.

**Syntax:**

**rename**

**Example:**

```
LE Services config> rename
Existing ELAN Name []? test
New ELAN Name []? newtest
```

## Security

Type the **security** command to enter the LES-LECS Security Interface Configuration environment. This environment is characterized by the `LECS INTERFACE config>` prompt.

**Syntax:**

**security**

**Example:**

```
LE Service config> security
LECS Interface configuration
LECS INTERFACE config>
```

For additional information, see “Configuration Commands for Security for ELANs” on page 26-38.

## Configuration Commands for a LES-BUS

This section describes the commands for configuring a LES-BUS. Enter the **les-bus** command at the `LE Services config>` prompt. The following example defines a new LES-BUS.

```
LE Services config>les-bus
  (  1) <<< New LES/BUS >>>
  (  2) Test Ethernet Elan
  (  3) Test Token Ring Elan
Choice of LES/BUS [1]?
New ELAN Name (ELANxx) []? elan01
LES-BUS configuration
LES-BUS config for ELAN 'elan01'>
```

The following example allows you to change the configuration of an existing LES-BUS.

```
Choice of LES/BUS [1]? 3
LES-BUS configuration
LES-BUS config for ELAN 'Test Token Ring Elan'>
```

You can enter the following commands:

*Table 26-2 (Page 1 of 2). LES-BUS 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 2-3. |
| Add | Adds a LES-BUS to a local configuration. |
| Disable | Disables Broadcast Manager, BUS-Monitor, LES-BUS, Redundancy, Security, or Source Route Manager. |

| Table 26-2 (Page 2 of 2). LES-BUS Configuration Commands Summary | |
|---|---|
| Command | Function |
| Enable | Enables Broadcast Manager, BUS-Monitor, LES-BUS, Redundancy, Security, or Source Route Manager. |
| List | Lists the operational characteristics of a LES-BUS. |
| Remove | Removes Broadcast Static Entries or LES-BUS. |
| Set | Sets operational characteristics. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Add

Use the **add** command to specify this LES-BUS type, ESI, and selector.

Each LES-BUS must have a unique ELAN name, and the combination of ESI and selector must be unique among all LE components.

**Syntax:**

**add**

**Example:**

```
LES-BUS config for ELAN 'elan01'> add
Select ELAN type
        (1) Token Ring
        (2) Ethernet

Enter Selection: [1]1
Select ESI
        (1) Use burned in ESI

Enter Selection: [1]?1


Selector 0 is generally reserved for use by the LECS,
Selector 1 is generally reserved for use by the LECS interface.

Enter selector [4]?4
Selection "Add LES-BUS" Complete
LES-BUS config for ELAN 'elan01'>
```

## Disable

Use the **disable** command to disable Broadcast Manager, BUS-Monitor, LES-BUS, Redundancy, Security, or Source Route Manager.

**Syntax:**

| **disable** | bcm ... |
|---|---|
| | bus-monitor |
| | les-bus |
| | redundancy |
| | security |
| | source |

**bcm all** *or* **ip** *or* **ipx** *or* **netbios** *or* **ipx-server-farm**
Disables all (or individual) protocols for Broadcast Manager or IPX Server Farm Detection. Broadcast manager is an IBM enhancement to

the BUS that reduces broadcast traffic by transforming certain broadcast frames into unicast frames. See “Broadcast Manager” on page 19-13 for additional information about Broadcast manager. You can disable broadcast manager for all protocols, or for a specific protocol.

**bus-monitor**
Disables BUS-Monitor. BUS Monitor is an IBM enhancement to the BUS that monitors BUS traffic to identify those stations generating the most BUS traffic. See “BUS Monitor” on page 19-18 for additional information.

**les-bus** Disables LES-BUS. This LES-BUS will be deactivated on the next restart of the router.

**redundancy**
Disables redundancy. Redundancy is an IBM enhancement to the LES-BUS that allows each LES-BUS to have a backup that will activate only if the primary LES-BUS fails. See “LAN Emulation Reliability” on page 19-16 for additional information.

**security** Disables LECS validation of joins.

**source route management**
Disables Source Route Management for an 802.5 ELAN.

## Enable

Use the **enable** command to enable Broadcast Manager, BUS-Monitor, LES-BUS, Redundancy, Security, or Source Route Management.

**Syntax:**

| | |
|---|---|
| **enable** | bcm ... |
| | bus-monitor |
| | les-bus |
| | redundancy |
| | security |
| | source |

**bcm all** *or* **ip** *or* **ipx** *or* **netbios** *or* **ipx-server-farm**
Enables all (or individual) protocols for Broadcast Manager. Broadcast manager is an IBM enhancement to the BUS that reduces broadcast traffic by transforming certain broadcast frames into unicast frames. See “Broadcast Manager” on page 19-13 for additional information about Broadcast manager. You can enable broadcast manager for all protocols, or for a specific protocol.

**Note:** You cannot enable the Broadcast Manager while the BUS is in Adapter or VCC-Splice mode.

When *ipx-server-farm* and *BCM IPX* are enabled, BCM IPX detects the presence of at least ***server-farm-threshold*** IPX servers behind a single LEC. When a server farm is detected, BCM IPX subsequently transmits a single broadcast to the LEC that is proxying for the server farm.

**bus-monitor**
Enables BUS-Monitor. BUS Monitor is an IBM enhancement to the BUS that monitors BUS traffic to identify those stations generating the most BUS traffic. See “BUS Monitor” on page 19-18 for additional information.

**Note:** You cannot enable the BUS-Monitor while the BUS is in VCC-Splice mode.

**les-bus** Enables LES-BUS. This LES-BUS will be activated on the next restart of the router.

**redundancy**
Enables redundancy. Redundancy is an IBM enhancement to the LES-BUS that allows each LES-BUS to have a backup that will activate only if the primary LES-BUS fails. See “LAN Emulation Reliability” on page 19-16 for additional information.

**Example:**

```
LES-BUS config for ELAN 'elan01'> enable redundancy
Redundancy protocol role
        (1) Primary LES-BUS
        (2) Backup LES-BUS

Enter Selection:  [1]? 1

ATM address of backup les-bus in 00.00.00.. form [ ]?00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.01
Selection "Enable Redundancy" Complete
LES-BUS config for ELAN 'elan01'>
```

**security** Enables LECS validation of joins. If enabled, the LES-BUS communicates with the LECS across the LES-LECS Security Interface in order to validate each LE Client’s request to join the ELAN. The LES-LECS Security Interface for this ATM Interface must be enabled (see “Configuration Commands for Security for ELANs” on page 26-38).

**source route management**
Enables Source Route Management for an 802.5 ELAN. SRM can transform spanning tree explorer and all routes explorer packets into specifically routed frames. SRM operates only on those frames managed by BCM IP or BCM NetBIOS. See “BCM Support for Source Route Bridging” on page 19-15 for additional information.

**Note:** You cannot enable Source Route Management while the BUS is in Adapter or VCC-Splice mode.

## List

Use the **list** command to list LES-BUS configuration values for this ELAN.

**Syntax:**

**list**

As part of the prompt in the following example, the expression `"--More--"` appears numerous times. When this happens, you have three options:

- Press the **Enter** key. This is useful if you want to examine your configuration values one line at a time (just press the **Enter** key when you are ready to view the next line of values).
- Press the space bar to display an entire page of your configuration data. This option was used in the following example.
- Enter the character **q** to discontinue the list and return to the previous prompt.

**Example:**

```
LES-BUS config for ELAN 'elan01'> list

LES-BUS Detailed Configuration
Name:  CFG
   LES-BUS Enabled/Disabled:                  Enabled
   ATM Device number:                         0
   End System Identifier (ESI):               Use Burned in ESI
   Selector Byte:                             0x03
   ELAN Type:       (S2)                      Ethernet
   Max Frame Size:  (S3)                      1516
   Control Timeout: (S4)                      120
   Max Frame Age:   (S5)                      1
   ELAN Identifier: (S7)                      0 (not configured)
   Mcast Send Disconnect Timeout: (S9)        60
   LECID Range Minimum:                       0x0001
   LECID Range Maximum:                       0xFEFF
   Validate Best Effort Peak Cell Rate (PCR): No
   Control Distribute VCC Traffic Type:       Best Effort VCC
   Control Distribute VCC PCR in Kbps:        155000
   Control Direct VCC Max Reserved Bandwidth: 0
   Multicast Forward VCC Traffic Type:        Best Effort VCC
   Multicast Forward VCC PCR in Kbps:         155000
   Multicast Send VCC MAX Reserved Bandwidth: 0
    -LES-BUS Options-
   BUS Mode:                                  Adapter
   Security (LECS Validation of Joins):       Disabled
   Partition LE_ARP_REQUEST Forwarding Domain: Yes
   LE_ARP RESPONSE Destination:               One client
   Partition Unicast Frame Domain:            Yes
   Redundancy:                                Disabled
   ATM address trace filter value: 0000000000000000000000000000000000000000
   ATM address trace filter mask:  FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
    -BUS Monitor Configuration-
   Monitor Host Usage of BUS:                 Disabled
   # Top Hosts to Record:                     10
   # Seconds in each sample interval:         10
   # Minutes between sample intervals:        30
   Frame sampling rate:                       1 out of 10
    -Broadcast Manager Configuration-
   IP BCM:                                    Disabled
   IPX BCM:                                   Disabled
   NetBIOS BCM:                               Disabled
   BCM IP Cache Aging Time:                   5
   BCM IPX Cache Aging Time:                  3
   BCM NetBIOS Cache Aging Time:              15
   BCM IPX Maximum Forwarding List:           50
   BCM IPX Server Farm Detection:             Disabled
   BCM IPX Server Farm Threshold:             20
   No BCM IPX Static Entries defined
   LES-BUS config for ELAN 'elan01'>
```

# Remove

Use the **remove** command to remove broadcast static entries or a LES-BUS pair.

**Syntax:**

**remove** broadcast
les-bus

**broadcast**
Removes static entries defined for IPX Broadcast Manager.

**les-bus** Deletes the LES-BUS configuration.

**Example:** `remove broadcast`

```
Choose static entry to remove
        (1) 1234567890123456789012345678901234567890/FFFFFFFFFFFF
        (2) 2123456789012345678901234567890123456789/FFFFFFFFFFFF
        (3) 3212345678901234567890123456789012345678/FFFFFFFFFFFF
        (4) < CANCEL >

Enter Selection:  [1]? 4
Remove operation canceled.
```

# Set

Use the **set** command to set operational characteristics associated with this ELAN.

**Syntax**

**set** address
broadcast
bus-mode
bus-monitor

control
elan-identifier
frame-age
frame-size
ip
ipx-broadcast
ipx-maximum
ipx-server-farm
le-arp
lecid range
local-segment-identifier
multicast-send-disconnect-time
netbios
partition
trace
traffic

**address** Specifies the End System Identifier (ESI) and selector components of the LES-BUS's ATM address. For more information on addressing in ATM and on the ATM address of the LE components on the server see "Addressing in ATM" on page 19-3 and "ATM Addresses of LAN Emulation Components" on page 19-4.

**Example: `set address`**

```
Select ESI
        (1) Use burned in ESI

Enter Selection:  [1]?1
Selector 0 is generally reserved for use by the LECS,
Selector 1 is generally reserved for use by the LECS Interface.

Enter selector [7]?7
Selection "Set Address" Complete
LES-BUS config for ELAN 'elan01'>
```

**broadcast**

Defines static entries for IPX Broadcast Manager (BCM). IPX BCM dynamically discovers IPX routers and servers in the IPX network containing this ELAN by monitoring traffic sent to the BUS for IPX advertisements.

Uses for static targets are:

- Any device that requires reception of IPX advertisements that does not transmit advertisements must be configured as a static target. An example would be a station running software that discovers IPX network topology by monitoring IPX advertisements. Broadcast Manager for IPX is not aware of this "quiet" station without a static target definition of its MAC address and the address of the representing LEC.
- Use to hard-code a particular LEC as representing an IPX Server Farm.
- Use to exclude a LEC from being detected as a Server Farm by automatic IPX Server Farm Detection.

If the IPX Server Farm Detection function is disabled on this LES/BUS, you can use a static target effectively when many IPX routers and servers are represented by a single LEC. By configuring a static target with the ATM address of the LEC, but with a broadcast MAC address of all X'F's, all IPX routers and servers behind the LEC receive a single broadcast advertisement rather than multiple unicast 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*.

**Example: `set broadcast`**

```
Enter ATM address in 00.00.00.. form [ ]? 00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.01
Enter MAC address in 00.00.00.. form [FF.FF.FF.FF.FF.FF]?FF.FF.FF.FF.FF.FF
Selection "Set Broadcast Static Entry" Complete
LES-BUS config for ELAN 'elan01'>
```

**bus-mode** *mode*
Sets the bus mode for this LES-BUS. The different modes trade intelligence for increased forwarding speed of the LES-BUS. The modes are:

**System**
All BUS features are available and can be enabled or disabled. Frames received by the BUS are moved into system memory for analysis before transmission.

**Adapter**
Frames received for the BUS are not moved into system memory but remain on the ATM adapter until transmitted. If the ELAN is operational in this mode, the Broadcast Manager and Source Route Management are unavailable and cannot be enabled.

All BUS frames for token-ring ELANs are counted as multicast frames.

**VCC-Splice**
The client's multicast send VCC to the BUS is “spliced” to the multicast forward VCC, allowing the ATM adapter to transmit received frames from one VCC to its spliced VCC pair without notifying the system processor. Statistics are not maintained by the BUS.

**Notes:**

1. Unicast partitioning must be disabled to set the BUS mode to VCC-Splice.
2. If the ELAN is operational in this mode, the Broadcast Manager and Source Route Management are unavailable and cannot be enabled.
3. BUS Monitor is unavailable in VCC-Splice mode.

**Default value:** Adapter.

**bus-monitor** *settings*
Specifies sample interval, sampling rate, inter-sample sampling time, and the number of MAC addresses to record for BUS Monitoring. The BUS Monitor parameters control how often BUS Monitor samples

frames. More frequent sampling leads to more accurate results, but also requires more processing time at the BUS.

**Example:** **`set bus-monitor duration`**

```
Duration of sample interval in seconds (1-600) [10]?10
Selection "Set BUS monitoring sample interval" Complete
LES-BUS config for ELAN 'elan01'>
```

**Example:** **`set bus-monitor sample`**

A value of 10 means 1 out of every 10 frames is sampled.

```
Frame sampling rate (1-1000) [10]?10
Selection "Set the sampling rate" Complete
LES-BUS config for ELAN 'elan01'>
```

**Example:** **`set bus-monitor time`**

```
Number of minutes between sample intervals (1-120) [30]?15
Selection "Set BUS monitoring inter-sample time" Complete
LES-BUS config for ELAN 'elan01'>
```

**Example:** **`set bus-monitor top`**

```
Number of top MAC addresses to record (1-100) [10]?10

Selection "Set number of top MAC addresses to record" Complete
LES-BUS config for ELAN 'elan01'>
```

**control** Sets the control timeout, in seconds, for the LE Server. This is the timeout used for many of the response/request exchanges. This parameter maps to the S4 parameter in the *ATM Forum LAN Emulation Over ATM Specification*. A smaller control timeout may lead to quicker response times, but may also lead to unnecessary retransmissions. This parameter should be coordinated with the control timeout of LE clients joining this LES.

**Example:** **`set control`**

```
Control Timeout (10-300): [120]?120
Selection "Set Control Timeout" Complete
LES-BUS config for ELAN 'elan01'>
```

**elan-identifier**

This parameter sets the identifier for this elan that is returned to LECs in join response and is used by LECs to de-multiplex LLC-multiplexed VCCs.

**Valid Values:** 0 - X'FFFFFFFF'
**Default Value:** 0

**frame-age**

Sets maximum frame age. The BUS must discard a frame if it has not transmitted the frame to all relevant VCCs within the Maximum Frame Age following the BUS's receipt of the frame. This parameter maps to the S5 parameter in the *ATM Forum LAN Emulation Over ATM Specification*.

**Example:** **`set frame-age`**

```
Maximum Frame Age (1-4): [1]?1
Selection "Set Maximum Frame Age" Complete
LES-BUS config for ELAN 'elan01'>
```

**frame-size**

Sets maximum frame size. The maximum size of an AAL-5 Service Data Unit (SDU) that the LE Service can guarantee not to drop for being too large. Also the minimum AAl-5 SDU size that every LE Client must be able to receive. This parameter maps to the S3 parameter in the *ATM Forum LAN Emulation Over ATM Specification*

**Example: `set frame-size`**

```
Maximum Frame Size:
        (1) 1516
        (2) 1580
        (3) 4544
        (4) 9234
        (5) 18190

Enter Selection:  [2]?2
Selection "Set Maximum Frame Size" Complete
LES-BUS config for ELAN 'elan01'>
```

**ip-broadcast** *cache age*

Sets IP Broadcast cache age in minutes. This is the maximum number of minutes an IP entry will be kept without re-verification of its location.

**Example: `set ip`**

```
IP cache age in minutes (2-20): [5]?5
Selection "Set IP broadcast cache age" Complete
LES-BUS config for ELAN 'elan01'>
```

**ipx-broadcast** *cache age*

Sets IPX Broadcast cache age in minutes. This is the maximum number of minutes an IPX entry will be kept without re-verification of its location.

**Example: `set ipx-broadcast`**

```
IPX cache age in minutes (1-10): [3]?3
Selection "Set IPX broadcast cache age" Complete
LES-BUS config for ELAN 'elan01'>
```

**ipx-maximum** *size of forwarding list*

Sets the maximum number of entries that BCM IPX will maintain in its forwarding list. The value of this parameter must be > the value of *ipx-server-farm threshold*.

**Note:** This parameter sets an upper limit to the device's performance, so use caution when increasing this limit. BCM IPX's forwarding list consists of one entry for each:

- BCM static target currently active on the ELAN
- LEC detected to be a server farm if IPX Server Farm Detection is enabled
- Dynamically discovered IPX router or server in the IPX network containing this ELAN.

  Individual routers and servers represented by a detected server farm or BCM static target do not count toward this limit.

Each broadcast frame managed by BCM IPX is individually transmitted to each member on the forwarding list. If the number of members ever exceeds the maximum, BCM IPX automatically shuts down, allowing BUS to forward IPX broadcasts as usual.

**Example: `set ipx-maximum`**

```
IPX Maximum Size of Forwarding List (5-65535): [50]? 60
Selection "Set IPX Maximum Size of Forwarding List" Complete
```

**ipx-server-farm**

Sets the minimum number of IPX routers and servers behind a given LEC required for BCM IPX Server Farm Detection to detect a server farm. 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 device in the server farm. The value of this parameter must be ≤ the value specified for *ipx-maximum size of forwarding list*. See “Broadcast Manager” on page 19-13 for additional information.

**Valid Values:** 2 - 65535
**Default Value:** 20

**lecid** *range*

Sets bounds on the range of lecids used by this LES. By configuring a lecid range, you can guarantee that all LESs within a Super ELAN use a disjoint set of lecids. Maintaining lecid uniqueness within a Super ELAN is required if any clients filter data-direct VCCs based on lecid, or if any clients do not implement the (C22) path switch delay timer.

This parameter can also be used to limit the number of clients served by this LES-BUS.

**local-segment-number**

This parameter sets the local segment identifier for token-ring ELANs.

**Valid Values:** 0 - X'0FFF'
**Default Value:** 0

**multicast-send-disconnect-timeout**

This parameter sets the maximum number of seconds that a LEC may be connected to the LES (using Control VCCs) but not connected to the BUS (using Multicast VCCs). If a LEC remains in such a state for this amount of time, the LES must terminate the ELAN membership of the LEC.

**Valid Values:** 10 - 300 seconds
**Default Value:** 60

**netbios** *broadcast cache age*

Sets NetBIOS cache age in minutes. This is the maximum number of minutes an NetBIOS will be kept without re-verification of its location.

**Example:** **`set netbios`**

```
NetBIOS cache age in minutes (10-20): [15]?12
Selection "Set NetBIOS broadcast cache age" Complete
LES-BUS config for ELAN 'elan01'>
```

**partition** Partitions the *control distribute* or *multicast forward* VCCs.

Proxy clients are placed on one Control Distribute VCC and all other clients are placed on another Control Distribute VCC. Partitioning the VCCs reduces nuisance traffic at many clients because non-proxy LECs do not receive proxy LEC traffic, and vice-versa. However, some frames must now be forwarded on two VCCs. In general, partitioning the VCCs is recommended.

The **set partition address** command partitions the control distribute VCC into a “proxy control distribute” VCC and a “non-proxy control distribute” VCC.

**Example:** **`set partition address`**

```
Partition address resolution forwarding domain [yes]yes
Selection "Partition address resolution forwarding domain" Complete
LES-BUS config for ELAN 'elan01'>
```

The **set partition unicast** command partitions the multicast forward VCC into a “proxy multicast forward” and a “non-proxy multicast forward” VCC.

**Note:** Unicast partitioning can not be set to *yes* when BUS Mode is set to *VCC-Splice*.

**Example:** `set partition unicast`

```
Partition unicast frame forwarding domain [yes]?no
Selection "Partition unicast frame domain" Complete
LES-BUS config for ELAN 'elan01'>
```

**trace mask** *or* **value**

Sets trace filter mask or trace filter value for ATM address. For each VCC, if the ATM address of the entity at the other end of the VCC matches the ATM-address-value on all bits set by the ATM-address-mask, then packet tracing *can* be performed on that VCC. For packet tracing to occur, enable it in the ELS subsystem (for additional information, refer to Chapter 15, “Using the Event Logging System (ELS)” on page 15-1.

**Example:** `set trace mask`

```
LES-BUS config for ELAN 'elan01'>set trace mask
ATM address trace filter mask [FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF]?
Selection "Set ATM address trace filter mask" Complete
LES-BUS config for ELAN 'elan01'>set trace value
ATM address trace filter value [00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00]?
Selection "Set ATM address trace filter value" Complete
```

**traffic ...** Sets traffic characteristics:

- *set traffic control* sets traffic characteristics of the “control distribute” VCC.

  **Example:** `set traffic control`

  ```
  Traffic type
          (1) Best Effort
          (2) Reserved Bandwidth

  Enter Selection:  [1]?1

  Peak cell rate in Kbps (1 - 155000) [155000]?155000

  Selection "Set Control distribute VCC" Complete
  LES-BUS config for ELAN 'elan01'>
  ```

- *set traffic maximum control* or *set traffic maximum multicast* sets the maximum reserved bandwidth allowed either on control direct or on multicast send reserved bandwidth VCCs. Reserved bandwidth VCCs with requested bandwidth higher than the maximum specified by this command are rejected.

  **Example:** `set traffic maximum control`

  ```
  Maximum reserved bandwidth in Kbps (0 - 155000) [0]?100000
  Selection "Set Control Direct VCC maximum reserved bandwidth" Complete
  LES-BUS config for ELAN 'elan01'>
  ```

- *set traffic multicast* sets traffic characteristics of the multicast forward VCC.

  **Example:** `set traffic multicast`

```
Traffic type
        (1) Best Effort
        (2) Reserved Bandwidth

Enter Selection:  [1]?1

Peak cell rate in Kbps (1 - 155000) [155000]?90000

Selection "Set Multicast Forward VCC" Complete
LES-BUS config for ELAN 'elan01'>
```

- *set traffic validate* determines whether the LES-BUS is to validate the peak cell rate specified on incoming control direct or multicast send VCCs. When you specify this command, the LES-BUS rejects all control direct or multicast send VCCs that specify a peak cell rate that is greater than the maximum data rate of the ATM interface.

  **Example: `set traffic validate`**

```
Validate peak cell rate of best effort VCCs [no]no
Selection "Validate Peak Cell Rate of best effort VCCs" Complete
LES-BUS config for ELAN 'elan01'>
```

## Configuration Commands for a LECS

Enter the **lecs** command at the `LE Services config>` prompt to enter the `LECS config>` environment where you initiate configuration for the individual ELANS for your network.

*Table 26-3. LECS 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 2-3. |
| Access-control | Provides ATM address screening for security at the LECS. |
| Add | Adds a LECS to the static configuration of the ATM network. |
| Elans | Configures the ELANs under the administrative domain of the LECS. |
| List | Lists the configuration of the LECS on the MSS Server. |
| Policies | Configures the policies guiding this LECS. |
| Remove | Removes the LECS from the static configuration of the ATM network. |
| Search | Lets you use "search keys" to simplify configuration management. |
| Set | Sets operational characteristics of the LECS. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Access-control

The **access-control** command puts you in the LECS Access Control configuration environment. These commands allow you to configure a list of ATM address prefixes ( 1 - 20 octets) which are not allowed access to the LECS configuration database. All LECS connection attempts and configuration requests from matching ATM addresses are rejected. The LECS Access Control configuration environment is characterized by the `LECS Access Control config>` prompt.

**Syntax:**

**access-control**

**Example:**

```
LECS config> access-control
LECS Access Control config>
```

For additional information, see “Configuration Commands for the Access Control of a LECS” on page 26-19.

## Add

The **add** command adds a LECS to the static configuration of the MSS Server. You are prompted to select the ESI to be used in the ATM address of the LECS. You are also asked to select whether to activate error logging on the LECS subsystem. For further information on error logging, see “ELS Configuration Commands” on page 16-1.

**Syntax:**

add

**Example:**

```
LECS config> add
  (  1) Use burned in ESI
End system identifier [1]?yes
LECS added to configuration
Enable standard Error Logging System for LECS? [Yes] Y
Standard ELS activated for LECS
LECS config>
```

## Elans

Type the **elans** command to enter the LECS ELANs Configuration environment. In this environment, you configure all ELANs under the administrative domain of the LECS. This environment is characterized by the `LECS ELANS config>` prompt.

**Syntax:**

elans

**Example:**

```
LECS config> elans
Configuration of ELANs for LECS
LECS ELANS config>
```

For a description of commands used in the `LECS ELANS config>` environment, see “Configuration Commands for ELANs at the LECS” on page 26-20.

## List

The **list** command displays the configuration of the LECS. The various configuration parameters are described under “Set” on page 26-18.

**Syntax:**

list

**Example:**

```
LECS config>list
LECS Detailed Configuration
   Lecs is                                     Enabled
   ATM Device number:                          0
   ESI:                                        Use burned in ESI
   Selector:                                   0x00
   Validate Best Effort PCR:                   No
   Configuration Direct Max Reserved BW (Kbps): 0
   Maximum number of simultaneous VCCs:        128
   Idle VCC Timeout (in seconds):              60
   Trace ATM address value: 00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
   Trace ATM address mask:  FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF
```

## Policies

The **policies** command puts you in the LECS Policies Configuration environment. In this environment, you configure the policies used to guide the LECS operation. The LECS Policies Configuration environment is characterized by the `LECS Policies config>` prompt.

**Syntax:**

p**olicies**

**Example:**

```
LECS config> policies
LECS Policies config>
```

For additional information, see “Configuration Commands for the Policies of a LECS” on page 26-36.

## Remove

The **remove** command removes the LECS from the static configuration of the MSS Server. You are prompted whether to remove all other LECS objects (for example, policies and ELANs) from the static configuration also.

**Syntax:**

r**emove**

**Example:**

```
LECS config>remove
Are you sure that you want to delete all LECS information from this configuration [no]? yes
Removed all policies and ELANs for LECS from configuration
Removed LECS
Selection "LAN Emulation Configuration Server (LECS) remove" Complete
LECS config>
```

## Search

The **search** command provides “search keys” to simplify configuration management. Each search key represents some unique aspect of LE Servers or LE Clients (ATM address, MAC address, name of ELAN, and so on). Search keys can be used to determine which ELAN a particular LES is serving, or to which LES a certain policy value is assigned.

**Syntax:**

| | |
|---|---|
| sea**rch** | atm |
| | les |
| | mac |
| | name |

route

**Example:** **search mac**

```
LECS config> search mac
Enter MAC address using its natural bit-order
MAC address to search for [ ]?11.11.11.11.11.11
MAC address 11.11.11.11.11.11
   for LES 00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00
      for ELAN 'lgrove01'
LECS config>
```

## Set

The **set** command lets you change the operational characteristics of the LECS.

**Syntax:**

set
- address
- enable-disable
- maximum
- reserved
- trace
- validate
- vcc

**Example:**

```
LECS config> set address
End system identifier
        (1) Use burned in ESI

Enter Selection: [1]?
Selector 0 is generally reserved for the LECS and
selector 1 is generally reserved for the LECS interface.
Selector [0]?4
Selector of LECS' ATM address is 4
Selection "LECS address modification" Complete
LECS config>
```

**Address**
Changes the address of the LECS. This is the local ATM address of the LECS. At the ATM switches, you may also configure the well-known LECS address to be associated with this local ATM address. See "Addressing in ATM" on page 19-3 for additional information about addressing.

**Enable/Disable**
Enables or disables the LECS. If the LECS is disabled, it will not be started the next time the router is restarted.

**Maximum number of VCCs**
Maximum number of configuration direct VCCs that the LECS supports at one time. If the actual number of VCCs to the LECS exceeds this number, the LECS releases *all* VCCs that have not been used in the number of seconds specified by the VCC idle time (described below).

**Reserved bandwidth maximum**
Maximum bandwidth (in Kbps) that the LECS accepts on any reserved band-width configuration direct VCC.

**Trace** *value* **or** *mask*
Each LE component supports packet tracing. You can specify an ATM address filter for packet tracing. For each VCC, if the ATM address of the entity at the other end of the VCC matches the ATM-address-value on all bits set by the

ATM-address-mask, then packet tracing *can* be performed on that VCC. For packet tracing to occur, enable it in the ELS subsystem (for additional information, refer to Chapter 15, “Using the Event Logging System (ELS)” on page 15-1.

**Validate best effort peak cell rate**
Answer **yes** or **no**.

When you configure the LECS to validate best effort PCR, the peak cell rate (specified while setting up each VCC) is examined. If the peak cell rate is greater than the maximum date rate of the ATM interface, the requested VCC is rejected.

**VCC idle time**
Number of seconds (of idle time) before LECS releases VCCs that have not been used when the number of VCCs exceeds the number that the LECS supports. (See also “Maximum number of VCCs” above.)

## Configuration Commands for the Access Control of a LECS

Use the **access-control** command to configure ATM address screening at the LECS. The following commands can be issued at the LECS Config> command prompt:

*Table 26-4. Access Control 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 2-3. |
| Add | Adds an ATM address to the screening list. |
| Disable | Disables ATM address screening. |
| Enable | Enables ATM address screening. |
| List | Displays the ATM address screening list. |
| Remove | Removes an ATM address from the screening list. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## Add

The **add** command adds an ATM address prefix (1 - 20 octets) to the access control screening list.

**Syntax:**

**add** ***atm-address-prefix***

**Example:**

```
LECS Access Control config>add
Suspect ATM address choice []? 39999999999999000099990101
Added suspect ATM address '39.99.99.99.99.99.99.00.00.99.99.01.01' successfully
LECS Access Control config>
```

## Disable

The **disable** command disables an address prefix for access control screening.

**Syntax:**

**disable** ***atm-address-prefix***

## Enable

The **enable** command enables an address prefix for access control screening.

**Syntax:**

**enable** ***atm-address-prefix***

## List

The **list** command displays the access control screening list.

**Syntax:**

**list**

**Example:**

```
LECS Access Control config>list

Suspect ATM addressess for LECS

Enabled  Suspect Atm Address
=======  ========================================================
    Yes   39.99.99.99.99.99.99.00.00.99.99.01.01

LECS Access Control config>
```

## Remove

The **remove** command removes an ATM address prefix from the access control screening list.

**Syntax:**

**remove** ***atm-address-prefix***

# Configuration Commands for ELANs at the LECS

The primary function of the LECS is to assign clients to LESs that serve ELANs. You enter commands at the `LECS ELANs config>` prompt to configure all of the ELANs under the administrative control of the LECS. Before *any* client for a particular ELAN can use this LECS, information on that ELAN must be configured on this LECS. Even if an ELAN is served by a local LES-BUS, the ELAN information must be configured here if the LECS is to refer any clients to that ELAN.

To configure ELANs under the administrative domain of the LECS, enter the **elans** command at the `LECS config>` prompt:

```
LECS config> elans
Configuration of ELANs for LECS
LECS ELANs config>
```

You can enter the following commands at the `LECS ELANs config>` prompt:

*Table 26-5. LECS ELANs 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 2-3. |
| Add | Adds an ELAN to the static configuration administered by the LECS. |
| List | Summarizes the ELANs that are under the administrative control of the LECS. |
| Remove | Removes an ELAN from the static configuration administered by the LECS. |
| Select elan | Selects an ELAN for more detailed configuration. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Add

The **add** command adds an ELAN to the static configuration administrated by the LECS. You will be prompted for the ELAN name, type, and maximum frame size.

**Syntax:**

**add**

**Example:**

```
LECS ELANs config> add
Name of ELAN [ ]? cary02
Type of ELAN
     (1) Ethernet
     (2) TokenRing
Enter Selection:  [2]? 2
Maximum frame size of ELAN
        (1) 1516
        (2) 4544
        (3) 9234
        (4) 18190
        (5) 1580
Enter Selection:  [2]? 2
ELAN 'cary02' added
Selection "ELAN addition" complete
LECS ELANs config>
```

## List

The **list** command summarizes the ELANs under the administrative domain of the LECS.

**Syntax:**

**list**

**Example:**

```
LECS ELANs config> list

ELAN Listing...
                               Name   Type   Packet Size   Enabled
===================================   ====   ===========   =======
                              ELAN1   TokR          4544   Yes
                              ELAN2   TokR          4544   Yes
LECS ELANs config>
```

## Remove

The **remove** command prompts you remove an ELAN from the static configuration administered by the LECS. After you enter your choice, a confirmation is displayed.

**Syntax:**

**remove**

**Example:**

```
LECS ELANs config>remove
Choice of ELAN
        (1) All
        (2) cary01
        (3) cary02
        (4) < CANCEL >

Enter Selection:  [1]? 3
Removed ELAN 'cary02'
Selection "ELAN removal" Complete
```

## Select

The **select** command prompts you to select an ELAN for additional (detailed) configuration.

**Syntax:**

**select**

**Example:**

```
LECS ELANS config> select
  (  1) cary01
  (  2) lgrove01
  (  3) lgrove02
  (  4) lgrove03
Choice of ELAN [1]?2
ELAN 'lgrove01' selected for detailed configuration

Selected ELAN 'lgrove01'>
```

Additional information on detailed configuration can be found at "Configuration Commands for ELAN Detailed Configuration."

# Configuration Commands for ELAN Detailed Configuration

This section provides examples of configuring an ELAN in detail. It assumes that you already have completed the configuration requirements outlined in "Configuration Commands for ELANs at the LECS" on page 26-20. Detailed configuration is done from the `ELAN 'elan-name' selected for detailed configuration>` prompt. For example:

```
LE Services config> lecs
Lan Emulation Configuration Server configuration
LECS config> elans
Configuration of ELANs for LECS
LECS ELANs config> select
  (  1) cary01
  (  2) lgrove01
  (  3) lgrove02
  (  4) lgrove03
Choice of ELAN [1]?2
ELAN 'lgrove01' selected for detailed configuration
Selected ELAN 'lgrove01'>
```

Use the following commands for detailed configuration:

*Table 26-6. LECS ELANs Detailed 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 2-3. |
| Les | Manages the LESs that serve the selected ELAN. |
| List | Lists the configuration of the selected ELAN. |
| Policy | Manages the policy values assigned to the LESs serving the selected ELAN. |
| Set | Enables or disables the selected ELAN, and manages the name, type, and maximum frame size of the ELAN. |
| ELAN-tlv | Manages TLVs associated with the selected ELAN. |
| LEC-tlv | Allows TLVs to be associated with an ELAN policy that is identified by ATM address, MAC address, route descriptor, or ELAN name. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Les

*Table 26-7. Selected ELAN LES 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 2-3. |
| Add | Adds a LES address to the ELAN static configuration administered by the LECS. |
| Disable | Disables a LES address in the ELAN static configuration administered by the LECS. |
| Enable | Enables a LES address in the ELAN static configuration administered by the LECS. |
| List | Summarizes the LES configuration for the ELANs that are under the administrative control of the LECS. |
| Remove | Removes a LES address. |
| Set | Sets ELAN static configuration parameters. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

Use the **les** command to manage the LES ATM addresses that represent LESs serving the selected ELAN. The ATM address of each LES serving this ELAN must exist here. Each LES ATM address can consist of two addresses, a primary LES address and a backup LES address. The backup LES address serves as a hot standby LES that activates when the primary LES goes down. The LECS permits two types of backups to be configured: backup LESs that utilize the IBM LES Redundancy VCC as specified in “LAN Emulation Reliability” on page 19-16, and backup LESs that do not.

The difference between these two options is that in the former option, the LECS attempts to use information on local LESs to determine the correct LES for the client. For example, the LECS can query a local backup LES to determine if the LES is currently in active or in standby mode. In the latter option, the LECS alternately assigns a client to the primary and backup, regardless of any local information. For more information on the redundancy features of the LES, see “LAN Emulation Reliability” on page 19-16 or the IBM 8210 Multiprotocol Switched Services Server Configuration Program User’s Guide.

You will be prompted to enter the ATM address of the primary and backup LES. If either of the LESs is located on the same MSS Server, then you can select the local option when prompted. Using this option, you do not need to know the 20-byte ATM address of the LES; it will be determined at run-time. If no backup support is provided for a particular LES, select the unspecified option.

For the **les disable**, **les enable**, and **les remove** commands, you are asked to select the LES to which the action applies.

The **les list** command displays the ATM address information for all LESs serving the selected ELAN.

Commands that can be used with the **les** command are illustrated in the following examples:

**Syntax:**

| | |
|---|---|
| <u>le</u>**s** | <u>a</u>dd |
| | <u>d</u>isable |
| | <u>e</u>nable |
| | <u>l</u>ist |
| | <u>r</u>emove |
| | <u>s</u>et ... |

**Example:**

```
Selected ELAN 'lgrove01'>les add
  (  1) Local
  (  2) Remote
Primary LES is [1]? 2
If primary LES is remote, enter ATM address
         []? 39.999999999999.000099990101.222222222222.04
  (  1) Unspecified
  (  2) Local
  (  3) Remote
Backup LES is  [1]? 3
If backup LES is remote, enter ATM address
         []? 39.999999999999.000099990102.001bcda02038.07
Do the LESs utilize IBM LES redundancy? [Yes]?: yes
LES ATM address 39.99.99.99.99.99.99.00.00.99.99.01.01.22.22.22.22.2
    added to ELAN 'lgrove01'
```

**Example:**

```
Selected ELAN 'lgrove01'>les disable
  ATM address of LES for ELAN
   (1) All
   (2) Local LES for: lgrove01

Enter Selection:  [1]?2
LES disabled: Local LES for: lgrove01
Selection "LES disable" Complete
Selected ELAN 'lgrove01'>
```

**Example:**

```
Selected ELAN 'lgrove01'>les enable
  ATM address of LES for ELAN
   (1) All
   (2) Local LES for: lgrove01

Enter Selection:  [1]?2
LES enabled: Local LES for: lgrove01
Selection "LES ATM address enable" Complete
Selected ELAN 'lgrove01'>
```

**Example:**

```
Selected ELAN 'lgrove01'>les list
LESs for ELAN 'lgrove01'

Enbld  LES ATM address
=====  ===========================================================
Yes  Local LES for: lgrove01
     no backup provided
Selected ELAN 'lgrove01'>
```

**Example:**

```
Selected ELAN 'lgrove01'>les remove
ATM address of LES for ELAN

 (1) All
 (2) Local LES for: lgrove01
 (3) < CANCEL >
Enter Selection:  [1]?2
Values assigned to LES removed
Delete LES: Local LES for: lgrove01
Selection "LES ATM address removal" Complete
Selected ELAN 'lgrove01'>
```

Use the **les set** command to modify the configuration of a particular LES. Use the **les set primary** command to modify the ATM address of the primary LES, and use the **les set backup** command to modify the ATM address of the backup LES.

**Example: `les set backup`**

```
  Selected ELAN 'lgrove01'>les set ba
    (  1) Local LES for: lgrove01
    (  2) 39.99.99.99.99.99.99.00.00.99.99.01.01.22.22.22.22.22.22.04
  Choice of LES [1]? 2
    (  1) Unspecified
    (  2) Local
    (  3) Remote
  Backup LES is  [3]? 3
  If backup LES is remote, enter ATM address
           [39.99.99.99.99.99.99.00.00.99.99.01.02.00.1B.CD.A0.20.38.06]?
  39.99.99.99.99.99.99.00.00.99.99.01.02.00.1B.CD.A0.20.38.06
  Do the LESs utilize IBM LES redundancy?? [Yes]: no
  Backup LES ATM address modified
```

#### Example: `les set primary`

```
Selected ELAN 'Accounting Ethernet Elan'> les set primary
  (  1) Local LES for: Accounting Ethernet Elan

Choice of LES [1]?1
  (  1) Local
  (  2) Remote

Primary LES is [1]?2
If primary LES is remote, enter ATM address
[Local LES for: Accounting Ethernet Elan]?39.00.00.00.00.00.00.d0.d0.d0.d0.d0.d0.10.10.10.10.10.10.03

Primary LES ATM address modified
Selected ELAN 'Accounting Ethernet Elan'>
```

## List

The **list** command provides the following information:

**Syntax:**

**list**

#### Example: `list`

```
Selected ELAN 'lgrove01'> list
ELAN Configuration:
ELAN is          Enabled
Name:            'lgrove01'
ELAN Type:       TokenRing
Max Frame Size:  1516
Selected ELAN 'lgrove01'>
```

## Policy

Use the **policy** command to add, disable, enable, list, or remove policy values that are assigned to the LESs serving the selected ELAN.

**add**

Use the **policy add** command to add a binding between a policy value and a LES to the static configuration of the LECS. Policy values are used to assign clients to LESs. Refer to "Overview of the LECS Function" on page 19-5 for details on how the LECS uses policy values to assign LECs to LESs.

**Syntax:**

**policy add** pv_type

Where *pv_type* is either:

- ESI/SEL of ATM address
- FRAME size
- MAC address
- NAME of ELAN
- PREFIX of ATM Address
- ROUTE descriptor
- TYPE of Elan

**Example:**

```
Selected ELAN 'lgrove01'>policy add prefix
 ATM address of LES for policy value(s)

  (1) Local LES for: lgrove01

Enter Selection:  [1]?1
ATM prefix [ ]?55
ATM address prefix 55
bound to LES Local LES for: lgrove01
Configure another address?? [Yes]:no
Selected ELAN 'lgrove01'>
```

### disable

Use the **policy disable** command to disable a policy value in the static configuration of the LECS. This policy value will not become active on the next router restart.

**Syntax:**

**policy disable** pv_type

Where *pv_type* is either:

- ESI/SEL of ATM address
- FRAME size
- MAC address
- NAME of ELAN
- PREFIX of ATM address
- ROUTE descriptor
- TYPE of ELAN

**Example:**

```
Selected ELAN 'lgrove01'>policy disable prefix
ATM prefix
(1) All
(2) 55
LES for: lgrove01
Enter Selection:   [1]? 2
ATM value disabled: 55
Selection "ATM address disable" Complete
Selected ELAN 'lgrove01'>
```

### enable

Use the **policy enable** command to enable a policy value in the static configuration of the LECS. The policy value must be enabled to become active at the next router restart.

**Syntax:**

**policy enable** pv_type

Where *pv_type* is either:

- ESI/SEL of ATM address
- FRAME size
- MAC address
- NAME of ELAN
- PREFIX of ATM address
- ROUTE descriptor
- TYPE of ELAN

**Example:**

```
Selected ELAN 'lgrove01'>policy enable prefix
ATM prefix
 (1) All
 (2) 25                              to Local LES for: lgrove01
 (3) 55                              to Local LES for: lgrove01

Enter Selection:  [1]?1
Enabled all ATM prefixes for ELAN 'lgrove01'
Selection "ATM address enable" Complete
Selected ELAN 'lgrove01'>
```

### list

Use the **policy list** command to display all of the policy values assigned to LESs of the selected ELAN.

**Syntax:**

**policy list** pv_type

Where *pv_type* is either:

- all
- ESI/SEL of ATM address
- FRAME size
- MAC address
- NAME of ELAN
- PREFIX of ATM address
- ROUTE descriptor
- TYPE of ELAN

**Example:**

```
Selected ELAN 'lgrove01'>policy list prefix
ATM prefixes for ELAN 'lgrove01'
Enabled  Value  =>  LES
=======  ==========================================
 Yes     55
  => Local LES for: lgrove01
 Yes     25
  => Local LES for: lgrove01

Selected ELAN 'lgrove01'>
```

### remove

Use the **policy remove** command to remove policy values from the static configuration of the LECS. You will be prompted to select the policy value to remove.

**Syntax:**

**policy rremove** pv_type

Where *pv_type* is either:

- ESI/SEL of ATM address
- FRAME size
- MAC address
- NAME of ELAN
- PREFIX of ATM address
- ROUTE descriptor
- TYPE of ELAN

**Example:**

```
Selected ELAN 'lgrove01'>policy remove prefix
 ATM prefix
  (1) All
  (2) 55          to Local LES for: lgrove01
LES for: lgrove01

Enter Selection:   [1]? 2
ATM addr prefix deleted: 55
Selection "ATM address removal" Complete
Selected ELAN 'lgrove01'>
```

## Set

Use the **set** command to modify the configuration of the selected ELAN. You can enable or disable the ELAN, or modify its name, type, or maximum frame size. Parameters that you can use with the **set** command are illustrated in the following examples:

**Syntax:**

| | |
|---|---|
| **set** | enable-disable |
| | frame |
| | name |
| | type |

**Example:**

```
Selected ELAN 'lgrove01'>set enable-disable
Enable ELAN for LEC assignment [yes]yes
ELAN enable-disable modified
Selection "ELAN enable-disable modification" Complete
Selected ELAN 'lgrove01'>
```

Example:

```
Selected ELAN 'lgrove01'>set frame
Maximum frame size of ELAN
 (1) 1516
 (2) 4544
 (3) 9234
 (4) 18190
 (5) 1580
Enter Selection:  [2]?2
ELAN max frame size modified
Selection "ELAN max frame size modification" Complete
Selected ELAN 'lgrove01'>
```

**Example:**

```
Selected ELAN 'lgrove01'> set name
Name of ELAN [lgrove01]lgrove001
ELAN name changed to 'lgrove001'
Selection "ELAN name modification" Complete
Selected ELAN 'lgrove001'>
```

**Example:**

```
Selected ELAN 'lgrove01'>set type
Type of ELAN
 (1) Ethernet
 (2) TokenRing

Enter Selection:  [2]?2
ELAN type modified
Selection "ELAN type modification" Complete
Selected ELAN 'lgrove001'>
```

## ELAN-TLV

Type/length/values (TLVs) are optional configuration parameters that can be returned to all clients assigned to the selected ELAN. ELAN-TLVs are TLVs that should be returned to all clients assigned to the selected ELAN.

See "LEC-TLV" on page 26-34 for information about configuring TLVs that are returned to a particular LEC assigned to the selected ELAN.

*Table 26-8. Selected ELAN-TLV 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 2-3. |
| Add | Adds a TLV to the selected ELAN. |
| Disable | Disables a TLV for the selected ELAN. |
| Enable | Enables a TLV for the selected ELAN. |
| List | List the configured ELAN-TLVs. |
| Remove | Removes a TLV from the selected ELAN. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

Use the **elan-tlv add** command to add the specified TLVs of the selected ELAN. You can use the following parameters with the **elan-tlv** command:

- ATM Forum TLVs
- IBM TLVs
- MPS (MPOA Server) TLVs
- MPC (MPOA Client) TLVs
- User Defined TLVs

**elan-tlv add**

**Syntax:**

**elan-tlv add** atm

Choose from :

- C7 : Control timeout
- C10:Maximum unknown frame count
- C11:Maximum unknown frame time
- C12:VCC timeout period
- C13:Maximum retry count
- C17:Aging time
- C18:Forward delay time
- C20:Expected LE_ARP response time
- C21:Flush timeout
- C22:Path switching delay

- C23:Local segment ID
- C24:Mcast send VCC type
- C25:Mcast send VCC avg rate
- C26:Mcast send VCC peak rate
- C28:Connection complete timer
- C31: ELAN Identifier
- C35: Preferred LES

**Syntax:**

**elan-tlv add** ibm

Choose from :

- I4: Validate PCR of DDVCCs
- I5: Maximum Reserved Bandwidth of DDVCCs
- I6: Requested DDVCC Type
- I7: Requested DDVCC Peak Cell Rate
- I8: Requested DDVCC Avg Cell Rate
- I9: Requested DDVCC QoS Class
- I10: Negotiate Cell Rates on DDVCCs
- I11: Maximum burst size of DDVCCs

**Syntax:**

**elan-tlv add** mps

Choose from :

- p1: Keep-Alive Time
- p2: Keep-Alive Lifetime
- p3: InternetWork-layer Protocols
- p4: Initial Retry Time
- p5: Retry Time Maximum
- p6: Give-up Time
- p7: Hold Down Time

**Syntax:**

**elan-tlv add** mpc

Choose from :

- p1: SC-Setup Frame Count
- p2: SC-Setup Frame Time
- p3: Flow-detection Protocols
- p4: Initial Retry Time
- p5: Retry Time Maximum
- p6: Hold Down Time

**Syntax:**

**elan-tlv add** user

You can define and add their own TLVs.

**Example:**

```
Selected ELAN 'joe'> elan-tlvs add user
Type of TLV (in hex) [0]
Description of TLV user-tlv example
Length of TLV [4]
Value of TLV (in hex) [] cabacaba
TLV added: user-tlv example
Selection "Flush timeout TLV add" Complete
Selected ELAN 'joe'>
```

**disable**

Use the **elan-tlv disable** command to disable a TLV in the static configuration. The TLV will not become active on the next router restart. You are prompted to select the TLV to disable.

**Syntax:**

**elan-tlv disable**

**Example:**

```
Selected ELAN 'lgrove001'> elan-tlv disable
TLV choice:
        (1) All
        (2) T x00A03E01 C7 : Control timeout (sec)       L 2   V 120
        (3) T x00A03E02 C10: Maxmm unknown frame count   L 2   V 1
        (4) T x00A03E03 C11: Mxmm unknwn frm time (sec)  L 2   V 1
        (5) T x00A03E04 C12: VCC timeout period (sec)    L 4   V 1200
        (6) T x00A03E05 C13: Maximum retry count         L 2   V 1
        (7) T x00A03E06 C17: Aging time (sec)            L 4   V 300
        (8) T x00A03E07 C18: Forward delay time (sec)    L 2   V 15
        (9) T x00A03E08 C20: Expctd LE_ARP rspnse (sec)  L 2   V 1
        (10) T x00A03E09 C21: Flush timeout (sec)         L 2   V 4
        (11) T x00A03E0A C22: Path switching delay (sec)  L 2   V 6
        (12) T x00A03E0B C23: Local segment ID (hex)      L 2   V ff:00
        (13) T x00A03E0C C24: Mcst send VCC type (dec)    L 2   V 2
        (14) T x00A03E0D C25: Mcst snd VCC avrg rt (cps)  L 4   V 0
        (15) T x00A03E0E C26: Mcst snd VCC peak rt (cps)  L 4   V 0
        (16) T x00A03E0F C28: Cnnctn complete time (sec)  L 2   V 4

 Enter Selection:  [1]? 1
 Disabled all TLVs for ELAN 'lgrove001'
 Selection "TLV disable" Complete
 Selected ELAN 'lgrove001'>
```

**enable**

Use the **elan-tlv enable** command to enable a TLV in the static configuration. The selected TLV will become active on the next router restart. You are prompted to select the TLV to enable.

**Syntax:**

**elan-tlv enable**

```
selected ELAN 'lgrove001'> elan-tlv enable
TLV choice:
        (1) All
        (2) T x00A03E01 C7 : Control timeout (sec)       L 2   V 120
        (3) T x00A03E02 C10: Maxmm unknown frame count   L 2   V 1
        (4) T x00A03E03 C11: Mxmm unknwn frm time (sec)  L 2   V 1
        (5) T x00A03E04 C12: VCC timeout period (sec)    L 4   V 1200
        (6) T x00A03E05 C13: Maximum retry count         L 2   V 1
        (7) T x00A03E06 C17: Aging time (sec)            L 4   V 300
        (8) T x00A03E07 C18: Forward delay time (sec)    L 2   V 15
        (9) T x00A03E08 C20: Expctd LE_ARP rspnse (sec)  L 2   V 1
        (10) T x00A03E09 C21: Flush timeout (sec)         L 2   V 4
        (11) T x00A03E0A C22: Path switching delay (sec)  L 2   V 6
        (12) T x00A03E0B C23: Local segment ID (hex)      L 2   V ff:00
        (13) T x00A03E0C C24: Mcst send VCC type (dec)    L 2   V 2
        (14) T x00A03E0D C25: Mcst snd VCC avrg rt (cps)  L 4   V 0
        (15) T x00A03E0E C26: Mcst snd VCC peak rt (cps)  L 4   V 0
        (16) T x00A03E0F C28: Cnnctn complete time (sec)  L 2   V 4
Enter Selection:  [1]?1
Enabled all TLVs for ELAN 'lgrove001'
Selection "TLV enable" Complete
Selected ELAN 'lgrove001'>
```

### list

Use the **elan-tlv list** command to list all TLVs of the selected ELAN.

**Syntax:**

**elan-tlv list**

```
Selected ELAN 'lgrove001'> elan-tlv list
             TLVs for ELAN 'lgrove001'

 Enabled  TLV
 =======  ==========================================================
     Yes  Type: x00A03E01 'C7 : Control timeout (sec)'
          Len: 2 Value: 120
     Yes  Type: x00A03E02 'C10: Maxmm unknown frame count'
          Len: 2 Value: 1
     Yes  Type: x00A03E03 'C11: Mxmm unknwn frm time (sec)'
          Len: 2 Value: 1
     Yes  Type: x00A03E04 'C12: VCC timeout period (sec)'
          Len: 4 Value: 1200
     Yes  Type: x00A03E05 'C13: Maximum retry count'
          Len: 2 Value: 1
     Yes  Type: x00A03E06 'C17: Aging time (sec)'
          Len: 4 Value: 300
     Yes  Type: x00A03E07 'C18: Forward delay time (sec)'
          Len: 2 Value: 15
     Yes  Type: x00A03E08 'C20: Expctd LE_ARP rspnse (sec)'
          Len: 2 Value: 1
     Yes  Type: x00A03E09 'C21: Flush timeout (sec)'
          Len: 2 Value: 4
     Yes  Type: x00A03E0A 'C22: Path switching delay (sec)'
          Len: 2 Value: 6
     Yes  Type: x00A03E0B 'C23: Local segment ID (hex)'
          Len: 2 Value: ff:00
     Yes  Type: x00A03E0C 'C24: Mcst send VCC type (dec)'
          Len: 2 Value: 2
     Yes  Type: x00A03E0D 'C25: Mcst snd VCC avrg rt (cps)'
          Len: 4 Value: 0
     Yes  Type: x00A03E0E 'C26: Mcst snd VCC peak rt (cps)'
          Len: 4 Value: 0
     Yes  Type: x00A03E0F 'C28: Cnnctn complete time (sec)'
          Len: 2 Value: 4
```

```
Selected ELAN 'lgrove001'>
```

**remove**

Use the **elan-tlv remove** command to remove a TLV from the static configuration of the selected ELAN. You are prompted to select the TLV to remove.

**Syntax:**

**elan-tlv remove**

**Example:**

```
Selected ELAN 'lgrove001'> elan-tlv remove
TLV Choice:
        (1) All
        (2) T x00A03E01 C7 : Control timeout (sec)       L 2   V 120
        (3) T x00A03E02 C10: Maxmm unknown frame count   L 2   V 1
        (4) T x00A03E03 C11: Mxmm unknwn frm time (sec)  L 2   V 1
        (5) T x00A03E04 C12: VCC timeout period (sec)    L 4   V 1200
        (6) T x00A03E05 C13: Maximum retry count         L 2   V 1
        (7) T x00A03E06 C17: Aging time (sec)            L 4   V 300
        (8) T x00A03E07 C18: Forward delay time (sec)    L 2   V 15
        (9) T x00A03E08 C20: Expctd LE_ARP rspnse (sec)  L 2   V 1
        (10) T x00A03E09 C21: Flush timeout (sec)         L 2   V 4
        (11) T x00A03E0A C22: Path switching delay (sec)  L 2   V 6
        (12) T x00A03E0B C23: Local segment ID (hex)      L 2   V ff:00
        (13) T x00A03E0C C24: Mcst send VCC type (dec)    L 2   V 2
        (14) T x00A03E0D C25: Mcst snd VCC avrg rt (cps)  L 4   V 0
        (15) T x00A03E0E C26: Mcst snd VCC peak rt (cps)  L 4   V 0
        (16) T x00A03E0F C28: Cnnctn complete time (sec)  L 2   V 4

Enter Selection:  [1]?2

            TLV deleted: T x00A03E01 C7 : Control timeout (sec)       L 2   V 120
            Selection "TLV remove" Complete
            Selected ELAN 'lgrove001'>
```

## LEC-TLV

Type/length/values (TLVs) can be associated with an individual LEC or group of LECs assigned to the selected ELAN. The LECs can be identified by any of the following policy values:

- ATM address
- MAC address
- Route descriptor
- ELAN name

**Note:** These policies must be already configured on this ELAN with the **policy add** command.

For example, LEC-TLVs can be used to distinguish LECs with different QOS, giving their traffic different priority or bandwidth than other LECs associated with the same ELAN.

See “ELAN-TLV” on page 26-30 for information about configuring TLVs to be associated with all LECs assigned to the selected ELAN.

The following table shows the different identifiers you can use to select the individual LECs associated with a particular policy.

| Table 26-9. Selected LEC-TLV Identifiers 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 2-3. |
| ESI/SEL of ATM address | Uses an ESI/Selector of ATM address policy to identify the LECs to be associated with the TLV. |
| MAC address | Uses a MAC address policy to identify the LECs to be associated with the TLV. |
| Name of ELAN | Uses an ELAN name policy to identify the LECs to be associated with the TLV. |
| PREFIX of ATM address | Uses an ATM address prefix policy to identify the LECs to be associated with the TLV. |
| Route Descriptor | Uses a route descriptor policy to identify the LECs to be associated with the TLV. |

After a policy is chosen, you can use the following commands to configure detailed TLVs to be returned to all LECs assigned by the selected policy.

| Table 26-10. Selected LEC-TLV 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 2-3. |
| Add | Adds a TLV to the selected ELAN policy. |
| Disable | Disables a TLV for the selected ELAN policy. |
| Enable | Enables a TLV for the selected ELAN policy. |
| List | Lists TLVs for the selected ELAN policy. |
| Remove | Removes a TLV from the selected policy. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

**Example**:

```
 Selected ELAN 'lgrove01'>policy list prefix

ATM prefixes for ELAN 'lgrove01'
Enabled  Value  =>  LES
=======  =========================================
     No  55
            => Local LES for: lgrove01
     No  25
            => Local LES for: lgrove01
Selected ELAN 'lgrove01'>lec-tlv prefix
  (  1) 55
  (  2) 25
ATM prefix [1]?
Policy Value '55' selected for detailed TLV configuration
Tlvs for '55' selected>add ibm i4
I4: Validate peak cell rate of Best Effort DDVCCs? [No]: yes
TLV added: I4: Vldt PCR of Bst Effrt DDVCC
Tlvs for '55' selected>list
Enabled  TLV
=======  =====================================================
    Yes  Type: x10005A04 'I4: Vldt PCR of Bst Effrt DDVCC'
         Len: 4 Value: 1

Tlvs for '55' selected>
```

## Configuration Commands for the Policies of a LECS

This section describes the commands to modify the policies that guide the LECS-to-LES assignment procedure. Enter the **policies** command at the `LECS config>` prompt to get to the `LECS Policies config>` prompt where you can enter the following commands:

*Table 26-11. LECS Policies 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 2-3. |
| Add | Add a policy to the static configuration of the LECS. |
| Disable | Disable a policy of the LECS. |
| Enable | Enable a policy of the LECS. |
| List | Lists policies configured for LECS. |
| Remove | Remove a policy of the LECS. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Add

The **add** command adds a policy to the LECS. When adding a policy, you are prompted for the "priority" and "type" of the policy.

Priority specifies the order in which policies are considered; policies with lower priorities are considered earlier. For a more detailed explanation of policies and how the LECS is guided by them, refer to "Overview of the LECS Function" on page 19-5.

Type specifies what information about the client should be used to assign it at the specified priority.

**Syntax:**

**add**

**Example:**

```
LECS Policies config> add
Priority of Policy [10]?10
Policy type
 (1) byAtmAddr
 (2) byMacAddr
 (3) byRteDesc
 (4) byLanType
 (5) byPktSize
 (6) byElanNm

Enter Selection: [1]?1
Added policy 'byAtmAddr' at priority 10
Selection "Add assignment policy" Complete
LECS Policies config>
```

## Disable

The **disable** command disables a policy in the static configuration of the LECS. Disabled policies will not become active on the next router restart.

**Syntax:**

**disable**

**Example:**

```
LECS Policies config> disable
Choice of policy
 (1) All
 (2) 10 byAtmAddr

Enter Selection: [1]?1
Disabled all policies
Selection "Disable assignment policy" Complete
LECS Policies config>
```

## Enable

The **enable** command enables a policy in the static configuration of the LECS. Enable policies become active on the next router restart.

**Syntax:**

**enable**

enable

**Example:**

```
LECS Policies config> enable
Choice of policy
 (1) All
 (2) 10   byAtmAddr
Enter Selection:  [1]?2
Enabled policy '10   byAtmAddr'
Selection "Enable assignment policy" Complete
LECS Policies config>
```

## List

The **list** command lists the policies currently configured for the LECS.

**Syntax:**

**list**

**Example:**

```
LECS Policies config> list
Policy Listing...
Enabled  Priority  Type
=======  ========  ===========
    Yes        10  byAtmAddr
LECS Policies config>
```

## Remove

The **remove** command removes a policy from the static configuration of the LECS.

**Syntax:**

**remove**

**Example:**

```
LECS Policies config> remove
Choice of policy
 (1) All
 (2) 10 byAtmAddr
Enter Selection: [1]?1
Removed all policies
Selection "Remove assignment policy" Complete
LECS Policies config>
```

# Configuration Commands for Security for ELANs

This section describes optional commands related to authentication of LE Client requests to join ELANs. The LES-LECS Security Interface is the LE Services component responsible for multiplexing configuration requests from the LESs on the MSS Server to the LECS (which may or may not be on the MSS Server). The LES-LECS interface is a required component if any of the LES-BUSs are using the security features of the MSS Server. See “LAN Emulation Security” on page 19-17 for additional information.

Enter the **security** command at the `LE-Services config>` prompt to get to the `LECS INTERFACE config>` prompt.

*Table 26-12 (Page 1 of 2). LECS Interface 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 2-3. |
| Add | Provides for authentication of client-joins. |
| Disable | Disables ability to authenticate client-joins. |
| Enable | Enables ability to authenticate client-joins. |
| List | Lists parameters for this interface. |

| Table 26-12 (Page 2 of 2). LECS Interface Configuration Commands Summary | |
|---|---|
| Command | Function |
| Remove | Removes ability to authenticate client-joins. |
| Set | Sets parameters for this interface (ATM address and traffic type). |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## Add

Use the **add** command to add a communication path to the LECS authentication of client-joins.

**Syntax:**

**add**

**Example:**

```
LECS INTERFACE config> add
  (  1) Use burned in ESI
Select ESI [1]?1
Selector 0 is generally reserved for use by the LECS,
Selector 1 is generally reserved for use by the LECS Interface.
LECS Interface Selector [1]?1
LECS INTERFACE config>
```

## Disable

Use the **disable** command to disable LECS authentication of client-joins.

**Syntax:**

**disable**

**Example:** `disable`

## Enable

Use the **enable** command to enable LECS authentication of client-joins.

**Syntax:**

**enable**

**Example:** `enable`

## List

Use the **list** command to see a detailed list of the parameters associated with this LECS interface.

**Syntax:**

**list**

**Example:**

```
LECS INTERFACE config> list
LECS Interface Detailed Configuration
   LECS Interface Enabled/Disabled: Enabled
   ATM Device number: 0
   ESI: Use Burned in ESI
   Selector: 0x01
   Configuration Direct VCC Traffic Type: Best Effort VCC
   Configuration Direct VCC PCR in Kbps: 155000
   Configuration Direct VCC SCR in Kbps: 0
LECS INTERFACE config>
```

## Remove

Use the **remove** command to remove the ability to authenticate client-joins for this ELAN.

**Syntax:**

**remove**

**Example:** **remove**

## Set

Use the **set** command to configure the address and the traffic type for this interface.

**Syntax:**

**set** address
traffic

**Example:**

```
LECS INTERFACE config> set address
  (  1) Use burned in ESI
Select ESI [1]?
Selector 0 is generally reserved for use by the LECS,
Selector 1 is generally reserved for use by the LECS Interface.
LECS Interface Selector [1]?1
LECS INTERFACE config>
```

**Example:**

```
LECS INTERFACE config> set traffic configuration
  (  1) Best Effort
  (  2) Reserved Bandwidth
Traffic type [1]?1
Peak cell rate in Kbps (1-155000) [155000]? 75000
LECS INTERFACE config>
```

# Accessing the LAN Emulation Services Monitoring Environment

The LE Services monitoring environment (available from the GWCON process) is characterized by the `LE-SERVICES+` prompt. Commands entered at this prompt permit you to work more closely with a particular LE component, or to create a LES-BUS.

To access the LE Services console:

1. At the OPCON prompt, enter **talk 5**. (For more detail on this command, refer to Chapter 7, "The OPCON Process and Commands" on page 7-1.) For example:

   ```
   * talk 5
   +
   ```

The GWCON prompt (+) is displayed on the console. If the prompt does not appear when you first enter configuration, press **Return** again.

2. At the GWCON prompt, enter the **network** command to display the network interface numbers for which the router is currently configured. For example:

```
*talk 5
+network ?
0  : ATM
Network number [0]? 0
ATM Console
ATM+
```

**Note:** Two ATM interfaces may be defined.

3. Enter the **le-services** command

**Example:**

```
ATM+le-s
LE-Services Console
LE-SERVICES+
```

## Monitoring Commands for LAN Emulation Services

Enter commands at the `LE-Services+` prompt.

*Table 26-13. LAN EMULATION Services 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 2-3. |
| Create | Creates an operating LES-BUS from its configuration data (the configuration data must also exist). |
| Lecs | Takes you to the LECS monitoring environment, described in “Monitoring Commands for LECS” on page 26-74. |
| Les-bus | Takes you to the monitoring environment for a particular LES-BUS, as described in “Monitoring Commands for LES-BUS” on page 26-45. |
| List | Displays a list of the operating LES-BUSs. |
| Security | Takes you to the LES-LECS Security monitoring environment, described in “Monitoring Commands for Security for LE Service” on page 26-101. |
| Summary | Displays a summary of the operating LES-BUSs, including the number of operational LE Clients. |
| Work | Takes you to the monitoring environment for a particular LES-BUS, as described in “Monitoring Commands for LES-BUS” on page 26-45. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## Create

Use the **create** command to create an operating LES-BUS from its configuration. Before you can create a LES-BUS, its configuration must first exist. See “Configuration Commands for a LES-BUS” on page 26-4 for an explanation of how to configure a LES-BUS.

**Syntax:**

**create** *elan-name*

where *elan-name* is the name of the ELAN.

**Example:**

```
LE-SERVICES+ create
ELAN Name (ELANxx) []? IBM Token Ring Test ELAN!
LES/BUS: 'IBM Token Ring Test ELAN!': STARTING
```

## Lecs

Use the **lecs** command to enter the LECS monitoring environment.

**Syntax:**

<u>lec</u>**s**

**Example:**

```
LE-SERVICES+ lecs
LECS console+
```

## Les-bus

Use the **les-bus** command to enter the monitoring environment for a particular operating LES-BUS. A selection list will appear, or one can use the **list** or **summary** command to display all of the operating LES-BUSs.

**Syntax:**

<u>les</u>**-bus** *elan-name*
*item-number*

**elan-name** Name of the ELAN.

**item-number** Item number from selection list.

**Example: `les-bus`**

```
LE-SERVICES+ les
  (  1) boston
  (  2) chicago
  (  3) losangeles
  (  4) miami
  (  5) newyork

Choice of LES/BUS [1]? 3
LE-Services Console for an existing LES-BUS Pair
EXISTING LES-BUS 'losangeles'
```

**Example: `les-bus` <u>`elan-name`</u>**

```
LE-SERVICES+ les losangeles
LE-Services Console for an existing LES-BUS Pair
EXISTING LES-BUS 'losangeles'+
```

**Example: `les-bus` <u>`item-number`</u>**

```
LE-SERVICES+ les 3
LE-Services Console for an existing LES-BUS Pair
EXISTING LES-BUS 'losangeles'+
```

## List

Use the **list** command to display a list of the currently operating LES-BUSs and their ATM addresses. Use the **summary** command to display the number of operational LE clients.

**Syntax:**

li**st**

**Example:**

```
LE-SERVICES+list
ELAN Type  (E=Ethernet/802.3, T=Token Ring/802.5)
| Interface #
| |  LES-BUS State  (UP=Up,    ID=Idle,  ND=Net Down,  ER=Error/Down,
| |  |               **=Other; Work with specific LES-BUS to see actual state)
| |  |
| |  | ELAN Name                       LES ATM Addr
- - -- ------------------------------- ----------------------------------------
T 1 UP boston                          3999999999999900009999310140008210400103
T 1 UP chicago                         3999999999999900009999310140008210400104
T 1 UP losangeles                      3999999999999900009999310140008210400102
T 1 UP miami                           3999999999999900009999310140008210400105
E 0 UP newyork                         3999999999999900009999310140008210400002
LE-SERVICES+
```

## Security

Use the **security** command to enter the monitoring environment for the LES-LECS Security Interface component. This is the component that multiplexes security requests between the LE Servers on this router and the LECS (which may or may not be on this router).

**Syntax:**

se**curity**

**Example:**

```
LE-SERVICES+ security
LES-LECS Security Interface
LES-LECS interface+
```

## Summary

Use the **summary** command to display a summary of the currently operating LES-BUSs including the number of operational LE Clients.

**Syntax:**

su**mmary**

**Example:**

```
LE-SERVICES+ summary
ELAN Type  (E=Ethernet/802.3, T=Token Ring/802.5)
| Interface #
| |  LES-BUS State  (UP=Up,    ID=Idle,  ND=Net Down,  ER=Error,
| |  |               **=Other; Work with specific LES-BUS to see actual state)
| |  |
| |  |                                                   Last LES/BUS
| |  |                                  #LECs      #LECs   State Change
| |  | ELAN Name                        Proxy   NonProxy   (Sys uptime)
- - -- ------------------------------  ------   --------   ------------
T 1 UP boston                               1          0    00.00.01.99
T 1 UP chicago                              1          0    00.00.01.99
T 1 UP losangeles                           2          0    00.00.01.99
T 1 UP miami                                1          0    00.00.01.99
E 0 UP newyork                              0          0    00.00.01.99
LE-SERVICES+
```

# Work

Use the **work** command to enter the monitoring environment for a particular operating LES-BUS. A selection list will appear or you can use the **list** command or **summary** command to display all of the operating LES-BUSs.

**Syntax:**

**work**  *elan-name*
*item-number*

**elan-name**
Name of the ELAN.

**item-number**
Item number from selection list.

**Example: work**

```
LE-SERVICES+ work
  (  1) boston
  (  2) chicago
  (  3) losangeles
  (  4) newyork
  (  5) miami
 Choice of LES/BUS [1]? 3
LE-Services Console for an existing LES-BUS Pair
EXISTING LES-BUS 'losangeles'+
```

**Example: work** elan-name

```
LE-SERVICES+ work losangeles
LE-Services Console for an existing LES-BUS Pair
EXISTING LES-BUS 'losangeles'+
```

**Example: work** item-number

```
LE-SERVICES+ work 3
LE-Services Console for an existing LES-BUS Pair
EXISTING LES-BUS 'losangeles'+
```

## Monitoring Commands for LES-BUS

Enter commands at the `EXISTING LES-BUS+` prompt.

*Table 26-14. LES-BUS 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 2-3. |
| Database | Flushes all cache entries for a specified Broadcast Manager Protocol, or lists database entries. |
| Delete | Deletes a LES-BUS. |
| Disable | Disables an existing LES-BUS component: Broadcast Manager (IP, IPX,IPX Server Farm Detection, or NetBIOS), BUS Monitor, Redundancy, Security, or Source Route Manager. It disables the chosen option immediately, but the LES-BUS's configured state in Static RAM does not change. |
| Enable | Enables an existing LES-BUS component: Broadcast Manager (IP, IPX, IPX Server Farm Detection, or NetBIOS), BUS Monitor, Redundancy, Security, or Source Route Manager. It enables the chosen option immediately, but the LES-BUS's configured state in Static RAM does not change. |
| List | Lists the status and current configuration parameters of the LES-BUS. |
| Restart | Restarts a running or stopped LES-BUS. A LES-BUS can be restarted using the parameters configured under the Talk 5 or Talk 6 interface. |
| Set | Sets LES-BUS configuration parameters. The parameter that you set is immediately used by the LES-BUS, but the LES-BUS's configured parameter values in Static RAM do not change. |
| Show | Shows information on LES-BUS databases, statistics, or current configuration. |
| Statistics | Clears or displays LES-BUS statistics. |
| Stop | Stops the operation of LES-BUS. |
| Terminate | Terminates a specified LEC from the LES-BUS. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Database

The **database** command has two uses. You can use it to **flush** all cache entries for a Broadcast Manager Protocol, or to **list** information about database entries. See "Database Flush" on page 26-45, "Database List" on page 26-46, and "Show" on page 26-61 for more information.

### Database Flush

Use this command to flush all cache entries for a Broadcast Manager Protocol.

**Syntax:**

<u>da</u>**tabase**      <u>f</u>lush *protocol*

Where *protocol* is one of:

- IP
- IPX
- NetBIOS
- Source Route Management

## Database List

Use this command to list general information about all entries in a given database, or to list detailed information about a user-specified entry in a database.

**Syntax:**

**database list** all . . .

specific . . .

**all** *database*

Lists general information about all entries in the specified database. Valid databases are:

- BCM-Learned-MAC
- IP
- IPX
- IPX-server-farms
- LEC
- NetBIOS
- Registered-MAC
- Route-Descriptors
- Source Route Management

**Note:** The result of the **database list all** command is the same as the result of the **show** command. For example, **database list all ip** produces the same information as **show ip**.

**Example:**

```
database list all ip
Number of IP Addresses to display: 2

IP Address        MAC Address         TTL   Usage Count
---------------   -----------------   ---   -----------
9.67.195.1        10.00.5A.11.98.76     3            10
9.67.195.151      10.00.5A.49.13.4B     1             1
```

Where:

**IP address**
Is the IP address

**MAC address**
Is the MAC address associated with the IP address

**TTL (Time to Live)**
Is the amount of time (in minutes) remaining before this entry is removed from the cache.

**Usage count**
Is the number of times the entry was refreshed.

**Example:**

```
database list all lec
Number of LEC's to display: 2

    LEC-LES and LEC-BUS State  (UP=Up,  ID=Idle,  --. --.
      **=Other; Show specific LEC to see actual)    v   v
                                             LEC    State   #ATM  #Reg   #Lrnd
LEC Primary ATM Address               Proxy  ID    LES BUS  Adrs  MACs    MACs
----------------------------------------  -  ----   --  --  ----  -----  -----
3999999999999999000099999310110005AF972A000  Y  0001   UP  UP     1      5      0
39999999999999990000999931010004134732310 2  Y  0002   UP  UP     1      1      0
```

Where:

**LEC primary ATM address**
Is the primary ATM address of the LEC

**Proxy**
Indicates whether or not this LE Client is a proxy LEC. A proxy LEC responds to LE ARP Requests for MAC addresses which it serves. These MAC addresses are not registered with the LES.

**LEC ID**
Is the LE Client Identifier

**State LES**
Is the operational state of the LEC at the LES. Possible states are:

- UP
- ID
- ** Other (to see this state use the **show specific LEC** command.)

**State BUS**
Is the operational state of the LEC at the BUS. Possible states are:

- UP = Up
- ID = Idle
- ** = Other (to see this state, use the **show specific LEC** command.)

**Number of ATM addresses**
Is the number of ATM addresses associated with the LEC.

**Number of registered MACs**
Is the number of registered MAC addresses associated with the LEC.

**Number of learned MACs**
Is the number of BCM–learned MAC addresses associated with the LEC.

**specific** *database*
Lists detailed information about a user specified entry. Valid databases are:

- IP
- IPX
- LEC
- MAC
- NetBIOS

- Route-Descriptor

**Note:** The result of the **database list specific** command is the same as the result of the **show specific** command. For example, **database list specific 1.2.3.4** produces the same information as **show specific ip 1.2.3.4**.

**Example:**

```
database list specific ip
   IP address [0.0.0.0]? 7.7.7.7
   IP Address:                      7.7.7.7
      MAC Address:                  10.00.5A.BA.D0.88
      MAC Address Type:             Registered
      LEC ATM Address:              39999999999999000099990102100051591762O2
      LEC ID:                       0x0001
      LEC State at LES:             OPERATIONAL
      LEC State at BUS:             OPERATIONAL
      If dormant, proto ages in:    4 minute(s)
      Usage Count:                  1
      SRM Ring Number:              unknown
```

Where:

**IP address**
Is a user entered IP address.

**MAC address**
Is the MAC address associated with the IP address.

**MAC address type**
Is the database entry type. Possible values are:

**Registered**
an entry registered by the LEC

**Static Volatile**
an entry created by the network manager

**BCM Learned**
an entry learned by the Broadcast Manager

**Unknown** an entry of an unknown type

**LEC ATM address**
Is the primary ATM address of the LEC that has the given MAC address.

**LEC ID** Is the LE Client Identifier

**LEC state at LES**
Is the operational state of the LEC at the LES. Possible states are:

**IDLE** the LES-BUS is not active.

**JOINING** A Control Direct VCC was accepted.

**JOIN REJECTED**
A Join request was rejected.

**JOIN VERIFICATION**
A request was sent to the LECS to validate the LEC’s join request.

**SIGNAL WAIT**
The LES is waiting for completion of an in-progress call to establish a first leaf of Control Distribute VCC.

**SIGNALLING**
The LES is initiating signalling to establish a Control Distribute VCC to the LEC.

**ADD PARTY RETRY**
The LES is delaying the Add Party request for adding this LEC on the Control Distribute VCC. Congestion is suspected in the ATM switch network. The Add Party request will take place after a random delay.

**OPERATIONAL**
The Join was successful.

**UNKNOWN**
Indicates an unknown state.

**LEC state at BUS**
Is the operational state of the LEC at the BUS. Possible states are:

**IDLE** A control Direct VCC was accepted, or a Multicast VCC to LEC was released.

**SIGNAL WAIT**
The BUS is waiting for completion of an in-process call to establish the first leaf of Multicast Forward VCC.

**SIGNALLING**
The BUS initiated signalling to establish Multicast Forward VCC to LEC.

**ADD PARTY RETRY**
The BUS is delaying the Add Party request for adding this LEC on the Multicast Forward VCC. Congestion is suspected in the ATM switch network. The Add Party request will take place after a random delay.

**OPERATIONAL**
A Multicast Forward VCC to the LEC was successfully established.

**UNKNOWN**
Indicates an unknown state.

**If dormant, proto ages in**
Is the amount of time (in minutes) remaining before this entry is removed from the cache.

**Usage count**
Is the number of times entry was refreshed

**SRM ring number**
For SRM, 802.5 ring number where IP address is located

**Example:**

```
database list specific lec lecid
LECID [0001]?
LEC ID:                    0x0001
   LEC ATM Address:        39999999999999000099999310110005AF972A000
   Proxy:                  Yes
   LEC State at LES:       OPERATIONAL
   Entered LES State at:   00.00.03.46   (System Up Time)
   LEC State at BUS:       OPERATIONAL
   Entered BUS State at:   00.00.03.51   (System Up Time)
   Control Direct Vcc:     OPERATIONAL  0/193
   Control Distribute Vcc: OPERATIONAL  0/194
   Multicast Send Vcc:     OPERATIONAL  0/195
   Multicast Forward Vcc:  OPERATIONAL  0/196
   MAC Address in Join Req: none
   Packet Tracing Eligible: No
   Add Party Being Delayed: No
   # ATM Address Mappings:  1
   # MAC Address Mappings:  5
   # RD Mappings:           1
   # BCM Learned MAC Addrs: 4
   # BCM Protocol Mappings: 4
   # BCM IPX Routers/Srvrs: 4
   IPX Server Farm Detected:No
   # SRM Ring Mappings:     2
   # TLVs registered:       0
```

Where:

**LEC ID** Is the LE Client Identifier

**LEC ATM address**
Is the ATM address of the LEC

**Proxy** Indicates whether this LEC is a proxy LEC. Proxy LECs respond to LE ARP Requests for MAC addresses they serve. These MAC

**LEC state at LES**
Indicates the operational state of the LEC at the LES. Possible states are:

**IDLE** the LEC is not connected to either the LES or the BUS.

**JOINING** A Control Direct VCC was accepted.

**JOIN REJECTED**
A Join request was rejected.

**JOIN VERIFICATION**
A request was sent to the LECS to validate the LEC's join request.

**SIGNAL WAIT**
The LES is waiting for completion of an in-progress call to establish a first leaf of Control Distribute VCC.

**SIGNALLING**
The LES is initiating signalling to establish a Control Distribute VCC to the LEC.

**ADD PARTY RETRY**
The LES is delaying the Add Party request for adding this LEC on the Control Distribute VCC.

Congestion is suspected in the ATM switch network. The Add Party request will take place after a random delay.

**OPERATIONAL**
The Join was successful.

**UNKNOWN**
Indicates an unknown state.

**Entered LES state at**
Is the System Up Time at which LEC transitioned into its current state at the LES. Time is in *hours.minutes.seconds.hundredths* format.

**LEC state at BUS**
Is the operational state of the LEC at the BUS. Possible states are:

**IDLE** A Control Direct VCC was accepted, or a Multicast VCC to LEC was released.

**SIGNAL WAIT**
The BUS is waiting for completion of an in-progress call to establish the first leaf of Multicast Forward VCC.

**SIGNALLING**
The BUS initiated signalling to establish Multicast Forward VCC to LEC.

**ADD PARTY RETRY**
The BUS is delaying the Add Party request for adding this LEC on the Multicast Forward VCC. Congestion is suspected in the ATM switch network. The Add Party request will take place after a random delay.

**OPERATIONAL**
A Multicast Forward VCC to the LEC was successfully established.

**UNKNOWN**
Indicates an unknown state.

**Entered BUS state at**
Is the time that the LEC transitioned into its current state at the BUS. Time is in hours.minutes.seconds.hundredths format.

**MAC address in Join Req**
The MAC address in the Join Request, if present.

**Packet tracing eligible**
Indicates whether packets are eligible for tracing, provided ELS trace events are enabled.

**Add Party Being Delayed**
Indicates whether this LEC's request to join the ELAN is being delayed to help alleviate congestion which is suspected in the ATM switch network.

**# ATM address mappings**
Is the number of ATM addresses associated with this LEC.

**# MAC address mappings**
Is the number of MAC addresses associated with this LEC.

**# RD mappings**
Is the number of route descriptors associated with this LEC.

**# BCM learned MAC addrs**
Is the number of Broadcast Manager–learned MAC addresses associated with this LEC.

**# BCM protocol mappings**
Is the number of protocols mapped to this LEC.

**# BCM IPX Routers/Srvrs**
Is the number of IPX Routers and Servers associated with this LEC dynamically discovered by BCM IPX.

**IPX Server Farm detected**
Indicates whether the LEC is considered an IPX Server Farm from the perspective of BCM IPX. An IPX Server Farm can be detected behind a LEC either dynamically via the IPX Server Farm Detection function, or statically by configuring a BCM IPX Static Target for this LEC using a broadcast MAC address.

**# SRM ring mappings**
Is the number of Source Route Management ring numbers associated with this LEC.

**# TLVs registered**
Is the number of Type/Length/Value elements contained in this LEC's Join Request. If any TLVs are present, they are displayed as well.

**Example:**

```
database list specific mac
Registered or BCM Learned MAC Address: []? 10.00.5A.BA.D0.88
Registered MAC Address:     10.00.5A.BA.D0.88
   LEC ATM Address:         39999999999999000099990102100005159176202
   Registering ATM Address: 39999999999999000099990102100005159176202
   LEC ID:                  0x0001
   Entry Type:              Registered
   LEC State at LES:        OPERATIONAL
   LEC State at BUS:        OPERATIONAL
   SRM Ring Number:         unknown
   # BCM Protocol Mappings: 1
       IPX Network / Node Number:      00.00.77.77 / 10.00.5A.BA.D0.88
```

Where:

**BCM learned MAC address**
Is the Broadcast Manger–learned MAC address. This field is displayed for learned MAC addresses only.

**Registered MAC address**
Is the registered MAC Address. This field is displayed for registered MAC addresses only.

**Registering ATM address**
Is an ATM address of the LEC that registered the MAC address. This field is displayed for registered MAC addresses only.

**Entry type**
Is the Database entry type. Possible values are:

**Registered**
Registered entry (Entry was registered by a LEC)

**Static Volatile**
Static volatile entry (Entry was created by the network manager)

**LEC ATM address**
Is the ATM address of the LEC that has the given MAC address.

**LEC ID** Is the LE Client Identifier.

**LEC state at LES**
Is the operational state of the LEC at the LES. Possible states are:

**IDLE** the LEC is not connected to either the LES or the BUS.

**JOINING** A Control Direct VCC was accepted.

**JOIN REJECTED**
A Join request was rejected.

**JOIN VERIFICATION**
A request was sent to the LECS to validate the LEC's join request.

**SIGNAL WAIT**
The LES is waiting for completion of an in-progress call to establish a first leaf of Control Distribute VCC.

**SIGNALLING**
The LES is initiating signalling to establish a Control Distribute VCC to the LEC.

**ADD PARTY RETRY**
The LES is delaying the Add Party request for adding this LEC on the Control Distribute VCC. Congestion is suspected in the ATM switch network. The Add Party request will take place after a random delay.

**OPERATIONAL**
The Join was successful.

**UNKNOWN**
Indicates an unknown state.

**LEC state at BUS**
Is the operational state of the LEC at the BUS.

Possible states are:

**IDLE** A Control Direct VCC was accepted, or a Multicast VCC to LEC was released.

**SIGNAL WAIT**
The BUS is waiting for completion of an in-progress call to establish the first leaf of Multicast Forward VCC.

**SIGNALLING**
The BUS initiated signalling to establish Multicast Forward VCC to LEC.

**ADD PARTY RETRY**
The BUS is delaying the Add Party request for adding this LEC on the Multicast Forward VCC. Congestion is suspected in the ATM switch network. The Add Party request will take place after a random delay.

**OPERATIONAL**
A Multicast Forward VCC to the LEC was successfully established.

**UNKNOWN**
Indicates an unknown state.

**SRM ring number**
For SRM, the 802.5 ring where the registered or BCM-Learned MAC address is located.

**# BCM protocol mappings**
Is the number of protocols mapped to this MAC address. A list of the protocol mappings will be displayed. The possible mappings are:

- IPX Network / Node Number
- IP address
- NetBIOS name string
- NetBIOS name in hex (shown only if NetBIOS name string has unprintable characters)

## Delete

Use the **delete** command to stop the LES-BUS and remove it from the active configuration. (The LES-BUS definition remains in static RAM). If the **delete** command is issued and you then want to start the LES-BUS, without restarting the MSS Server, you must issue the **create** command.

**Syntax:**

<u>de</u>**lete**

**Example:**

```
EXISTING LES-BUS 'losangeles'+ delete
Are you sure you want to delete this LES/BUS? [No]:
LES/BUS:'losangeles':not deleted
```

## Disable

Use the **disable** command to disable various LES-BUS functions.

You can dynamically disable Broadcast Manager (IP, IPX, IPX Server Farm Detection, or NetBIOS), BUS Monitor, Redundancy, Security, or Source Route Manager. Disabling of the chosen option occurs immediately, but the LES-BUS's configured state in Static RAM does not change. If you wish to change permanently the configured state in Static RAM, use the `config>` interface.

**Syntax:**

di**sable**

**Example:**

```
EXISTING LES-BUS 'losangeles'+ disable ?
BCM
BUS-MONITOR
REDUNDANCY
SECURITY (LECS validation of Joins)
SOURCE route management
EXISTING LES-BUS 'losangeles'+ disable bcm ?
ALL
IP
IPX
IPX-Server-Farm detection
NETBIOS
EXISTING LES-BUS 'losangeles'+disable bcm all
LES/BUS: 'losangeles' : Disable BCM for IP successful
LES/BUS: 'losangeles' : Disable BCM for IPX successful
LES/BUS: 'losangeles' : Disable BCM for NetBIOS successful
EXISTING LES-BUS 'losangeles'+ disable bcm ip
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+ disable bcm ipx
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+ disable bcm ipx-server-farm
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+ disable bcm netbios
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+ disable bus-monitor
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+ disable redundancy
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+ disable security
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+ disable source
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+
```

## Enable

Use the **enable** command to enable various LES-BUS functions. You may dynamically enable Broadcast Manager (IP, IPX, IPX Server Farm Detection, or NetBIOS), BUS Monitor, Redundancy, Security (LECS validation of Joins), or Source Route Manager. The chosen option is enabled immediately, but the LES-BUS's configured state in Static RAM does not change. If you wish to change permanently the configured state in Static RAM, you should use the `config>` interface.

**Notes:**

1. You cannot enable the Broadcast Manager while the BUS is in *Adapter* or *VCC-Splice* mode.
2. You cannot enable the BUS-Monitor while the BUS is in *VCC-Splice* mode.

**Syntax:**

**enable**

**Example:**

```
EXISTING LES-BUS 'losangeles'+ enable ?
BCM
BUS-MONITOR
REDUNDANCY
SECURITY (LECS validation of Joins)
SOURCE route management
EXISTING LES-BUS 'losangeles'+enable bcm ?
ALL
IP
IPX
IPX-SERVER-FARM detection
NETBIOS
EXISTING LES-BUS 'losangeles'+enable bcm all
LES/BUS: 'losangeles' : Enable BCM for IP successful
LES/BUS: 'losangeles' : Enable BCM for IPX successful
LES/BUS: 'losangeles' : Enable BCM for NetBIOS successful
EXISTING LES-BUS 'losangeles'+enable bcm ip
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+enable bcm ipx
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+enable bcm ipx-server-farm
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'enable bcm netbios
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+enable bus-monitor
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+enable redundancy
  (  1) Primary LES-BUS
  (  2) Backup LES-BUS
Redundancy Role [0]? 2
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+enable security
LES/BUS: 'losangeles' : parameter successfully set
EXISTING LES-BUS 'losangeles'+enable source
LES/BUS: 'losangeles' : parameter successfully set
```

# List

Use the **list** command to list the LES-BUS's status and currently running configuration parameters.

**Syntax:**

**list**

**Example:**

```
list

ELAN Name:               CB-A
   ELAN Type:            Ethernet
   ATM Device number:    0
   # of Proxy LEC's:     0
   # of Non-Proxy LEC's: 0
   LES ATM Address:       (addr not valid in this LES-BUS State)
-Status-
   LES-BUS State:                      NET DOWN
   Major Reason LES-BUS was last Down: none
   Minor Reason LES-BUS was last Down: none
   LES-BUS State last changed at:      00.00.01.75   (System Up Time)
   LES-LEC Status Table changed at:    00.00.00.00   (System Up Time)
   BUS-LEC Status Table changed at:    00.00.00.00   (System Up Time)
   UNI Version:                        unknown in this LES-BUS State
   IP BCM:                             INACTIVE
   IPX BCM:                            INACTIVE
   NetBIOS BCM:                        INACTIVE
-Current Configuration-
   LES-BUS Enabled/Disabled:                  Enabled
   ATM Device number:                         0
   End System Identifier (ESI):               40.00.82.10.00.02
   Selector Byte:                             0x10
   ELAN Type:       (S2)                      Ethernet
   Max Frame Size:  (S3)                      1516
   Control Timeout: (S4)                      120
   Max Frame Age:   (S5)                      1
   ELAN Identifier: (S7)                      0 (not configured)
   Mcast Send Disconnect Timeout: (S9)        60
   LECID Range Minimum:                       0x0001
   LECID Range Maximum:                       0xFEFF
   Validate Best Effort Peak Cell Rate (PCR): No
   Control Distribute VCC Traffic Type:       Best Effort VCC
   Control Distribute VCC PCR in Kbps:        155000
   Control Direct VCC Max Reserved Bandwidth: 0
   Multicast Forward VCC Traffic Type:        Best Effort VCC
   Multicast Forward VCC PCR in Kbps:         155000
   Multicast Send VCC MAX Reserved Bandwidth: 0
    -LES-BUS Options-
   BUS Mode:                                  Adapter
   Security (LECS Validation of Joins):       Disabled
   Partition LE_ARP_REQUEST Forwarding Domain: Yes
   LE_ARP RESPONSE Destination:               One client
   Partition Unicast Frame Domain:            Yes
   Redundancy:                                Disabled
   ATM address trace filter value: 0000000000000000000000000000000000000000
   ATM address trace filter mask:  FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
    -BUS Monitor Configuration-
   Monitor Host Usage of BUS:                 Disabled
   # Top Hosts to Record:                     10
   # Seconds in each sample interval:         10
   # Minutes between sample intervals:        30
   Frame sampling rate:                       1 out of 10
    -Broadcast Manager Configuration-
   IP BCM:                                    Disabled
   IPX BCM:                                   Disabled
   NetBIOS BCM:                               Disabled
   BCM IP Cache Aging Time:                   5
   BCM IPX Cache Aging Time:                  3
   BCM NetBIOS Cache Aging Time:              15
   BCM IPX Maximum Forwarding List:           50
   BCM IPX Server Farm Detection:             Disabled
   BCM IPX Server Farm Threshold:             20
   No BCM IPX Static Entries defined
```

Where:

**LES-BUS State**
is the operational state of the LES-BUS. Possible states are:

**IDLE** LES-BUS not active.

**INITIALIZATION**
LES-BUS control block is being initialized.

**ATM ADDR ACTIVATION**
LES-BUS ATM addresses are being activated.

**GET UNI VERSION**
Getting UNI version that is being run.

**GOT UNI VERSION**
UNI version has been determined.

**OPERATIONAL**
LES-BUS state is up or operational.

**ATM ADDR DEACTIVATED**
ATM address deactivated by switch.

**NET DOWN**
ATM interface not operational.

**ERROR /DOWN**
The operation of LES-BUS instance terminated due to fatal error.

**UNKNOWN**
Unknown state.

**Major Reason LES-BUS was last Down**
is the reason why the LES-BUS was last down, if ever.

**Minor Reason LES-BUS was last Down**
contains additional information about why the LES-BUS was last down, if ever.

**LES-BUS State last changed at**
is the system up time at which the LES-BUS entered its current state. The format is *hours.minutes.seconds.hundredths*

**LES-LEC Status Table changed at**
is the most recent system up time at which a LEC's state changed at the LES.

**BUS-LEC Status Table changed at**
is the most recent system up time that a LEC entered or exited operational state at the BUS.

**IP BCM** The current status of IP BCM.

**IPX BCM** The current status of IPX BCM. IPX BCM can only be *ACTIVE* if IPX BCM is configured to Enabled, the LES-BUS State is Operational, and if the **IPX BCM Active Forwarding List Size** has not exceeded its configured threshold, **BCM IPX Maximum Forwarding List**. See 26-12 for additional information.

**NetBIOS BCM**
The current status of NetBIOS BCM.

**IPX BCM Active Forwarding List Size**
The number of entries currently in IPX BCM's Forwarding List. If this number exceeds the configured threshold for **BCM IPX Maximum Forwarding List**, IPX BCM will become *INACTIVE*, and the BUS will

forward all IPX broadcast frames. Note that this information is only displayed if IPX BCM is currently *ACTIVE*.

See "Configuration Commands for a LES-BUS" on page 26-4 for more information about the configuration parameters.

## Restart

Use the **restart** command to restart a running or stopped LES-BUS. A LES-BUS can be restarted using the parameters configured under the `Talk 5` or `Talk 6` interface.

**Syntax:**

| | |
|---|---|
| **restart** | *t5* |
| | *t6* |

**Example:**

```
EXISTING LES-BUS 'elan01'+restart ?
T5 (Using config parms in Talk 5)
T6 (Using config parms written in Talk 6)
EXISTING LES-BUS 'elan01'+restart t5
Are you sure you want to restart this LES/BUS? [No] : yes
LES/BUS: 'elan01': RESTARTING


EXISTING LES-BUS 'elan01'+restart t6
Are you sure you want to restart this LES/BUS? [No] : yes
LES/BUS: 'elan01': RESTARTING
```

## Set

Use the **set** command to dynamically set the values of various LES-BUS configuration parameters.

**Syntax:**

| | |
|---|---|
| se**t** | bus-monitor |
| | control |
| | frame-age |
| | ip |
| | ipx |
| | ipx-server-farm |
| | le-arp |
| | multicast-send-disconnect-time |
| | netbios |
| | trace |
| | traffic |

You can dynamically set the following LES-BUS configuration parameters. The parameter that you set is immediately used by the LES-BUS, however the LES-BUS's configured parameter values in Static RAM do not change. To permanently change the configured state in Static RAM, use the `config>` interface.

See 26-8 for detailed information about the **set** parameters.

```
 EXISTING LES-BUS+ set ?
  BUS-MONITOR settings
  CONTROL timeout
  FRAME-AGE
  IP broadcast cache age
  IPX broadcast cache age
  IPX-SERVER-FARM threshold
  LE ARP response destination
  MULTICAST send disconnect time
  NETBIOS broadcast cache age
  TRACE
  TRAFFIC type

EXISTING LES-BUS+ set bus-monitor ?
DURATION-OF-SAMPLE    (# Seconds in each sample interval)
SAMPLE-RATE           (Frame sampling rate)
TIME-BETWEEN-SAMPLES  (# Minutes between sample intervals)
TOP-NUMBER-MACS       (# Top Hosts to Record)

EXISTING LES-BUS+ set bus-monitor duration
Duration of sample interval in seconds (1-600) [10]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set bus-monitor sample
Frame sampling rate (1-1000) [10]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set bus-monitor time
Number of minutes between sample intervals (1-120) [30]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set bus-monitor top
Number of top MAC addresses to record (1-100) [10]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set control
Control timeout (10-300) [110]? 120
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set frame-age
Maximum frame age (1-4) [1]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set ip
IP cache age, in minutes (2-20) [5]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set ipx
IPX cache age, in minutes (1-10) [3]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set ipx-server-farm
IPX Server Farm Threshold (2 -50) [20]?10
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set le
  (  1) One client
  (  2) All clients
LE ARP response destination [1]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set multicast
Multicast Send disconnect time [60]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set netbios
NetBIOS cache age, in minutes (10-20) [15]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set trace ?
MASK
VALUE

EXISTING LES-BUS+ set trace mask
ATM address trace filter mask [FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF.FF]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set trace value
ATM address trace filter value [00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00.00]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set traffic ?
MAXIMUM reserved bandwidth
VALIDATE peak cell rate
```

```
EXISTING LES-BUS+ set traffic maximum ?
CONTROL Direct VCC maximum
MULTICAST Send VCC maximum

EXISTING LES-BUS+ set traffic maximum control
Maximum reserved bandwidth in Kbps (0 - 155000) [0]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set traffic maximum multicast
Maximum reserved bandwidth in Kbps (0 - 155000) [0]?
LES-BUS: 'test' : parameter successfully set

EXISTING LES-BUS+ set traffic validate
Validate peak cell rate of best effort VCCs? [No]:
LES-BUS: 'test' : parameter successfully set
```

## Show

Use the **show** command to display various information related to this LES-BUS. The **show** command consolidates other LES-BUS Console display commands and uses a shorter command syntax.

The **show** commands are equivalent to other commands contained in this chapter. For example, **show lec** is equivalent to **database list all lec**. See "Database List" on page 26-46 for additional information.

**Syntax:**

| | |
|---|---|
| **show** | *database* |
| | specific *database* |
| | statistics |
| | current |

**Example:**

```
EXISTING LES-BUS 'losangeles'+show ?
BCM-LEARNED-MAC entries
CURRENT configuration of LES-BUS
IP entries
IPX entries
IPX-server-farms
LEC entries
NETBIOS entries
REGISTERED-MAC entries
ROUTE-DESCRIPTOR entries
SOURCE route management
SPECIFIC entry
STATISTICS
```

**database** This command is equivalent to **database list all** *database*, where *database* can be one of the following:

- bcm-learned-mac
- ip
- ipx
- ipx-server-farm
- lec
- netbios
- registered-mac
- route-descriptor

See "Database List" on page 26-46 for additional information.

**Example:**

```
EXISTING LES-BUS 'losangeles'+show lec
Number of LEC's to display: 2

    LEC-LES and LEC-BUS State  (UP=Up,  ID=Idle,  --. --.
      **=Other; Show specific LEC to see actual)    v   v
                                            LEC    State   #ATM  #Reg   #Lrnd
LEC Primary ATM Address               Proxy ID     LES BUS  Adrs  MACs   MACs
----------------------------------------  -  ----   --  --  ----  -----  -----
39999999999999000099993101100005AF972A000  Y  0001   UP  UP     1      5      0
3999999999999900009999310100041347323102  Y  0002   UP  UP     1      1      0
```

**specific** *database*
This command is equivalent to **database list specific** *database*, where *database* can be one of the following:

- ip

- ipx
- lec
- mac
- netbios
- registered-mac
- route-descriptor

See “Database List” on page 26-46 for additional information.

**Example:** *database*

```
EXISTING LES-BUS 'losangeles'+show specific ip
IP address [0.0.0.0]? 1.2.3.4
```

**statistics** *type*
This command is equivalent to **statistics display** *type*, where *type* can be one of the following:

- bcm
- bus monitor
- les-bus
- source route management

See 26-63 for additional information.

**Example:**

```
EXISTING LES-BUS 'losangeles'+show statistics bcm all
```

**current** This command is equivalent to **list**. See “List” on page 26-56 for additional information.

**Example:**

```
EXISTING LES-BUS 'losangeles'+show current
```

## Statistics

Use the **statistics** command to either clear or display statistics associated with LAN Emulation MIBs. Some of the fields displayed by the **statistics** command correspond to specific MIB entries that are in **ibmlesrv.mib** located at
| **ftp://ftp.nways.raleigh.ibm.com/pub/netmgmt/mss/**.

**Syntax:**

| | |
|---|---|
| **statistics** | clear ... |
| | display ... |

The **statistics clear** command zeroes statistical data that previously was gathered for BCM, LES-BUS, or Source Route Management.

**Note:** Some LES-BUS counters, such as the number of proxy LECs, are not cleared, since they have other function in addition to maintaining statistical data.

**Syntax:**

| | |
|---|---|
| **clear** | bcm *protocol* |
| | les-bus *type* |
| | source *protocol* |

Where *protocol* or *type* can be:

| | protocol or type |
|---|---|
| **clear bcm** | all |
| | ip |
| | ipx |
| | netbios |
| **clear les** | bus |
| | lec-bus *atm-address* |
| | lec-bus *lecid* |
| | lec-les *atm-address* |
| | lec-les *lecid* |
| | les |
| **clear source** | all |
| | ip |
| | ipx |
| | netbios |

**Example:**

```
Existing LES-BUS+ statistics clear bcm all
Existing LES-BUS+
```

The **statistics display** command provides statistical data for BCM, LES-BUS, and Source Route Management.

**Syntax:**

| | |
|---|---|
| **statistics display** | bcm *protocol-stats* |
| | bus monitor |
| | les-bus *type* |
| | source *protocol-stats* |

Where *protocol-stats* can be:

| | protocol-stats |
|---|---|
| statistics display bcm | all<br>ip<br>ipx<br>netbios |
| statistics display source | all<br>ip<br>ipx<br>netbios |

or where *type* can be:

| | type |
|---|---|
| **statistics display les-bus** | bus |

lec-bus *atm-address*

lec-bus *lecid*

lec-les *atm-address*

lec-les *lecid*

les

**Example:**

```
EXISTING LES-BUS+ statistics display bcm all

                                                             Total BCM
                          IP          IPX       NetBIOS     Processed
                  ----------   ----------    ----------    ----------
 inFrms:              182972          324           374        299518
 inOctets:          11410392        36798         32840      22342391
 inReturns:           129888            6           334        246076
 inReturnOctets:     8113160          564         30254      19006339
 inFiltered:               0            0            40            40
 inFilteredOctets:         0            0          2586          2586
 outFrms:              53084          318             0         53402
 outFrmsOctets:      3297232        36234             0       3333466
 outError:                 0            0             0             0
 outErrorOctets:           0            0             0             0
```

The statistical counters for the **statistics display bcm all** command map to MIB variables as follows:

```
Total BCM Processed
Displayed Name                      MIB ENTRY
---------------------               ---------
inFrms                             bcmFramesReceived
inOctets                           bcmOctetsReceived
inReturns                          bcmFramesReturned
inReturnOctets                     bcmOctetsReturned
inFiltered                         bcmFramesDiscarded
inFilteredOctets                   bcmOctetsDiscarded
outFrms                            bcmFramesTransmitted
outFrmsOctets                      bcmOctetsTransmitted
outError                           bcmTransmitErrorFrames
outErrorOctets                     bcmTransmitErrorOctets

IP DISPLAYED NAME                    MIB ENTRY
-----------------                    ---------
inFrms                             bcmIpFramesReceived
inOctets                           bcmIpOctetsReceived
inReturns                          bcmIpFramesReturned
inReturnOctets                     bcmIpOctetsReturned
inFiltered                         bcmIpFramesDiscarded
inFilteredOctets                   bcmIpOctetsDiscarded
outFrms                            bcmIpFramesTransmitted
outFrmsOctets                      bcmIpOctetsTransmitted
outError                           bcmIpTransmitErrorFrames
outErrorOctets                     bcmIpTransmitErrorOctets

IPX DISPLAYED NAME                    MIB ENTRY
-----------------                     ---------
inFrms                             bcmIpxFramesReceived
inOctets                           bcmIpxOctetsReceived
inReturns                          bcmIpxFramesReturned
inReturnOctets                     bcmIpxOctetsReturned
inFiltered                         bcmIpxFramesDiscarded
inFilteredOctets                   bcmIpxOctetsDiscarded
outFrms                            bcmIpxFramesTransmitted
outFrmsOctets                      bcmIpxOctetsTransmitted
outError                           bcmIpxTransmitErrorFrames
outErrorOctets                     bcmIpxTransmitErrorOctets


NetBIOS DISPLAYED NAME                 MIB ENTRY
----------------------                 ---------
inFrms                             bcmNbFramesReceived
inOctets                           bcmNbOctetsReceived
inReturns                          bcmNbFramesReturned
inReturnOctets                     bcmNbOctetsReturned
inFiltered                         bcmNbFramesDiscarded
inFilteredOctets                   bcmNbOctetsDiscarded
outFrms                            bcmNbFramesTransmitted
outFrmsOctets                      bcmNbOctetsTransmitted
outError                           bcmNbTransmitErrorFrames
outErrorOctets                     bcmNbTransmitErrorOctets
```

**display bus**

Displays statistical data associated with BUS Monitoring.

**Example:**

```
EXISTING LES-BUS+ statistics display bus
   -BUS Monitor Status-
   Currently in a sample interval ?            no
   Next sample interval scheduled in:          0 minute(s), 18 second(s)

   -Results of Last Complete Sample-
   BUS Monitor sample interval started at:     13.27.03.98   (System Up Time)
   Duration of sample interval:                59 second(s)
   # Top Hosts Actually Recorded:              5
   # Frames Received in sample interval:       301
   # Frames Sampled in sample interval:        301
   Frame sampling rate:                        1 out of 1
                                                                          # frames
Rank  Source MAC Addr.    Associated LEC ATM Address                      sampled
----  -----------------   ----------------------------------------   ----------
   1  10.00.5A.AA.AA.AA   39999999999999900009999010110005A12340002          100
   2  10.00.5A.66.66.66   39999999999999900009999010110005A12340002           60
   3  10.00.5A.EE.EE.EE   39999999999999900009999010110005A12340002           52
   4  10.00.5A.55.55.55   39999999999999900009999010110005A12340001           50
   5  10.00.5A.99.99.99   39999999999999900009999010110005A12340001           39
EXISTING LES-BUS+
```

**statistics display les lec-bus lecid**

Lists the number of multicast, broadcast, and unknown forward requests received or discarded by the BUS from this LEC.

```
EXISTING LES-BUS+ statistics display les lec-bus lecid
LECID [0]? 1
ATM Forum LEC-BUS MIB Statistics:
   recvs:                           1
   discards:                        0
```

The statistical counters for some fields generated by the **statistics display les lec-bus** command map to MIB variables as follows:

```
LEC-BUS Displayed Name              MIB ENTRY
----------------------              ---------
recvs                               busLecRecv
discards                            busLecDiscards
```

**statistics display [les bus or lec-bus or lec-les or les]**

Displays statistical data for a given LEC or ELAN.

**Example:**

```
EXISTING LES-BUS+ statistics display les-bus bus
ATM Forum BUS MIB Statistics:
   inDiscards:                              0
   inOctets:                                67200
   inUcastFrms:                             0
   inMcastFrms:                             1050
   frmTimeouts:                             0
   mcastSendRefused:                        0
   mcastFwdFailure:                         0
Other Statistics:
   inExplorer:                              0
   inFlushReq:                              0
   outFlushReq_mcastFwd:                    0
   outFlushReq_mcastSend:                   0
   outUcastFrms_mcastFwd:                   0
   outUcastFrms_mcastSend:                  0
   outMcastFrms:                            1050
   outOctets:                               67200
   mcastSendReleased:                       0
   mcastFwdReleased:                        0
   mcastFwdPartyReleased:                   0
   invalidProtocol_droppedFrames:           0
   verNotSup_droppedFrames:                 0
   invalidOpcode_droppedFrames:             0
   invalidLecid_droppedFrames:              0
   invalidSize_droppedFrames:               0
   flushToBus_droppedFrames:                0
   incompleteSourceConnect_droppedFrames:   0
   incompleteTargetConnect_droppedFrames:   0
   noProxy_droppedFrames:                   0
   lecsWaitingForMcastFwd:                  0
   mcastSendDisconnectTimeouts:             0
   badRifFrames:                            0
   flushTargetMismatch_droppedFrames:       0
   flushInvalidTag_droppedFrames:           0
```

**ATM Forum BUS MIB Statistics:**

The statistical counters for some fields generated by the **statistics display les-bus bus** command map to MIB variables as follows:

```
BUS DISPLAYED NAME          MIB ENTRY
------------------          ---------
inDiscards                  busStatInDiscards
inOctets                    busStatInOctets
inUcastFrms                 busStatInUcastFrms
inMcastFrms                 busStatInMcastFrm
frmTimeouts                 busStatFrmTimeOuts
mcastSendRefused            busStatMcastSendRefused
mcastFwdFailure             busStatMcastFwdFailure
```

**Other Statistics:**

**The following definitions are not MIB-related:**

**inExplorer**
Number of Token-Ring explorer frames received by BUS

**inFlushReq**
Number of Flush request control frames received by BUS

**outFlushReq_mcastFwd**
Number of Flush request control frames forwarded by BUS on Multicast Forward VCC(s)

**outFlushReq_mcastSend**
Number of Flush request control frames forwarded by BUS on Multicast Send VCC

**outUcastFrms_mcastFwd**
Number of unicast frames forwarded by BUS on Multicast Forward VCC(s)

**outUcastFrms_mcastSend**
Number of unicast frames forwarded by BUS on Multicast Send VCC

**outMcastFrms**
Number of multicast frames forwarded by BUS

**outOctets**
Number of octets forwarded by BUS (includes both control and data)

**mcastSendReleased**
Number of Multicast Send VCCs released by LEC/network for any reason

**mcastFwdReleased**
Number of Multicast Forward VCCs released by LEC/network for any reason (this is release of entire point-to-multipoint VCC, not just one party)

**mcastFwdPartyReleased**
Number of times call to party on Multicast Forward VCC was released by LEC/network for any reason

**invalidProtocol_droppedFrames**
Number of control frames dropped by BUS due to invalid protocol

**verNotSup_droppedFrames**
Number of control frames dropped by BUS due to incorrect version #

**invalidOpcode_droppedFrames**
Number of control frames dropped by BUS due to invalid opcode

**invalidLecid_droppedFrames**
number of frames (control or data) dropped by BUS due to invalid LECID

**invalidSize_droppedFrames**
Number of frames (control or data) dropped by BUS due to frame size being invalid

**flushToBus_droppedFrames**
Number of FLUSH request frames dropped by BUS because target ATM address was ATM address of BUS

**incompleteSourceConnect_droppedFrames**
Number of frames (control or data) dropped by BUS because source LEC had not completed the BUS connect phase

**incompleteTargetConnect_droppedFrames**
Number of frames (control or data) dropped by BUS because target LEC had not completed the BUS connect phase

**noProxy_droppedFrames**
Number of "unknown" FLUSH request or non-multicast data frames dropped by BUS because the ELAN had no proxy LEC members

**lecsWaitingForMcastFwd**
Number of LECs on this ELAN waiting to be added to the BUS Multicast Forward VCC due to the Add Party message being delayed due to suspected ATM switch congestion.

**mcastSendDisconnectTimeouts**
Number of times a LEC Multicast Send Disconnect Timer has expired. If the associated LEC had not reached full operational status with the BUS, the LEC was terminated from the ELAN.

**badRifFrames**
Number of frames received with bad RIFs.

**Note:** This only applies when BUS is configured to use a Partitioned Unicast Frame Domain and when the Local Segment Number is configured.

**flushTargetMismatch_droppedFrames**
Number of Flush frames with target LAN destination not registered by target ATM address.

**flushInvalidTag_droppedFrames**
Number of Flush frames with invalid tag in target LAN destination.

**Example:**

```
EXISTING LES-BUS+ statistics display les les
ATM Forum LES MIB Statistics:
   joinOK:                                 2
   verNotSup:                              0
   invalidReqParam:                        0
   dupLanDest:                             0
   dupAtmAddr:                             0
   insRes:                                 0
   accDenied:                              0
   invalidReqId:                           0
   invalidLanDest:                         0
   invalidAtmAddr:                         0
   badPkts:                                0
   outRegFails:                            0
   leArpIn:                                2
   leArpFwd:                               0
Other Statistics:
   leArpAnswers:                           2
   leArpRspFwd:                            0
   topologyFwd:                            0
   narpFwd:                                0
   flushRspFwd:                            0
   outJoinFails:                           0
   regOK:                                  2
   unRegOK:                                0
   outUnRegFails:                          0
   proxyLecs:                              1
   nonProxyLecs:                           0
   macAddrMappings:                        1
   rdMappings:                             0
   atmAddrMappings:                        1
   joinRetransmits:                        0
   joinParmChanges:                        0
   joinTimeouts:                           0
   reRegs:                                 0
   ctlDirRefused:                          0
   ctlDirReleased_err:                     0
   ctlDistFailure:                         0
   ctlDistReleased_err:                    0
   ctlDistPartyReleased_err:               0
   redundancyVccRefused:                   0
   redundancyVccReleased:                  0
   redundancyVccFailure:                   0
   oam_droppedFrames:                      0
   invalidSize_droppedFrames:              0
   invalidMarker_droppedFrames:            0
   invalidProtocol_droppedFrames:          0
   verNotSup_droppedFrames:                0
   invalidLecid_droppedFrames:             0
   unknownLecid_droppedFrames:             0
   invalidOpcode_droppedFrames:            0
   dupJoin_droppedFrames:                  0
   incompleteSourceJoin_droppedFrames:     0
   incompleteTargetJoin_droppedFrames:     0
   noProxy_droppedFrames:                  0
   lecsWaitingForCtrlDist:                 0
   verifyOk:                               0
   outVerifyFails:                         0
```

**ATM Forum LES MIB Statistics:**
The statistical counters for some fields generated by the **statistics display les les** command map to MIB variables as follows:

```
LES DISPLAYED NAME              MIB ENTRY
------------------              ---------
joinOK                          lesStatJoinOk
verNotSup                       lesStatVerNotSup
invalidReqParam                 lesStatInvalidReqParam
dupLanDest                      lesStatDupLanDest
dupAtmAddr                      lesStatDupAtmAddr
insRes                          lesStatInsRes
accDenied                       lesStatAccDenied
invalidReqId                    lesStatInvalidReqId
invalidLanDest                  lesStatInvalidLanDest
invalidAtmAddr                  lesStatInvalidAtmAddr
badPkts                         lesStatInBadPkts
outRegFails                     lesStatOutRegFails
leArpIn                         lesStatLeArpIn
leArpFwd                        lesStatLeArpFwd
```

**Other Statistics:**

**The following definitions are not MIB-related:**

**leArpAnswers**
Number of ARP requests answered by LES

**leArpRspFwd**
Number of ARP responses forwarded by LES

**topologyFwd**
Number of topology frames forwarded by LES

**narpFwd** Number of NARP frames forwarded by LES

**flushRspFwd**
Number of flush response frames forwarded by LES

**outJoinFails**
Number of join responses transmitted with unsuccessful status values, includes retransmissions

**regOK** Number of successful registration responses sent by LES, includes reregistrations

**unRegOK**
Number of successful unregistration responses sent by LES

**outUnRegFails**
Number of unregistration responses transmitted with unsuccessful status values

**proxyLecs**
Number of Proxy LECs currently joined to LES

**nonProxyLecs**
Number of Non-Proxy LECs currently joined to LES

**regMacAddr**
Number of MAC address mappings currently in database

**regRd** Number of route descriptor mappings currently in database

**regAtmAddr**
Number of unique ATM addresses currently in mapping database

**joinRetransmits**
Number of join response retransmissions

**joinParmChanges**
Number of LEC ELAN memberships terminated because parms changed on subsequent JOIN request

**joinTimeouts**
Number of join timeouts

**reRegs**
Number of reregistrations

**ctlDirRefused**
Number of Control Direct VCC call setup requests rejected by the LES for any reason

**ctlDirReleased_err**
Number of Control Direct VCCs released by LEC/network with cause code indicating error

**ctlDistFailure**
Number of Control Distribute VCC requests made by LES that failed for any reason (includes calls to first and subsequent parties)

**ctlDistReleased_err**
Number of Control Distribute VCCs released by LEC/network due to error (this is release of entire point-to-multipoint VCC, not just one party)

**ctlDistPartyReleased_err**
Number of times call to party on Control Distribute VCC was released by LEC/ network with cause code indicating error

**oam_droppedFrames**
Number of OAM frames dropped by LES

**invalidSize_droppedFrames**
Number of frames dropped by LES due to frame size being invalid for a control frame

**invalidMarker_droppedFrames**
Number of frames dropped by LES due to invalid marker

**invalidProtocol_droppedFrames**
Number of frames dropped by LES due to invalid protocol

**verNotSup_droppedFrames**
Number of frames dropped by LES due to incorrect version #

**invalidLecid_droppedFrames**
Number of frames dropped by LES due to invalid LECID NARP and topology requests

**unknownLecid_droppedFrames**
Number of frames dropped by LES due to unknown LECID ARP and FLUSH responses

**invalidOpcode_droppedFrames**
Number of frames dropped by LES due to invalid opcode

**dupJoin_droppedFrames**
Number of duplicate join requests dropped by LES because processing of the original request had not completed

**incompleteSourceJoin_droppedFrames**
Number of frames dropped by LES because the source LEC had not completed the JOIN phase

**incompleteTargetJoin_droppedFrames**
Number of frames dropped by LES because the target LEC had not completed the JOIN phase

**noProxy_droppedFrames**
Number of “unknown” ARP requests dropped by LES because the ELAN had no proxy LEC members

**lecsWaitingForCtrlDist**
Number of LECs on this ELAN waiting to be added to the LES Control Distribute VCC due to the Add Party message being delayed due to suspected ATM switch congestion.

**verifyOk** Number of successful VERIFY responses.

**outVerifyFails**
Number of failed VERIFY responses.

**Example:**

```
EXISTING LES-BUS+ statistics display les lec-les lecid
LECID [0]? 1
ATM Forum LEC-LES MIB Statistics:
   recvs:                              3
   inRegReq:                           1
   inUnReg:                            0
   inLeArpUcast:                       0
   inLeArpBcast:                       1
   inLeArpResp:                        0
   inNArp:                             0
Other Statistics:
   directedResp:                       3
   inLeArpRd:                          0
   inTopology:                         0
   inFlushResp:                        0
```

**ATM Forum LES MIB Statistics:**

**The statistical counters for some fields generated by the statistics display les lec-les command map to MIB variables as follows:**

```
LEC-LES DISPLAYED NAME          MIB ENTRY
----------------------          ---------
recvs                            lesLecRecvs
inRegReq                         lesLecInRegReq
inUnReg                          lesLecInUnReg
inLeArpUcast                     lesLecInLeArpUcast
inLeArpBcast                     lesLecInLeArpBcast
inLeArpResp                      lesLecInLeArpResp
inNArp                           lesLecInNAr
```

**Other Statistics:**

The following definitions are not MIB-related:

**directedResp**
Number of responses sent directly to LEC on Control Direct VCC

**inLeArpRd**
Number of ARP requests for route descriptors received from LEC

**inFlushResp**
Number of FLUSH responses received from LEC

**inTopology**
Number of topology requests received from LEC

**display source [all or ip or ipx or netbios]**
Displays statistical data for Source Management.

**Example:**

```
EXISTING LES-BUS+ statistics display source all
                             IP         IPX     NetBIOS       Total
                     ----------  ----------  ----------  ----------
   outNoRif:                  0           0           0           0
   outAre:                    0           0           0           0
   outSte:                    0           0           0           0
   outSrf:                    1           0           0           1
```

The statistical counters for the **statistics display source all** command map to MIB variables as follows:

```
TOTALS DISPLAYED NAME             MIB ENTRY
---------------------             ---------
outNoRif                          bcmBroadcastFramesDirectedNoRif
outAre                            bcmBroadcastFramesDirectedAre
outSte                            bcmBroadcastFramesDirectedSte
outSrf                            bcmBroadcastFramesDirectedSrf


IP DISPLAYED NAME                 MIB ENTRY
-----------------                 ---------
outNoRif                          bcmIpBroadcastFramesDirectedNoRif
outAre                            bcmIpBroadcastFramesDirectedAre
outSte                            bcmIpBroadcastFramesDirectedSte
outSrf                            bcmIpBroadcastFramesDirectedSrf

IPX DISPLAYED NAME                MIB ENTRY
------------------                ---------
outNoRif                          bcmIpxBroadcastFramesDirectedNoRif
outAre                            bcmIpxBroadcastFramesDirectedAre
outSte                            bcmIpxBroadcastFramesDirectedSte
outSrf                            bcmIpxBroadcastFramesDirectedSrf

NetBIOS DISPLAYED NAME            MIB ENTRY
----------------------            ---------
outNoRif                          bcmNbBroadcastFramesDirectedNoRif
outAre                            bcmNbBroadcastFramesDirectedAre
outSte                            bcmNbBroadcastFramesDirectedSte
outSrf                            bcmNbBroadcastFramesDirectedSrf
```

## Stop

Use the **stop** command to stop the operation of a LES-BUS.

**Syntax:**

<u>sto</u>**p**

**Example:**

```
EXISTING LES-BUS 'losangeles'+stop
Are you sure you want to stop this LES/BUS? [No]:
LES/BUS:'losangeles':not stopped
```

## Terminate

Use the **terminate** command to terminate a specific LE Client from the currently operating LES-BUS.

**Note:** The LE Client may subsequently rejoin this ELAN or another ELAN.

**Syntax:**

**terminate**
- atm *atm-address*
- lecid *lecid*
- mac *mac-address*
- route-descriptor *route-descriptor*

**Example:**

```
EXISTING LES-BUS 'losangeles'+terminate lecid
LECID of LEC to Terminate []? 0001
The following LEC was found based on given criteria:
LEC ID:                     0x0001
   LEC ATM Address:         3999999999999900009999310110005AF972A000
   Proxy:                   Yes
   LEC State at LES:        OPERATIONAL
   LEC State at BUS:        OPERATIONAL
   MAC Address in Join Req: none
   # ATM Address Mappings:  1
   # MAC Address Mappings:  5
   # RD Mappings:           1

If you choose to TERMINATE this LEC, it may rejoin
this ELAN, or another ELAN.
Are you sure you want to terminate this LEC? [No]: no
LEC not terminated.
```

## Monitoring Commands for LECS

You can create, delete, or restart an operating LECS and modify certain operating parameters of the LECS. (These changes are lost on the next restart.) You can also search through the databases of the LECS or enter into the subenvironments of the LECS console.

Enter the following commands at the `LECS console+` prompt:

*Table 26-15 (Page 1 of 2). LECS 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 2-3. |
| Access-control | Provides ATM address screening for security at the LECS. |
| Create | Creates a LECS from its configuration data (the configuration data must already exist). |
| Delete | Deletes the operating LECS. |
| Elans | Enters the LECS ELANs Console Environment. |
| List | Displays the parameters of the operating LECS. |
| Memory | Resets the short-term memory of the LECS. |
| Policies | Enters the LECS Policies Console Environment. |
| Restart | Restarts the LECS |
| Search | Searches the databases of the LECS. |
| Set | Modifies an operating parameter of the LECS. |
| Statistics | Resets or displays values of LECS counters. |

| Table 26-15 (Page 2 of 2). LECS Monitoring Commands Summary | |
|---|---|
| Command | Function |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Access-control

Use the **access-control** command to enter the LECS Access Control monitoring environment. These commands allow you to create a list of previously configured ATM address prefixes ( 1 - 20 octets) which are not allowed access to the LECS configuration database. All LECS connection attempts and configuration requests from matching ATM addresses are rejected. You can also delete and display access controls and associated statistics.

**Note:** To add an ATM address prefix to the list of configured prefixes, use the **access-control** command from `t 6`. See "Configuration Commands for the Access Control of a LECS" on page 26-19.

**Syntax:**

**access-control**

**Example:**

```
LECS console+ access-control
Access-Control console
LECS Access Control+
```

For additional information, see "Monitoring Commands for the Access Control of a LECS" on page 26-83.

## Create

Use this command to create an operating LECS from the configuration data. Only one LECS is permitted on the MSS Server. This command also creates all of the policies, ELANs, and so on, for the LECS. These objects are created directly from the LECS configuration, described in "Configuration Commands for a LECS" on page 26-15. You can delete the LECS with the **delete** command.

**Syntax:**

**create**

**Example:**

```
LECS console+ create
LECS created successfully
  created all configured LECS objects
LECS console+
```

## Delete

Use the **delete** command to delete an operating LECS. The LECS, along with all of its policies, ELANs, and so on, is deleted from operation. You can recreate the LECS using either the **create** or the **restart** command.

**Syntax:**

**delete**

**Example:**

```
LECS console+ delete
Delete LECS and all of its resources? [No]:yes
LECS deleted
LECS console+
```

## Elans

Use the **elans** command to enter the LECS ELANs console environment where you can create the ELANs, LESs, and so on, known to this LECS.

**Syntax:**

**elans**

**Example:**

```
LECS console+ elans
LECS ELANs console
LECS ELANs+
```

## List

Use this command to list the operating parameters of the LECS. Only the parameters of the LECS are listed. Individual policies, ELANs, and so on, must be accessed through submenus. The operating parameters of the LECS include its current state, an error log, the LECS ATM address, whether or not the LECS was able to register the ATM Forum well-known address with local switch, the UNI version being used, and the configuration parameters described at "Set" on page 26-80.

**Syntax:**

**list**

**Example:**

```
LECS console+ list
Status of LECS:
ATM device number:              0
State:                          Operating normally(88)
  Time of last state change:    00.24.50.03
  Elapsed time since last change: 00.15.41.42
Error Log:                      no err (0)
Local ATM address:              39840F0000000000000000000110005A00000B00
 Well-known address:            (unable to confirm WKA registered with switch)
 UNI version:                   UNI Version 3.0
Validate best effort PCR:       No
Maximum config direct VCC reserved bandwidth:
                                0 Kbps
Maximum number of config direct VCCs to LECS:
                                128
Seconds before VCC declared idle: 60
Trace ATM address value:        0000000000000000000000000000000000000000
Trace ATM address mask:         FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
LECS console+
```

**ATM device number**
Number of the ATM interface over which the LECS is operating.

**State** The possible states of the LECS are:

*Idle* - The LECS exists but is not functional. This is a temporary state of the LECS; if the idle state persists, either delete or restart the LECS.

*Initializing* - The LECS is initializing its memory.

*Activating ATM address* - The LECS has initiated registration of its ATM address with the local switch but has not received confirmation of the address registration.

*Activated ATM address* - The LECS has received confirmation that its ATM address is registered with the local switch.

*Getting UNI version* - The LECS is attempting to query the local switch to determine the UNI version.

*Got UNI version* - The LECS has determined the UNI version being used.

*ATM address deactivated* - The local ATM switch has deactivated the ATM address of the LECS. If this state persists, restart the LECS.

*ATM network down* - The ATM interface has detected that the ATM network is not functioning correctly. LECS operation should return to normal once the ATM network is operational.

*Operating normally* - The normal state of the LECS.

*Down due to error* - An error occurred that terminated the operation of the LECS. The error log contains information explaining the error. The LECS must be restarted.

*Polling status of well-known address* - Certain ATM switches let you register ATM addresses that do not use the same 13–octet ATM address prefix used by the switch. For such switches, dynamic registration of the ATM Forum's well-known LECS address is possible. During initialization, the LECS always attempts to register the well-known address with the switch. This state indicates that the LECS is currently attempting this well-known address registration.

*Operating but rejecting VCCs* - The **set stop** command puts the LECS into this state where it rejects all configuration direct VCCs. Use the **set start** command to return to the normal operating state.

*State unknown* - An error caused the state variable of the LECS to assume an unknown value. Restart or delete the LECS.

**Time of last... and Elapsed time since...**
These two fields indicate the last time that the LECS changed its state. The field is in the format *hh.mm.ss.dd* where *hh* is hours, *mm* is minutes, *ss* is seconds, and *dd* is hundredths of seconds. The first field lists the time that elapsed between the system initialization and the last state change, while the second field lists the time that elapsed since the last state change.

**Error Log:**
Describes the error that caused the LECS to enter the 'Down due to error' state. This information is used for diagnostic purposes.

**Local ATM address:**
ATM address of the LECS consisting of the first 13 octets from the network prefix of the local ATM switch, and appending the configured ESI and selector value. The ATM address is displayed only if it has been successfully registered with the local ATM switch.

**Well-known address:**
The well-known address of the LECS. The LECS attempts to register the well-known address dynamically with the ATM switch. If this dynamic registration succeeds, or if the LECS begins to receive calls to the well-known address (indicating that some other entity has registered the

LECS with the local ATM switch), then this field contains the ATM Forum well-known ATM address.

**UNI version:**
The UNI version being used by the LECS.

**Validate best effort PCR**
See the **set validate** command.

**Maximum config direct VCC reserved bandwidth:**
See the **set reserved** command.

**Maximum number of config direct VCCs to LECS:**
See the **set maximum** command.

**Seconds before VCC declared idle:**
See the **set vcc** command.

**Trace ATM address...**
See the **set trace** command.

## Memory

Use the **memory** command to clear the LECS short-term memory. The short-term memory of the LECS functions in both the redundancy and security aspects of the MSS Server LAN Emulation Service. For additional information on redundancy and security, see “LAN Emulation Reliability” on page 19-16. The **memory** command can be used to reinitialize the short-term memory without restarting the LECS.

**Syntax:**

**memory** clear

**Example:**

```
LECS console+ memory clear
Cleared short-term memory of LECS
LECS console+
```

## Policies

Use the **policies** command to enter the LECS Policies Console environment, where you can work closely with the policies guiding the LEC-to-LES assignment procedure of the LECS. You can create, delete, and display policies, and modify various policy-related counters.

**Syntax:**

**policies**

**Example:**

```
LECS console+ policies
LECS policies console
LECS policies+
```

## Restart

Use the **restart** command to restart or create the LECS. The **restart** command stops an operating LECS, frees its resources, and reinitializes/restarts the LECS. You are prompted to either keep the current databases or to rebuild them from the static configuration data when the LECS restarts.

**Syntax:**

**restart**

**Example:**

```
LECS console+ restart
( 1) rebuild
( 2) retain
Retain current LECS databases or rebuild from SRAM [1]?2
LECS restarted successfully
LECS console+
```

## Search

Use the **search** command to search for LES or policy value information in the LECS databases. For example, if you wanted to know to which LES the LEC with ATM address 39.00.82.48.29.10.39.38.10.AB.CD.E1.02.FA.83.29.00.00.00.1D would be assigned, use the command **search atm**, or
**search atm 39.00.82.48.29.10.39.38.10.AB.CD.E1.02.FA.83.29.00.00.00.1D**

**Syntax:**

**search** atm
les
mac
name
route

Use the **search atm** command to search the LECS database of client ATM address prefixes. The output lists the longest prefix of that address found in the database, the LES associated with that prefix, and the ELAN associated with the LES.

**Note:** You can also search for a LES ATM address if you entered it as a non-local LES. See “Configuration Commands for ELAN Detailed Configuration” on page 26-22 for a description of local and non-local LESs.

**Example:**

```
LECS console+ search atm
ATM prefix to search for [ ]?39.00.82.48.29.10.39.38.10.AB.CD.E1.02.FA.83.29.00.00.00.1D
ATM address prefix 39.00.82.48.29.10.39.38.10.AB.CD.E1.02.FA.83.29.00.00.00.1D
  longest prefix 39.00.82.48.29.10.39.38.10.AB.CD.E1.02.FA.83.29.00.00.00.1D
      for LES address Local LES for: Accounting Ethernet Elan
            for ELAN 'Accounting Ethernet Elan'
LECS console+
```

Use the **search les** command to search for a given LES address in the LECS database of LES ATM addresses. The output lists the ELAN associated with the LES.

**Example:**

```
LECS console+ search les
LES to search for [ ]?39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
LES address 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
      for ELAN 'R&D Token Ring Elan'
LECS console+
```

Use the **search mac** command to search for a given MAC address in the LECS database of client MAC addresses. You are prompted to enter whether the MAC address was entered in token-ring or Ethernet bit format (the difference being which bit is most significant). The output lists the LES associated with the MAC address and the ELAN associated with that LES.

**Example:**

```
LECS console+ search mac
MAC address to search for [ ]?12.34.12.34.12.35
  (  1) Ethernet bit-order
  (  2) Token ring bit-order
Bit order used by MAC address [1]?1
MAC address 12.34.12.34.12.35
    for LES address Local LES for: Accounting Ethernet Elan
      for ELAN 'Accounting Ethernet Elan'
LECS console+
```

Use the **search name** command to search for a given ELAN name in the LECS database of ELAN name policy values. The ELAN name policy value is the ELAN name used by clients in their configuration requests. The output lists the LES associated with the given ELAN name, and the ELAN associated with the LES.

**Example:**

```
LECS console+ search name
ELAN name to search for [ ]?R&D Elan
ELAN name 'R&D Elan'
    for LES address 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
      for ELAN 'R&D Token Ring Elan'
LECS console+
```

Use the **search route** command to search for a route descriptor in the LECS database of client route descriptors. The output lists the LES associated with that route descriptor, and the ELAN associated with that LES.

**Example:**

```
LECS console+ search route
Route descriptor to search for [ ]?39.02
Route descriptor 39.02
    for LES address 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
      for ELAN 'R&D Token Ring Elan'
LECS console+
```

## Set

Use the **set** command to set various operating parameters of the LECS. These parameters take effect immediately but are not saved when you restart the LECS or the router.

**Syntax:**

| | |
|---|---|
| set | maximum |
| | reserved |
| | start |
| | stop |
| | trace ... |
| | validate |
| | vcc |

Use the **set maximum** command to set the maximum number of simultaneous configuration direct VCCs permitted by the LECS. When this number is exceeded, the

LECS releases all VCCs not used within the VCC idle time. VCCs that have been used within the VCC idle time are not released.

**Example:**

```
LECS console+ set maximum
Maximum number of simultaneous VCCs [128]?64
LECS modified
LECS console+
```

Use the **set reserved** command to set the maximum reserved bandwidth on a configuration direct VCC. The LECS will not accept reserved bandwidth connections specifying a reserved bandwidth that is larger than this maximum.

**Example:**

```
LECS console+ set reserved
Configuration direct maximum reserved bandwidth (in Kbps) [0]?1000
LECS modified
LECS console+
```

Use the **set start** command to move the LECS into a state where it accepts VCCs (this is its normal operating state).

**Example:**

```
LECS console+ set start
Reject all incoming VCCs? [No]no
LECS now accepting calls
LECS console+
```

Use the **set stop** command to move the LECS into a state where it rejects all incoming VCCs. You should put the LECS in such a state before creating or deleting ELANs, policies, and so on. Otherwise, changing these other structures could result in a client issuing two identical configuration requests, but being assigned to different LESs with each request, because the modifications changed the LECS databases between configuration requests.

**Example:**

```
LECS console+ set stop
Reject all incoming VCCs? [Yes]:yes
LECS rejecting all VCCs
LECS console+
```

Use the **set trace** command to change the “trace mask” or the “trace value.” The trace mask and trace value are used by the LECS to determine over which VCCs packet tracing should be active. For each VCC, the LECS compares the logical AND of the trace value and the trace mask with the logical AND of the calling ATM address and the trace mask. If the resulting bit strings are identical, then the LECS should perform packet tracing on that VCC. To activate packet tracing over all VCCs, use a mask of all zeros. Packet tracing over particular VCCs is indicated by using a more specific trace mask and trace value. Packet tracing must also be enabled for the LECS subsystem through the ELS console or configuration. For additional information, refer to Chapter 15, “Using the Event Logging System (ELS)” on page 15-1 and Chapter 16, “Configuring and Monitoring the Event Logging System (ELS)” on page 16-1.

In the following examples, packet tracing is used over all VCCs with a calling party ATM address beginning with 39.84.0f.00.00.00.00.01.01.d0.d0.58.24

**Example:**

```
LECS console+ set trace mask
Trace ATM addr mask [ ]?ff.ff.ff.ff.ff.ff.ff.ff.ff.ff.ff.ff.ff.00.00.00.00.00.00.00
LECS modified
LECS console+
```

**Example:**

```
LECS console+ set trace value
Trace ATM addr value [ ]?39.84.0f.00.00.00.00.01.01.d0.d0.58.24.00.00.00.00.00.00.00
LECS modified
LECS console+
```

Use the **set validate** command to determine whether the LECS validates the peak cell rate of best-effort connections. If this parameter is true, the LECS rejects connections specifying a peak cell rate greater than the line rate of the ATM interface. Clients specifying such a peak cell rate expect that they may use more bandwidth than is available *which can adversely affect network performance*. Setting this parameter to true may create interoperability problems with clients exhibiting this behavior.

**Example:**

```
LECS console+ set validate
Validate best effort peak cell rate? [No]:yes
LECS modified
LECS console+
```

Use the **set vcc** command to set the VCC idle time of the LECS.

**Example:**

```
LECS console+ set vcc
Time (in seconds) before a VCC is declared idle [60]?30
LECS modified
LECS console+
```

## Statistics

Use the **statistics** command to reset or to display many of the LECS counters.

**Syntax:**

**statistics** — clear
list

Use the **statistics clear** command to reset the counters of the LECS.

**Example:**

```
LECS console+ statistics clear
LECS statistics cleared
LECS console+
```

Use the **statistics list** command to display the counters of the LECS.

**Example:**

```
LECS console+ statistics list
LECS has:
     13 ELAN(s)
     6 policy(ies) at 6 priority(ies)
LECS has 0 configure direct VCCs
     has accepted 434 VCCs and rejected 4 VCCs
     0 VCCs have been dropped by LECS, 434 dropped by caller
     has exceeded its maximum number of VCCs 0 times
LECS discarded frames: 16
LECS responses by status (zero responses if status not displayed)

     Success( 0) : 512
     Invalid request parameters( 2) : 8
     Invalid REQESTOR-ID( 8) : 4
     Invalid LAN Destination( 9) : 12
     Invalid ATM Address(10) : 4
     LE_CONFIGURE Error(21) : 12
LECS console+
```

**LECS has:**
This is a two-line description of counters for the number of ELANs, policies, and policy priority levels at the LECS. These counters are not reset with the **statistics clear** command.

**LECS has 0 configure direct VCCs**
Describes counters on the VCC use of the LECS. The counter for the current number of VCCs will not be reset by the **statistics clear** command, but the other counters will.

**LECS discarded frames:**
Shows the number of frames that have been discarded by the LECS.

**LECS responses by status ...**
Describes counters for the number of responses sent by the LECS with various status values. For each possible status there is a counter. The counter value is displayed only if it is non-zero.

## Monitoring Commands for the Access Control of a LECS

Use the **access-control** command to monitor ATM address screening at the LECS. The following commands can be issued at the `LECS Access Control+` command prompt:

*Table 26-16. Access Control 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 2-3. |
| Create | Dynamically adds an ATM address to the screening list. |
| Delete | Deletes ATM address screening. |
| List | Displays the ATM address screening list. |
| Statistics | Displays statistics associated with an ATM address from the screening list. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Create

Use the **create** command to dynamically add a previously configured ATM address prefix (1 - 20 octets) to the access control screening list.

**Note:** To add an ATM address prefix to the list of configured prefixes, use the **access-control** command from `t 6`. See "Configuration Commands for the Access Control of a LECS" on page 26-19.

**Syntax:**

**create**

**Example:**

```
LECS console+access
LECS Access-Control console
LECS Access Control+create
  (  1) All enbld suspect ATM addresses
  (  2) 39.99.99.99.99.99.99.00.00.99.99.01.01
Suspect ATM address choice [1]? 2
Suspect ATM address created: '39.99.99.99.99.99.99.00.00.99.99.01.01'
LECS Access Control+
```

## Delete

The **delete** command deletes an address prefix for access control screening.

**Syntax:**

**delete**

## List

The **list** command displays the access control screening list.

**Syntax:**

**list**

**Example:**

```
LECS Access Control+list

Suspect ATM addresses listing....

Suspect ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.01
LECS Access Control+
```

## Statistics

Use the **statistics** command to display or reset the counters associated with an ATM address prefix from the access control screening list.

**Syntax:**

**statistics** clear
list

**clear** resets the counters associated with an ATM address prefix.

**list** displays the ATM address prefix statistics.

**Example:**

```
LECS Access Control+statistics list
  (  1) All active suspect ATM addresses
  (  2) 39.99.99.99.99.99.99.00.00.99.99.01.01
Suspect ATM address choice [1]? 2

Suspect ATM address: 39.99.99.99.99.99.99.00.00.99.99.01.01
  #times access denied to address: 0

LECS Access Control+
```

## Monitoring Commands for ELANs at the LECS

The LECS ELAN monitoring environment is characterized by the `LECS ELANs+` prompt. From this environment, one can create, delete, and display the ELANs of the LECS. ELAN counters can be displayed and reset. There is also a subenvironment in which one can work with the details of the ELAN, including the LESs and policy values.

Enter commands at the `LECS ELANs+` prompt.

*Table 26-17. ELAN 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 2-3. |
| Create | Creates an ELAN from its configuration. The configuration data must already exist. |
| Delete | Deletes an ELAN from the operating LECS. |
| List | Lists all ELANs of the LECS. |
| Select ELAN | Selects an ELAN to monitor in more detail. |
| Statistics | Clears or displays the ELAN counters. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Create

Use the **create** command to create an ELAN for the LECS from the ELAN configuration data. The configuration data must already exist in static memory. For information on entering ELAN configuration data, see Chapter 25, "Using LAN Emulation Services" on page 25-1. Creating the ELAN results in the creation of all LESs, TLVs, and policy values for that ELAN. If you select the `All enabled ELANs` choice, then all ELANs enabled in the static configuration are created.

**Syntax:**

**create**

**Example:**

```
LECS ELANs+ create
 (  1) All enabled ELANs
 (  2) Accounting Ethernet Elan
 (  3) Finance Ethernet Elan
 (  4) R&D Token Ring Elan
Choice of ELAN [1]? 2
ELAN created 'Accounting Ethernet Elan'
Created TLVs for ELAN 'Accounting Ethernet Elan'
Created LESs for ELAN 'Accounting Ethernet Elan'
```

## Delete

Use the **delete** command to delete an ELAN from the LECS. The LESs, TLVs, and policy values of that ELAN are also deleted. You are prompted for the ELAN to delete. If you select the ‘All Active ELANs’ choice, then all ELANs of the LECS are deleted.

**Syntax:**

**delete**

**Example:**

```
LECS ELANs+ delete
 ( 1) All active ELANs
 ( 2) Finance Ethernet Elan
 ( 3) R&D Token Ring Elan
 ( 4) Accounting
 ( 5) < CANCEL >
Ethernet Elan Choice of ELAN [1]? 2
Deleted ELAN 'Finance Ethernet Elan'
```

## List

Use the **list** command to display a summary of the ELANs on the operating LECS.

**Syntax:**

**list**

**Example:**

```
LECS ELANs+ list

ELAN listing...

Type         MFS   ELAN name
============ ===== ================================
  TokenRing  4544 'R&D Token Ring Elan'
   Ethernet  1516 'Accounting Ethernet Elan'
```

## Select

Use the **select** command to enter into the LECS ELAN Details monitoring environment. In this environment, you work more closely with a particular ELAN. The monitoring of LESs, TLVs, and policy values is performed in this environment. You will be prompted to select an ELAN.

**Syntax:**

**select**

**Example:**

```
LECS ELANs+ select
 (  1) R&D Token Ring Elan
 (  2) Accounting Ethernet Elan
 (  3) Finance Ethernet Elan
Choice of ELAN [1]? 2
ELAN 'Accounting Ethernet Elan' selected for detailed console
ELAN 'Accounting Ethernet Elan' selected+
```

## Statistics

Use the **statistics** command to display or reset the counters associated with each ELAN.

**Syntax:**

**statistics** clear

list

**clear** resets the counters associated with an ELAN. You can clear the counters for all ELANS, or for a selected ELAN.

**Example:**

```
LECS ELANs+ statistics clear
 (  1) All active ELANs
 (  2) R&D Token Ring Elan
 (  3) Accounting Ethernet Elan
 (  4) Finance Ethernet Elan
 (  5) < CANCEL >
Choice of ELAN [1]? 2
Cleared stats of 1 ELANs
```

**list** displays the ELAN counters. You can display the counters for all ELANs or for a selected ELAN.

**Example:**

```
LECS ELANs+ statistics list
 (  1) All active ELANs
 (  2) R&D Token Ring Elan
 (  3) Accounting Ethernet Elan
 (  4) Finance Ethernet Elan
Choice of ELAN [1]? 3

Type         MFS   ELAN name
============ ===== ================================
   Ethernet  1516 'Accounting Ethernet Elan'
 # TLVs: 0
 # bytes in TLV data: 0
 # LES ATM addresses: 1
```

Where:

**# TLVs** is the number of TLVs which will be returned to clients assigned to this ELAN.

**# bytes in TLV data**
is the total size of the TLV information which will be returned to clients assigned to this ELAN.

**# LES ATM addresses**
is the number of LESs currently serving this ELAN.

## Monitoring Commands for ELAN Details at the LECS

The LECS ELAN Details Console environment is characterized by the `ELAN 'elan_name' selected+` prompt, where *elan_name* is the name of the ELAN with which you are currently working. In this environment, you can modify the operational characteristics of the selected ELAN. Objects associated with the ELAN are also monitored and controlled in this environment. Such objects include:

- LESs
- TLVs
- Policy values

Enter commands at the `ELAN 'elan_name' selected+` prompt for the selected ELAN.

*Table 26-18. ELAN Details 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 2-3. |
| LESs | Monitor and control the LESs for this ELAN. |
| List | Display a summary of the ELAN. |
| Policy | Monitor and control the policy values assigned to any LES for this ELAN. |
| Set | Change the ELAN name, maximum frame size, or type of the ELAN. |
| ELAN-tlv | Manages TLVs associated with the selected ELAN. |
| LEC-tlv | Allows TLVs to be associated with an ELAN policy that is identified by ATM address, MAC address, route descriptor, or ELAN name. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## LES

Use the **les** command to monitor and control the LES ATM addresses that represent the LESs serving this ELAN. Note that no monitoring or control of the actual LES or BUS occurs. This command monitors and controls only the LES ATM address information that is returned to clients.

**Syntax:**

| | |
|---|---|
| **les** | create |
| | delete |
| | list |
| | set . . . |
| | statistics . . . |

**create** Use the **les create** command to create LES ATM address information from the configuration. Note that configuration data must already exist (refer to Chapter 25, "Using LAN Emulation Services" on page 25-1). You will be prompted to select the LES ATM address to create. Creation of this address information also creates all policy value information associated with that LES. If you select the 'All enabled LESs' choice, then all LESs that are enabled in static memory for this ELAN will be created.

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ les create
 ( 1) All enabled LESs
 ( 2) 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 ( 3) Local LES for: R&D Token Ring Elan
Choice of LES [1]? 3
LES created: Local LES for: R&D Token Ring Elan
Created all values for LES Local LES for: R&D Token Ring Elan
```

**delete** Use the **les delete** command to delete a LES ATM address from the LECS. The policy value information associated with that LES is also deleted. You must select the LES ATM address to delete. If you select the 'All active LESs' choice, then all LESs associated with this ELAN will be deleted.

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ les delete
 (  1) All active LESs
 (  2) 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 (  3) Local LES for: R&D Token Ring Elan
 (  4) < CANCEL >
Choice of LES [1]? 3
LES deleted: Local LES for: R&D Token Ring Elan
```

**list** Use the **les list** command to display the LES ATM address information associated with the selected ELAN.

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ les l
Primary ATM address:
39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
bckup ATM address: (no backup provided)
Primary ATM address: Local LES for: R&D Token Ring Elan
bckup ATM address: (no backup provided)
```

**set** *primary/backup*

Use the **les set** command to change the ATM address of primary or backup LES. You must select the LES ATM address information to modify. Refer to Chapter 25, "Using LAN Emulation Services" on page 25-1 for an explanation of a primary and backup LES ATM addresses.

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ les set primary
 (  1) 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 (  2) Local LES for: R&D Token Ring Elan
Choice of LES [1]?
 (  1) Local
 (  2) Remote
Primary LES is [2]?
If primary LES is remote, enter ATM address

[39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03]?
39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.05
Primary LES ATM address modified
```

**statistics [clear or list]**

Use the **les statistics** command to display or reset the counters associated with LESs.

**clear** Use the **les statistics clear** command to reset the counters of the LESs. You can reset the counters for all of the LESs, or a selected LES.

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ les statistics clear
 (  1) All active LESs
 (  2) 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.05
 (  3) Local LES for: R&D Token Ring Elan
 (  4) < CANCEL >
Choice of LES [1]? 2
Cleared stats of 1 LESs
```

**list** Use the **les statistics list** command to display the various counters associated with each LES. You can display the counters of all LESs or a selected LES.

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ les statistics list
 (  1) All active LESs
 (  2) 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.05
 (  3) Local LES for: R&D Token Ring Elan
Choice of LES [1]? 2

Primary ATM address:
39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.05
# ATM prefixes:            5  # MAC addresses:           6
# Route descriptors:       4  # Lan types:               1
# Packet sizes:            2  # ELAN names:              4
# LECs assigned to primary LES address: 0
# LECs assigned to backup LES address:  0
# LECs assigned by local check:  0
```

Note:

- The first six counters are the number of policy values in the LECS database that are associated with this LES. There is one counter for each type of policy value, and these counters are not reset with the les statistics clear command.
- The `# LECs assigned to primary LES address` field indicates the number of clients that have been given the LES ATM address information of this primary LES. This counter records the assignment only if the primary LES ATM address is a non-local LES.
- The `# LECs assigned to backup LES address` field indicates the number of clients that have been given the LES ATM address information of this backup LES. This counter records the assignment only if the backup LES ATM address is a non-local LES.
- The `# LECs assigned by local check` field indicates the number of clients that have been given LES ATM address information obtained by searching the LES-BUSs local to this MSS Server. After the LECS decides to which LES the client belongs, it queries the LES-BUSs on the MSS Server for the ATM address of an active LES for this ELAN. If there is a local LES-BUS serving this ELAN, either as a primary or backup, then the LECS obtains the definitive LES serving the ELAN. Otherwise, the LECS must use its heuristic redundancy algorithm.

## List

Use this command to display a summary of the selected ELAN, including its name, maximum frame size, and type.

**Syntax:**

**list**

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ list

ELAN name:      'R&D Token Ring Elan'
ELAN type:      TokenRing
Max frame size: 4544
```

## Policy

Use this command to create, delete, or display the policy values assigned to LESs for this ELAN.

**Syntax:**

**policy** create *pv_type*
delete *pv_type*
list *pv_type*

**create**

Use the **policy create** command to create an active binding between a policy value and a LES. The policy values must already exist in the static configuration (see Chapter 25, "Using LAN Emulation Services" on page 25-1). Policy values are used to assign requesting clients to specific LESs. You will be prompted to select the policy value to create. If you choose the 'All enabled values' option, then all policy values of that type that exist in the static configuration will be created.

*Pv_type* is one of:

- ESI/SEL of ATM address
- FRAME size
- MAC address
- NAME of ELAN
- PREFIX of ATM address
- ROUTE descriptor
- TYPE of ELAN

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ policy create mac
 (  1) All enabled MAC values
 (  2) 29.29.29.93.92.01 to
39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 (  3) 29.29.29.93.92.02 to
39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 (  4) 29.29.29.93.92.03 to
39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 (  5) 29.29.29.93.92.04 to
39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 (  6) 29.29.29.93.92.05 to
39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 (  7) 29.29.29.93.92.06 to
39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
MAC address [1]? 4
MAC address value created:
29.29.29.93.92.03 to 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
```

**delete**

Use this command to delete active policy values. You will be prompted for the policy value to delete. If you select the ‘All active values’ option, then all policy values of that type will be deleted.

*Pv_type* is one of:

- ESI/SEL of ATM address
- FRAME size
- MAC address
- NAME of ELAN
- PREFIX of ATM address
- ROUTE descriptor
- Type of ELAN

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ policy delete route
 (  1) All active route descriptor values
 (  2) 39.92 to
 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 (  3) 39.93 to
 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 (  4) 39.02 to
 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 (  5) 39.03 to
 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
Route descriptor [1]? 4
Deleted route descriptor value:
39.02 to 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
```

**list**

Use this command to list the active policy values for this ELAN.

*Pv_type* is one of:

- ESI/SEL of ATM address
- FRAME size
- MAC address
- NAME of ELAN
- PREFIX of ATM address
- ROUTE descriptor
- TYPE of ELAN

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ policy list name

ELAN name => LES
=========================================================================
 'R&D Elan'
 => 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
 'R&D'
  => 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
  'R & D'
  => 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
  'R&D Token Ring Elan'
  => 39.99.99.99.99.99.99.01.01.01.02.02.02.84.92.84.92.83.83.03
```

## Set

Use this command to change the ELAN name, maximum frame size, or type. These modifications do not affect the static configuration and are lost on a restart of the LECS or router.

**Syntax: set** frame

name

type

**frame** Use this command to change the maximum frame size of the selected ELAN.

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ set frame
(  1) 1516
(  2) 4544
(  3) 9234
(  4) 18190
Maximum frame size of ELAN [2]? 3
Attempting to modify max frame size...ELAN modified
```

**name** Use this command to change the name of the selected ELAN.

**Example:**

```
ELAN 'R&D Token Ring Elan' selected+ set name
Name of ELAN [R&D Token Ring Elan]? R&D Token Ring Elan 1
Attempting to modify ELAN name...ELAN modified
```

**type** Use this command to change the type of the selected ELAN.

**Example:**

```
ELAN 'R&D Token Ring Elan 1' selected+ set type
(  1) Ethernet
(  2) TokenRing
Type of ELAN [2]? 2
Attempting to modify ELAN type...ELAN modified
```

## ELAN-TLV

Type/length/values (TLVs) are optional configuration parameters that can be returned to all clients assigned to the selected ELAN. ELAN-TLVs are TLVs that should be returned to all clients assigned to the selected ELAN.

See “LEC-TLV” on page 26-34 for information about configuring TLVs that are returned to a particular LEC assigned to the selected ELAN.

*Table 26-19. Selected ELAN-TLV Monitoring Commands Summary*

| Command | Function |
|---|---|
| Add | Adds a TLV to the selected ELAN. |
| Disable | Disables a TLV for the selected ELAN. |
| Enable | Enables a TLV for the selected ELAN. |
| List | List the configured ELAN-TLVs. |
| Remove | Removes a TLV from the selected ELAN. |

Use the **elan-tlv add** command to add the specified TLVs of the selected ELAN. You can use the following parameters with the **elan-tlv** command:

- ATM Forum TLVs
- IBM TLVs
- MPS (MPOA Server) TLVs
- MPC (MPOA Client) TLVs
- User Defined TLVs

elan-tlv add

**Syntax:** elan-tlv add *atm*.

Choose from :

- C7 : Control timeout
- C10:Maximum unknown frame count
- C11:Maximum unknown frame time
- C12:VCC timeout period

- C13:Maximum retry count
- C17:Aging time
- C18:Forward delay time
- C20:Expected LE_ARP response time
- C21:Flush timeout
- C22:Path switching delay
- C23:Local segment ID
- C24:Mcast send VCC type
- C25:Mcast send VCC avg rate
- C26:Mcast send VCC peak rate
- C28:Connection complete timer
- C31: ELAN Identifier
- C35: Preferred LES

**Syntax:** elan-tlv add *ibm*.

Choose from :

- I4: Validate PCR of DDVCCs
- I5: Maximum Reserved Bandwidth of DDVCCs
- I6: Requested DDVCC Type
- I7: Requested DDVCC Peak Cell Rate
- I8: Requested DDVCC Avg Cell Rate
- I9: Requested DDVCC QoS Class
- I10: Negotiate Cell Rates on DDVCCs
- I11: Maximum burst size of DDVCCs

**Syntax:** elan-tlv add *mps*.

Choose from :

- p1: Keep-Alive Time
- p2: Keep-Alive Lifetime
- p3: InternetWork-layer Protocols
- p4: Initial Retry Time
- p5: Retry Time Maximum
- p6: Give-up Time
- p7: Hold Down Time

**Syntax:** elan-tlv add *mpc*.

Choose from :

- p1: SC-Setup Frame Count
- p2: SC-Setup Frame Time
- p3: Flow-detection Protocols

- p4: Initial Retry Time
- p5: Retry Time Maximum
- p6: Hold Down Time

**Syntax:** elan-tlv add *user*.

You can define and add their own TLVs.

**Example:**

```
Selected ELAN 'joe'> elan-tlvs add user
Type of TLV (in hex) [0]
Description of TLV user-tlv example
Length of TLV [4]
Value of TLV (in hex) [] cabacaba
TLV added: user-tlv example
Selection "Flush timeout TLV add" Complete
Selected ELAN 'joe'>
```

disable

Use the **elan-tlv disable** command to disable a TLV in the static configuration. The TLV will not become active on the next router restart. You are prompted to select the TLV to disable.

**Syntax:** elan-tlv disable

**Example:**

```
Selected ELAN 'lgrove001'> elan-tlv disable
TLV choice:
        (1) All
        (2) T x00A03E01 C7 : Control timeout (sec)       L 2   V 120
        (3) T x00A03E02 C10: Maxmm unknown frame count   L 2   V 1
        (4) T x00A03E03 C11: Mxmm unknwn frm time (sec)  L 2   V 1
        (5) T x00A03E04 C12: VCC timeout period (sec)    L 4   V 1200
        (6) T x00A03E05 C13: Maximum retry count         L 2   V 1
        (7) T x00A03E06 C17: Aging time (sec)            L 4   V 300
        (8) T x00A03E07 C18: Forward delay time (sec)    L 2   V 15
        (9) T x00A03E08 C20: Expctd LE_ARP rspnse (sec)  L 2   V 1
        (10) T x00A03E09 C21: Flush timeout (sec)         L 2   V 4
        (11) T x00A03E0A C22: Path switching delay (sec)  L 2   V 6
        (12) T x00A03E0B C23: Local segment ID (hex)      L 2   V ff:00
        (13) T x00A03E0C C24: Mcst send VCC type (dec)    L 2   V 2
        (14) T x00A03E0D C25: Mcst snd VCC avrg rt (cps)  L 4   V 0
        (15) T x00A03E0E C26: Mcst snd VCC peak rt (cps)  L 4   V 0
        (16) T x00A03E0F C28: Cnnctn complete time (sec)  L 2   V 4

Enter Selection:  [1]? 1
Disabled all TLVs for ELAN 'lgrove001'
Selection "TLV disable" Complete
Selected ELAN 'lgrove001'>
```

enable

Use the **elan-tlv enable** command to enable a TLV in the static configuration. The selected TLV will become active on the next router restart. You are prompted to select the TLV to enable.

list

Use the **elan-tlv list** command to list all TLVs of the selected ELAN.

```
Selected ELAN 'lgrove001'> elan-tlv list
TLVs for ELAN 'lgrove001'

Enabled  TLV
=======  ======================================================
    Yes  Type: x00A03E01 'C7 : Control timeout (sec)'
    Len: 2 Value: 120
    Yes  Type: x00A03E02 'C10: Maxmm unknown frame count'
    Len: 2 Value: 1
    Yes  Type: x00A03E03 'C11: Mxmm unknwn frm time (sec)'
```

```
       Len: 2 Value: 1
       Yes  Type: x00A03E04 'C12: VCC timeout period (sec)'
       Len: 4 Value: 1200
       Yes  Type: x00A03E05 'C13: Maximum retry count'
       Len: 2 Value: 1
       Yes  Type: x00A03E06 'C17: Aging time (sec)'
       Len: 4 Value: 300
       Yes  Type: x00A03E07 'C18: Forward delay time (sec)'
       Len: 2 Value: 15
       Yes  Type: x00A03E08 'C20: Expctd LE_ARP rspnse (sec)'
       Len: 2 Value: 1
       Yes  Type: x00A03E09 'C21: Flush timeout (sec)'
       Len: 2 Value: 4
       Yes  Type: x00A03E0A 'C22: Path switching delay (sec)'
       Len: 2 Value: 6
       Yes  Type: x00A03E0B 'C23: Local segment ID (hex)'
       Len: 2 Value: ff:00
       Yes  Type: x00A03E0C 'C24: Mcst send VCC type (dec)'
       Len: 2 Value: 2
       Yes  Type: x00A03E0D 'C25: Mcst snd VCC avrg rt (cps)'
       Len: 4 Value: 0
       Yes  Type: x00A03E0E 'C26: Mcst snd VCC peak rt (cps)'
       Len: 4 Value: 0
       Yes  Type: x00A03E0F 'C28: Cnnctn complete time (sec)'
       Len: 2 Value: 4
      Selected ELAN 'lgrove001'>
```

remove

Use the **elan-tlv remove** command to remove a TLV from the static configuration of the selected ELAN. You are prompted to select the TLV to remove.

**Example:**

```
Selected ELAN 'lgrove001'> elan-tlv remove
TLV Choice:
 (1) All
 (2) T x00A03E01 C7 : Control timeout (sec)       L 2   V 120
 (3) T x00A03E01 C7 : Control timeout (sec)       L 2   V 100
 (4) T x00A03E02 C10: Maxmm unknown frame count   L 2   V 1
 (5) T x00A03E03 C11: Mxmm unknwn frm time (sec)  L 2   V 1
 (6) T x00A03E04 C12: VCC timeout period (sec)    L 4   V 1200
 (7) T x00A03E05 C13: Maximum retry count         L 2   V 1
 (8) T x00A03E06 C17: Aging time (sec)            L 4   V 300
 (9) T x00A03E07 C18: Forward delay time (sec)    L 2   V 15
 (10) T x00A03E08 C20: Expctd LE_ARP rspnse (sec)  L 2   V 1
 (11) T x00A03E09 C21: Flush timeout (sec)         L 2   V 4
 (12) T x00A03E0A C22: Path switching delay (sec)  L 2   V 6
 (13) T x00A03E0B C23: Local segment ID (hex)      L 2   V ff:00
 (14) T x00A03E0C C24: Mcst send VCC type (dec)    L 2   V 2
 (15) T x00A03E0C C24: Mcst send VCC type (dec)    L 2   V 0
 (16) T x00A03E0D C25: Mcst snd VCC avrg rt (cps)  L 4   V 0
 (17) T x00A03E0E C26: Mcst snd VCC peak rt (cps)  L 4   V 0
 (18) T x00A03E0F C28: Cnnctn complete time (sec)  L 2   V 4
 Enter Selection:  [1]?2

 TLV deleted: T x00A03E01 C7 : Control timeout (sec)       L 2   V 120
 Selection "TLV remove" Complete
 Selected ELAN 'lgrove001'>
```

## LEC-TLV

Type/length/values (TLVs) can be associated with an individual LEC or group of LECs assigned to the selected ELAN. The set of LECs effected is determined by one of the configured ELAN policy values. For example, LEC-TLVs can be used to distinguish LECs with different QOS, giving their traffic different priority or bandwidth than other LECs associated with the same ELAN.

See “ELAN-TLV” on page 26-30 for information about configuring TLVs to be associated with all LECs assigned to the selected ELAN.

The following table shows the different identifiers you can use to select the individual LECs associated with a particular policy.

*Table 26-20. Selected LEC-TLV Identifiers Summary*

| Identifier | Purpose |
|---|---|
| ESI/SEL of ATM address | Uses an ESI/Selector of ATM address policy to identify the LECs to be associated with the TLV. |
| MAC address | Uses a MAC address policy to identify the LECs to be associated with the TLV. |
| Name of ELAN | Uses an ELAN name policy to identify the LECs to be associated with the TLV. |
| PREFIX of ATM address | Uses an ATM address prefix policy to identify the LECs to be associated with the TLV. |
| Route Descriptor | Uses a route descriptor policy to identify the LECs to be associated with the TLV. |

After a policy is chosen, use the following commands to select and monitor TLVs to be returned to all LECs assigned by the selected policy.

*Table 26-21. Selected LEC-TLV Command Summary*

| Command | Function |
|---|---|
| Add | Adds a TLV to the selected ELAN policy. |
| Disable | Disables a TLV for the selected ELAN policy. |
| Enable | Enables a TLV for the selected ELAN policy. |
| List | Lists TLVs for the selected ELAN policy. |
| Remove | Removes a TLV from the selected ELAN policy. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

**Example**:

```
 Selected ELAN 'lgrove01'>policy list prefix

ATM prefixes for ELAN 'lgrove01'
Enabled  Value  =>  LES
=======  ==========================================
     No  55
            => Local LES for: lgrove01
     No  25
            => Local LES for: lgrove01
Selected ELAN 'lgrove01'>lec-tlv prefix
  (  1) 55
  (  2) 25
ATM prefix [1]?
Policy Value '55' selected for detailed TLV configuration
Tlvs for '55' selected+add ibm i4
I4: Validate peak cell rate of Best Effort DDVCCs? [No]: yes
TLV added: I4: Vldt PCR of Bst Effrt DDVCC
Tlvs for '55' selected+list
Enabled  TLV
=======  ========================================================
    Yes  Type: x10005A04 'I4: Vldt PCR of Bst Effrt DDVCC'
         Len: 4 Value: 1

Tlvs for '55' selected+
```

## Monitoring Commands for LECS Policies

The LECS Policy monitoring environment is characterized by the `LECS policies+` prompt. From this environment, you can monitor and control the policies guiding the LEC-to-LES assignment procedure of the LECS. You can create, delete, or display policies, and display or reset certain counters associated with the policies.

Enter commands at the `LECS policies+` prompt which you can get to from the `LECS console+` prompt for the specified LES-BUS.

*Table 26-22. LECS Policies 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 2-3. |
| Create | Creates a policy for the operating LECS (the policy must already exist in the configuration data). |
| Delete | Deletes a policy for the operating LECS. |
| List | Lists the policies for the operating LECS. |
| Statistics | Displays or resets certain counters associated with the LECS policies. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## Create

Use the **create** command to create a policy from the configuration data. Note that the policy must exist in the static configuration before it can be created. You are prompted for the policy that you wish to create. If you specify the `All enbld pols` choice, then all policies that are enabled in the static configuration are created.

**Syntax:**

**create**

**Example:**

```
LECS policies+ create
(  1) All enbld pols
(  2) 100  byAtmAddr
(  3) 200  byMacAddr
(  4) 300  byRteDesc
(  5) 400  byElanNm
(  6) 1000 byLanType
(  7) 1100 byPktSize
Choice of policy [1]? 5
Policy created: '400  byElanNm '
LECS policies+
```

## Delete

Use the **delete** command to delete a policy from the operating LECS. You will be prompted for the policy that you wish to delete. If you specify the `All active pols` choice, all policies of the LECS are deleted.

**Syntax:**

**delete**

**Example:**

```
LECS policies+ delete
(  1) All active pols
(  2) 100  byAtmAddr
(  3) 200  byMacAddr
(  4) 300  byRteDesc
(  5) 400  byElanNm
(  6) 1000 byLanType
(  7) 1100 byPktSize
Choice of policy [1]? 3
Deleted policy: '200  byMacAddr'
LECS policies+
```

## List

Use the **list** command to list the policies of the active LES.

**Syntax:**

**list**

**Example:**

```
LECS policies+ list

Policy listing....

Priority:    100  Policies: byAtmAddr
Priority:    300  Policies: byRteDesc
Priority:    400  Policies: byElanNm
Priority:   1000  Policies: byLanType
Priority:   1100  Policies: byPktSize
LECS policies+
```

## Statistics

Use the **statistics clear** command to reset the counters associated with the LECS policies. You can clear the statistics of all policies, or only of the policies at a certain priority level.

**Syntax:**

| | |
|---|---|
| **statistics** | clear |
| | list |

**Example:**

```
LECS policies+ statistics clear
(  1) All active policies
(  2) 100   byAtmAddr
(  3) 300   byRteDesc
(  4) 400   byElanNm
(  5) 1000  byLanType
(  6) 1100  byPktSize
(  7) < CANCEL >
Choice of policy [1]? 3
Cleared stats of 1 priority levels
LECS policies+
```

Use the **statistics list** command to display the counters associated with the LECS policies. You can display the counters for all policies, or only for the policies at a certain priority level.

**Example:**

```
LECS policies+ statistics list
(  1) All active policies
(  2) 100   byAtmAddr
(  3) 300   byRteDesc
(  4) 400   byElanNm
(  5) 1000  byLanType
(  6) 1100  byPktSize
Choice of policy [1]? 4
Priority:    400  Policies: byElanNm
#policies at this priority: 1
#times assigned by policy: 158
#times policy failed: 253

LECS policies+
```

**Priority** Counters are maintained for each priority level.

**#policies at this priority**
This counter is not reset by the statistics clear command.

**#times assigned by policy**
This counts the number of times that the LECS used the policies at this priority level to assign a client to a LES.

**#times policy failed**
This counts the number of times that the LECS attempted to use the policies at this priority level to assign a client to a LES, but failed.

## Monitoring Commands for Security for LE Service

The LES-LECS Security Interface monitoring environment is characterized by the `LES-LECS interface+` prompt. From this environment, the LES-LECS interface can be created, deleted, or restarted. Counters associated with the LES-LECS interface can be reset or displayed. The LES-LECS Security Interface is the LE Services component responsible for multiplexing configuration requests from the LESs on the MSS Server to the LECS (which may or may not be on the MSS Server). The LES-LECS interface is a required component if any of the LES-BUSs are using the security features of the MSS Server.

Enter commands at the `LES-LECS interface+` prompt. To access the prompt for monitoring, do the following:

```
+ network net#
ATM+ le-s
LE-Services Console
LE-SERVICES+ security
LES-LECS Security Interface
LES-LECS interface+
```

*Table 26-23. Security for LE Services 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 2-3. |
| Create | Creates the LES-LECS interface for the authentication of LE client joins. |
| Delete | Deletes the LES-LECS interface for the authentication of LE client joins. |
| List | Lists the LES-LECS interface's status and current configuration parameters. |
| Restart | Restarts a running LES-LECS interface. |
| Statistics | Clears or lists statistics of the LES-LECS interface. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## Create

Use the **create** command to create the LES-LECS Interface for authentication of LE Client Joins. The LES-LECS Interface configuration must exist before it can be created (see "Configuration Commands for Security for ELANs" on page 26-38). By default, when an Multiprotocol Switched Services (MSS) boots up, the LES-LECS Interface is created if it is configured and enabled. The **create** command allows the LES-LECS Interface to be created without restarting the entire router.

**Syntax:**

**create**

**Example:**

```
LES-LECS interface+ create
LECS interface created on device 0
```

## Delete

Use the **delete** command to stop an LES-LECS Interface and remove it from the active configuration. (The LES-LECS Interface definition remains in Static configuration.) If you issue the **delete** command and then want to start the LES-LECS Interface without restarting the Multiprotocol Switched Services (MSS), issue the **create** command.

**Syntax:**

d**elete**

**Example:**

```
LES-LECS interface+ delete
LECS interface deleted
```

## List

Use the **list** command to list the status and current configuration parameters of the LES-LECS Interface.

**Syntax:**

l**ist**

**Example:**

```
LES-LECS interface+ list
Status of LES-LECS Security Interface
  ATM Device Number:     0
  State:                 Operating normally(110)
    Time of last state change:      00.23.44.26
    Elapsed time since last change: 00.01.10.70
  Error Log:             no err(0)
  ATM address:           3999999999999990000999901011000 5a68001201
  UNI version            UNI Version 3.0
  Connected LECS:        47007900000000000000000000000a03e00000100(local)
  VCC characteristics:
    Configuration direct VCC type:      Best Effort
    Configuration direct VCC PCR:       155000
```

Where:

**State** Is the operational state of the LES-LECS Interface. Possible states are:

- Idle
- Initializing
- Activating ATM address
- Activated ATM address
- Getting UNI version
- Got UNI version
- Getting list of LECSs
- Got list of LECSs
- Attempting to connect to LECS
- Failed to connect to LECS - will retry
- Operating normally
- Connection to LECS released - will retry
- ATM address deactivated
- ATM network down
- Down due to error
- State unknown!!!

**Time of last state change**
Is the system up time that the LES-LECS Interface entered its current state. The format is *hours.minutes.seconds.hundredths*

**Elapsed time since last change**
Is the amount of time since the last state change. The format is hours.minutes.seconds.hundredths

**Error Log**
Is the reason the LES-LECS Interface last went down. If the LES-LECS Interface has not been down since the last MSS Server restart, `no err` appears. An additional error code is contained within the parentheses.

**ATM Address**
Is the ATM address of the LES-LECS Interface.

**Connected LECS**
Is the ATM address used by the LES-LECS Interface to connect to the LECS. Following this ATM address is an indication of whether the LECS is local to this MSS Server or remote, that is, on another device.

**Configuration direct VCC type**
Indicates whether the LES-LECS Interface uses a best effort or reserved bandwidth VCC to the LECS.

**Configuration direct VCC PCR**
Indicates the peak cell rate of the configuration direct VCC to the LECS.

**VCC characteristics**
If VCC type is Reserved Bandwidth, the Sustained Cell Rate of the VCC in Kbps is shown.

## Restart

Use the **restart** command to restart a running LES-LECS Interface.

**Syntax:**

**restart**

**Example:**

```
LES-LECS interface+ restart
LECS interface restarted on device 0
```

## Statistics

Use the **statistics** command to clear or list all LES-LECS Interface statistics.

**Syntax:**

**statistics** clear
list

**clear** Sets all LES-LECS Interface statistics to zero.

**Example:**

```
LES-LECS interface+ statistics clear
LECS interface statistics cleared
```

**list** Shows all statistics for the LES-LECS Interface.

**Example:**

```
LES-LECS interface+ statistics list
Statistics of LES-LECS Security Interface
  # queries to local LECS:         3
  # frames transmitted:            0
  # frames received:               0
  # discarded frames:              0
  # VCCs released by LECS/network: 0
  # failed VCC setup attempts:     0
```

Where:

**# VCCs released by LECS/network**
Is the number of times Security VCC from the LES-LECS Interface to the LECS has been released. Releases due to LES-LECS Interface errors or changes in the LES-LECS Interface administrative status are not counted.

**# failed VCC setup attempts**
Is the number of Security VCC call setup requests made by the LES-LECS Interface that failed for any reason.

# Chapter 27. Using Quality of Service (QoS)

This chapter describes how to use the Quality of Service (QoS) feature in the device.

## Quality of Service Overview

The QoS feature leverages the benefits of ATM QoS capabilities for LAN Emulation Data Direct VCCs. This support is referred to as “Configurable QoS for LAN Emulation.” The key attributes and the benefits of this feature are as follows:

- An LE Client makes use of configured QoS parameters for its Data Direct VCCs.
- QoS parameters can be configured for:
  - LE Client
  - Emulated LAN
  - ATM Interface
- The set of QoS parameters configured are for use with ATM Forum UNI 3.0/3.1 signaling. The parameters include the desired Peak Cell Rate, Sustained Cell Rate, QoS Class and Maximum Burst Size.
- Maximum Reserved Bandwidth per VCC can be configured to protect an LE Client from accepting/establishing VCCs whose traffic parameters it cannot support.
- The QoS Negotiation mechanism enables the participating LE Clients to be aware of each other’s QoS parameters. A data-direct VCC is set up using the negotiated parameters.

## Benefits of QoS

- Using QoS for the LE Client, ATM Interface, or Emulated LAN provides mthe following benifits for LANE Data Direct VCCs.
  - An LE Client can be configured with QoS if the QoS required by the client is different from the QoS required by other clients on the ELAN. For example, if an LE Client serves a file server, then the user may want to configure appropriate QoS parameters for all traffic to and from the file server.
  - An Emulated LAN can be configured with QoS if the user wishes to provide QoS for all traffic in that ELAN. For example, an ELAN carrying SNA traffic can be given priority by configuring QoS parameters for that ELAN.
  - An ATM Interface can be configured with QoS if a user wants all LE Clients on that ATM interface to use the same set of parameters. For example, if an ATM Interface is connected at 25 Mbps, the user can configure appropriate parameters that are different from those at a 155-Mbps interface.

# Chapter 28. Configuring and Monitoring Quality of Service (QoS)

This chapter describes Quality of Service (QoS) configuration and operational commands for LAN and ELAN interfaces in the router. It contains the following sections:



## QoS Configuration Parameters

This section describes nine parameters that are used for QoS configuration. The following six parameters can be configured for an LE Client, ATM Interface, and an Emulated LAN:

1. max-reserved-bandwidth
2. traffic-type
3. peak-cell-rate
4. sustained-cell-rate
5. max-burst-size
6. qos-class

The following two parameters can be configured for an Emulated LAN and an LE Client:

1. *validate-pcr-of-best-effort-vccs*
2. *negotiate-qos*

The *accept-qos-parms-from-lecs* parameter can be configured only for an LE Client.

The first six parameters control the traffic characteristics of Data Direct VCCs established by the LE Client while the first parameter also applies to the calls received by the LE Client. The following characteristics are associated with all the Data Direct VCCs established by the LE Client:

- Bandwidth is not reserved for best-effort traffic.
- Traffic parameters apply to both forward and backward directions.
- When a reserved bandwidth connection is rejected due to the traffic parameters or QoS Class, the call is retried as a best-effort connection with the configured peak cell rate (cause codes on release or release-complete messages are used to determine why a VCC was released).

- When a best-effort connection is rejected due to the Peak Cell Rate (PCR), the call may be automatically retried with a lower PCR. Retries are performed under the following conditions:
  1. If the rejected PCR is greater than 100 Mbps, the call is retried with a PCR of 100 Mbps.
  2. Otherwise, if the rejected PCR is greater than 25 Mbps, the call is retried with a PCR of 25 Mbps.

## Maximum Reserved Bandwidth (max-reserved-bandwidth)

The maximum reserved bandwidth acceptable for a Data Direct VCC. This parameter applies to both Data Direct VCC calls received by the LE Client and Data Direct VCC calls placed by the LE Client. For incoming calls, this parameter defines the maximum acceptable SCR for a Data Direct VCC. If SCR is not specified on the incoming call, then this parameter defines the maximum acceptable PCR for a Data Direct VCC with reserved bandwidth.

Calls received with traffic parameters specifying higher rates will be released. If SCR is specified on the incoming call, the call will not be rejected due to the PCR or Maximum Burst Size. The constraint imposed by this parameter is not applicable to BEST_EFFORT connections. For outgoing calls, this parameter sets an upper bound on the amount of reserved bandwidth that can be requested for a Data Direct VCC. Therefore the traffic-type and sustained-cell-rate parameters are dependent upon this parameter.

**Valid Values:**
Integer in the range 0 to the line speed of ATM device in Kbps

**Default Value:**
0

## Traffic Type (traffic-type)

The desired traffic type for Data Direct VCCs. If QoS parameters are not negotiated, then this parameter specifies the type of calls placed by the LE Client. Otherwise, if QoS parameters are negotiated, this parameter specifies the desired type of traffic characteristics for Data Direct VCCs. When QoS parameters are negotiated, if either the source or target LEC desires a reserved bandwidth connection and both LECs support reserved bandwidth connections (that is, max-reserved-bandwidth > 0), then an attempt will be made to establish a reserved bandwidth Data Direct VCC between the two LECs. Otherwise, the Data Direct VCC will be a best-effort connection. Dependencies: max-reserved-bandwidth

**Valid Values:**
best_effort or reserved_bandwidth

**Default:** best_effort

## Peak Cell Rate (peak-cell-rate)

The desired peak cell rate for Data Direct VCCs. If QoS parameters are not negotiated, then this parameter specifies the PCR traffic parameter for Data Direct VCC calls placed by the LE Client. Otherwise, if QoS parameters are negotiated, this parameter specifies the desired PCR traffic parameter for Data Direct VCCs. The minimum of the desired PCRs of the two LECs is used for negotiated best-effort VCCs.

When a reserved bandwidth VCC is negotiated and only one of the LE Clients requests a reserved bandwidth connection, then the desired PCR of that LEC is used for the Data Direct VCC subject to the upper bound imposed by the line rate of the local ATM device. If both LECs request a reserved bandwidth connection, then the maximum of the desired PCRs of the LE Clients is used for the Data Direct VCC subject to the upper bound imposed the line rate of the local ATM device.

**Valid Values:**
An integer value in the range 0 to the line speed of ATM device in Kbps

**Default Value:**
Line speed of LEC ATM Device in Kbps.

## Sustained Cell Rate (sustained-cell-rate)

The desired sustained cell rate for Data Direct VCCs. If QoS parameters are not negotiated, then this parameter specifies the SCR traffic parameter for Data Direct VCC calls placed by the LE Client. Otherwise, if QoS parameters are negotiated, this parameter specifies the desired SCR traffic parameter for Data Direct VCCs.

When a reserved bandwidth VCC is negotiated and only one of the LE Clients requests a reserved bandwidth connection, then the desired SCR of that LEC is used for the Data Direct VCC (subject to the upper bound imposed by the max-reserved-bandwidth parameter of the other LEC). If both LECs request a reserved bandwidth connection, then the maximum of the desired SCRs of the LE Clients is used for the Data Direct VCC (subject to the upper bound imposed by the max-reserved-bandwidth parameters of both LECs). In any case (negotiation or not), if the SCR that is to be signaled equals the PCR that is to be signaled, then the call is signaled with PCR only.

Dependencies: max-reserved-bandwidth, traffic-type and peak-cell-rate. This parameter is applicable only when traffic-type is RESERVED_BANDWIDTH.

**Valid Values:**
An integer value in the range 0 to the minimum of max-reserved-bandwidth and peak-cell-rate, specified in Kbps

**Default Value**
None

## Maximum Burst Size (max-burst-size)

The desired maximum burst size for Data Direct VCCs. If QoS parameters are not negotiated, then this parameter specifies the Maximum Burst Size traffic parameter for Data Direct VCC calls placed by the LE Client. Otherwise, if QoS parameters are negotiated, this parameter specifies the desired Maximum Burst Size traffic parameter for Data Direct VCCs.

When a reserved bandwidth VCC is negotiated and only one of the LE Clients requests a reserved bandwidth connection, then the desired Maximum Burst Size of that LEC is used for the Data Direct VCC. If both LECs request a reserved bandwidth connection, then the maximum of the desired Maximum Burst Sizes of the LE Clients is used for the Data Direct VCC.

In any case (negotiation or not), the Maximum Burst Size is signaled only when SCR is signaled. Although this parameter is expressed in units of cells, it is configured as an integer multiple of the Maximum Data Frame Size (specified in LEC's C3 parameter) with a lower bound of 1.

Dependencies: This parameter is applicable only when traffic-type is RESERVED_BANDWIDTH.

**Valid Values:**
An integer number of frames; must be greater than 0

**Default:** 1 frame

## QoS Class (qos-class)

The desired QoS class for reserved bandwidth calls. If QoS parameters are not negotiated, then this parameter specifies the QoS Class to be used for reserved bandwidth Data Direct VCC calls placed by the LE Client. Otherwise, if QoS parameters are negotiated, this parameter specifies the QoS Class that is desired for Data Direct VCCs. Unspecified QoS Class is always used on best-effort calls. Specified QoS Classes define objective values for ATM performance. Specified QoS Classes define objective values for ATM performance parameters such as cell loss ratio and cell transfer delay.

The UNI Specification states that:

**Specified QoS Class 1**
should yield performance comparable to current digital private line performance.

**Specified QoS Class 2**
is intended for packetized video and audio in teleconferencing and multimedia applications.

**Specified QoS Class 3**
is intended for interoperation of connection oriented protocols, such as frame relay.

**Specified QoS Class 4**
is intended for interoperation of connectionless protocols, such as IP or SMDS.

LECs must be able to accept calls with any of the above QoS Classes. When QoS parameters are negotiated, the configured QoS Classes of the two LECs are compared, and the QoS Class with the more stringent requirements is used.

**Valid Values:**
0: for Unspecified QoS Class

1: for Specified QoS Class 1

2: for Specified QoS Class 2

3: for Specified QoS Class 3

4: for Specified QoS Class 4

**Default Value:**
0 (Unspecified QoS Class)

## Validate PCR of Best-Effort VCCs (validate-pcr-of-best-effort-vccs)

To validate Peak Cell Rate of Best-Effort VCCs. When FALSE, best-effort VCCs will be accepted without regard to the signaled forward PCR. When TRUE, best-effort VCCs will be rejected if the signaled forward PCR exceeds the line rate of the LE Client ATM device. Calls will not be rejected due to the backward PCR. The signaled backward PCR will be honored if it does not exceed the line rate; otherwise, transmissions to the caller will be at line rate.

**Notes:**

1. Accepting best-effort VCCs with forward PCRs that exceed the line rate can result in poor performance due to excessive retransmissions; however, rejecting these VCCs can result in interoperability problems.
2. The YES setting is useful when callers will retry with a lower PCR following call rejection due to unavailable cell rate.

**Valid Values:**
yes, no

**Default Value:**
no

## Negotiate QoS (negotiate-qos)

Enable QoS parameter negotiation for Data Direct VCCs. This parameter should be enabled only when connecting to an IBM MSS LES. When this parameter is YES, the LE Client will include an IBM Traffic Parameter TLV in LE_JOIN_REQUEST and LE_ARP_RESPONSE frames sent to the LES. This TLV will include the values of max-reserved-bandwidth, traffic-type, peak-cell-rate, sustained-cell-rate, max-burst-size and qos-class. An IBM Traffic Parameter TLV may also be included in a LE_ARP_RESPONSE returned to the LE Client by the LES.

If there is no TLV in a LE_ARP_RESPONSE received by the LE Client, then the local configuration parameters must be used to setup the Data Direct VCC. If a TLV is included in a LE_ARP_RESPONSE, the LE Client must compare the contents of the TLV with the corresponding local values to determine the “negotiated” or “best” set of parameters acceptable to both parties before signalling for the Data Direct VCC.

**Valid Values:**
yes, no

**Default Value:**
no

## Accept QoS Parms from LECS (accept-qos-parms-from-lecs)

This parameter gives the ability to configure an LE Client to accept/reject QoS parameters from a LECS. When this parameter is YES, the LE Client should use the QoS parameters obtained from the LE Clients in the LE_CONFIGURE_RESPONSE frames, that is, the QoS parameters from the LE Clients override the locally configured QoS parameters. If this parameter is NO then the LE Client will ignore any QoS parameters received in an LE_CONFIGURE_RESPONSE frame from the LE Clients.

**Valid Values:**
yes, no

**Default Value:**
no

## Accessing the QoS Configuration Prompt

Use the **feature** command from the CONFIG process to access the Quality of Service configuration commands. Enter **feature** followed by the feature number (6) or short name (QOS). For example:

```
Config> feature qos
Configurable Quality of Service for LAN Emulation
QoS Config>
```

Once you access the `QoS Config>` prompt, you can configure the Quality of Service (QoS) of an LE Client, an Emulated LAN, or an ATM Interface. To return to the `Config>` prompt at any time, enter the **exit** command at the `QoS Config>` prompt.

Alternatively, you can configure QoS parameters for an LE Client, an Emulated LAN, or an ATM Interface by accessing the entities as follows:

- LE Client
  1. At the `Config>` prompt, enter the **network** command and the LE Client interface number.
  2. At the `LE Client configuration>` prompt enter **qos-configuration**.

     **Example:**

     ```
     config> network 3
     Token Ring Forum Compliant LEC Config> qos-configuration
     elan-x LEC QoS Config>
     ```
- ATM Interface
  1. at the `Config>` prompt, enter the **network** command and the ATM interface number to get you to the `ATM Config>` prompt.
  2. Enter the **interface** parameter to get to the `ATM Interface Config>` prompt.
  3. At the `ATM InterfaceConfig>` prompt enter **qos-configuration**.

     **Example:**

     ```
     config> network 0
     ATM Config> interface
     ATM Interface Config> qos-configuration
     ATM-I/F 0 QoS>
     ```
- Emulated LAN
  1. At the `Config>` prompt, enter the **network** command and the ATM interface number to get to the `ATM Config>` prompt.
  2. Enter **le-service** to get to the `LE Services config>` prompt.
  3. Enter **lecs** to get to the `LECS config>` prompt.
  4. At the `LECS config>` prompt enter **elans** to get to the `LECS ELANS configuration>` prompt.
  5. Select an ELAN by entering **select elan** *elan-x*, where *elan-x* is the ELAN you wish to configure. This will get you to the `Selected ELAN '.elan-x'>` prompt.

6. At the `Selected ELAN 'elan-x'>` prompt, QoS parameters can be configured as TLVs. See “Configuration Commands for ELAN Detailed Configuration” on page 26-22 for more information.

**Example:**

```
config> network 0
ATM Config> le-services
LE Services config> lecs
LECS config> elans
LECS ELANs config> select elan elan-x
Selected ELAN 'elan-x'>
```

## Quality of Service Commands

This section summarizes the QoS configuration commands. Use the following commands to configure Quality of Service. Enter the commands from the `QoS Config>` prompt.

*Table 28-1. Quality of Service (QoS) 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 2-3. |
| LE-CLIENT | Gets you to the `LE Client QoS configuration >` prompt for the selected LE client. |
| ATM-INTERFACE | Gets you to the `ATM Interface QoS configuration>` prompt for the selected ATM interface. |
| ELAN (at LECS) | Gets you to the `ELAN QoS configuration>` prompt at LECS for configuring QoS parameters. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## LE Client QoS Configuration Commands

This section summarizes and explains the commands for configuring QoS for a specific LE Client.

Use the following commands at the `LEC QoS config>` prompt.

*Table 28-2. LE Client Quality of Service (QoS) 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 2-3. |
| List | Lists the current QoS configuration of the LE Client. |
| Set | Sets the QoS parameters of the LE Client. |
| Remove | Removes the QoS configuration of the LE Client. |
| Exit | Returns you to the previous command level. See “Exiting a Lower-Level Environment” on page 2-3. |

## List

Use the **list** command to list the QoS configuration of this LE Client. QoS parameters are listed only if at least one has been specifically configured (see Example 1). Otherwise, no parameters are listed (see Example 2).

**Syntax:**

**list**

**Example 1:**

```
LEC QoS Config> list

           LE Client QoS Configuration for Data Direct VCCs
           ==========================================
     (ATM interface number = 0,  LEC interface number = 3)

  Maximum Reserved Bandwidth for a Data-Direct VCC = 10000 Kbps
  Data-Direct VCC Type ........................... = Best-Effort
  Data-Direct VCC Peak Cell Rate ................. = 155000 Kbps
  Data-Direct VCC Sustained Cell Rate ............ = 155000 Kbps
  Desired QoS Class of Reserved Connections ...... = 0
  Max Burst Size of Reserved Connections    ...... = 0 frames

  Validate Peak Rate of Best-Effort connections .. = No
  Enable QoS Parameter Negotiation ............... = Yes
  Accept QoS Parameters from LECS ................ = Yes

LEC QoS Config>
```

**Example 2:**

```
LEC QoS Config> list

   QoS has not been configured for this LEC.
   Please use the SET option to configure QoS.

LEC QoS Config>
```

## Set

Use the **set** command to specify LE Client QoS parameters.

**Syntax:**

**set**
- accept-qos-parms-from-lecs
- all-default-values
- max-burst-size
- max-reserved-bandwidth
- negotiate-qos
- peak-cell-rate
- qos-class
- sustained-cell-rate
- traffic-type
- validate-pcr-of-best-effort-vccs

**accept-qos-parms-from-lecs**
Use this option to enable/disable the LE Client to accept/reject the QoS parameters received from an LECS as TLVs. See “Accept QoS Parms

from LECS (accept-qos-parms-from-lecs)” on page 28-5 for a more detailed description of this parameter.

**Valid Values:**
YES,NO

**Default Value:**
YES

**Example:**

```
elan-x LEC QoS Config> se acc y
elan-x LEC QoS Config>
```

**all-default-values**

Use this option to set the QoS parameters to default values. In the following example the default values are also listed.

**Example:**

```
LEC QoS Config> set all-default-values
   Failed to locate existing QoS configuration record!
   Using a new set of default values ...
   Initializing all parameters to default values
   elan-x LEC QoS Config>  list

              LE Client QoS Configuration for Data Direct VCCs
              ==========================================
        (ATM interface number = 0,  LEC interface number = 3)

     Maximum Reserved Bandwidth for a Data-Direct VCC = 0 Kbps
     Data-Direct VCC Type ........................... = Best-Effort
     Data-Direct VCC Peak Cell Rate ................. = 155000 Kbps
     Data-Direct VCC Sustained Cell Rate ............ = 155000 Kbps
     Desired QoS Class of Reserved Connections ...... = 0
     Max Burst Size of Reserved Connections    ...... = 0 frames

     Validate Peak Rate of Best-Effort connections .. = No
     Enable QoS Parameter Negotiation ............... = No
     Accept QoS Parameters from LECS ................ = Yes

  LEC QoS Config>
```

**max-burst-size**

Sets the desired maximum burst size in frames. See “Maximum Burst Size (max-burst-size)” on page 28-3 for a more detailed description of this parameter.

**Valid Values:**
An integer number of frames; must be greater than 0

**Default:** 1 frame

**Example:**

```
elan-x LEC QoS Config>  se ma
   Maximum Burst Size in Kbps [1]? 10000
   elan-x LEC QoS Config>
```

**max-reserved-bandwidth**

Use this option to set the maximum reserved bandwidth allowable per Data Direct VCC. See “Maximum Reserved Bandwidth (max-reserved-bandwidth)” on page 28-2 for a more detailed description of this parameter.

**Valid Values:** Integer in the range 0 to the line speed of ATM device in Kbps

**Default Value:** 0

**Example:**

```
LEC QoS Config> set max-reserved-bandwidth
Maximum reserved bandwidth acceptable for a data-direct VCC (in Kbps) [0]? 20000
LEC QoS Config>
```

**negotiate-qos**

Use this option to enable/disable the LE Client's participation in QoS negotiation. See "Negotiate QoS (negotiate-qos)" on page 28-5 for a more detailed description of this parameter.

**Valid Values:**
YES, NO

**Default Value:**
NO

**Example:**

```
elan-x LEC QoS Config>  se neg y
elan-x LEC QoS Config>
```

**peak-cell-rate**

Sets the desired peak cell rate for Data Direct. See "Peak Cell Rate (peak-cell-rate)" on page 28-2 for a more detailed description of this parameter.

**Valid Values:**
An integer value in the range 0 to the line speed of ATM device in Kbps

**Default Value:**
Line speed of LEC ATM Device in Kbps.

**Example:**

```
elan-x LEC QoS Config>  set peak-cell-rate
Data-Direct VCC Peak Cell Rate in Kbps [1]? 25000
elan-x LEC QoS Config>
```

**qos-class**

Sets the desired QoS Class for Data Direct VCCs. See "QoS Class (qos-class)" on page 28-4 for a more detailed description of this parameter.

**Valid Values:**
0: for Unspecified QoS Class

1: for Specified QoS Class 1

2: for Specified QoS Class 2

3: for Specified QoS Class 3

4: for Specified QoS Class 4

**Default Value:**
0 (Unspecified QoS Class)

**Example:**

```
elan-x LEC QoS Config>  se qos
Desired QoS Class for Data Direct VCCs [0]? 1
elan-x LEC QoS Config>
```

**sustained-cell-rate**

Sets the desired sustained cell rate for Data Direct VCCs. See "Sustained Cell Rate (sustained-cell-rate)" on page 28-3 for a more detailed description of this parameter.

**Valid Values:**
An integer value in the range 0 to the minimum of max-reserved-bandwidth and peak-cell-rate, specified in Kbps

**Default Value**
None

**Example:**

```
elan-x LEC QoS Config>  se sus
Data-Direct VCC Sustained Cell Rate in Kbps [1]? 10000
elan-x LEC QoS Config>
```

**traffic-type**

Sets the desired traffic for Data Direct VCCs. See "Traffic Type (traffic-type)" on page 28-2 for a more detailed description of this parameter.

**Valid Values:**
BEST_EFFORT or RESERVED_BANDWIDTH

**Default:** BEST EFFORT.

**Example:**

```
elan-x LEC QoS Config> set traffic-type
  Choose from:
     (0): Best-Effort
     (1): Reserved-Bandwidth
Data Direct VCC Type [0]? 1
NOTE: Peak Cell Rate has been reset to 1
      Sustained Cell Rate has been reset to 1
      Max Reserved Bandwidth has been reset to 1
      Please configure appropriate values.
elan-x LEC QoS Config>
```

**validate-pcr-of-best-effort-vccs**

Use this option to enable/disable validation of the Peak Cell Rate traffic parameter of the Data Direct VCC calls received by this LE Client. See "Validate PCR of Best-Effort VCCs (validate-pcr-of-best-effort-vccs)" on page 28-5 for a more detailed description of this parameter.

**Valid Values:**
YES,NO

**Default Value:**
NO

**Example:**

```
elan-x LEC QoS Config>  se val y
elan-x LEC QoS Config>
```

## Remove

Use the **remove** command to remove the QoS configuration of this LE Client.

**Syntax:**

**remove**

**Example:**

```
elan-x LEC QoS Config>  remove
WARNING: This option deletes the QoS configuration.
         To re-configure use any of the SET options.
Should the LEC QoS configuration be deleted? [No]: yes
Deleted QoS configuration successfully
elan-x LEC QoS Config>
```

## ATM Interface QoS Configuration Commands

*Table 28-3. LE Client Quality of Service (QoS) 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 2-3. |
| List | Lists the current ATM Interface QoS configuration. |
| Set | Sets the ATM Interface QoS parameters. |
| Remove | Removes the QoS configuration of the ATM Interface. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## List

Use the **list** command to list the QoS configuration of this ATM Interface. QoS parameters are listed only if at least one parameter has been configured (see following example). Otherwise, no parameters are listed.

**Syntax:**

**list**

**Example:**

```
ATM-I/F 0 QoS> list

          ATM Interface  Quality of Service' Configuration
          ================================================
                    (ATM interface number = 0  )

     Maximum Reserved Bandwidth for a VCC = 15000 Kbps
     VCC Type .......................... = RESERVED-BANDWIDTH
     Peak Cell Rate .................... = 20000 Kbps
     Sustained Cell Rate ............... = 5000 Kbps
     QoS Class ......................... = 4
     Maximum Burst Size ................ = 5 frames
ATM-I/F 0 QoS>
```

## Set

Use the **set** command to specify ATM Interface QoS parameters.

**Syntax:**

**set** max-burst-size
max-reserved-bandwidth
peak-cell-rate
qos-class
sustained-cell-rate
traffic-type

**max-burst-size**
Sets the desired maximum burst size in frames. See "Maximum Burst Size (max-burst-size)" on page 28-3 for a more detailed description of this parameter.

**Valid Values:**
An integer number of frames; must be greater than 0

**Default:** 1 frame

**Example:**

```
ATM-I/F 0 QoS Config> se ma
Maximum Burst Size in Kbps [1]? 10000
ATM-I/F 0 QoS Config>
```

**max-reserved-bandwidth**
Use this option to set the maximum reserved bandwidth allowable for each Data Direct VCC. See “Maximum Reserved Bandwidth (max-reserved-bandwidth)” on page 28-2 for a more detailed description of this parameter.

**Valid Values:**
Integer in the range 0 to the line speed of ATM device in Kbps

**Default Value:**
0

**Example:**

```
ATM-I/F 0 QoS> se max-reserved-bandwidth
Maximum reserved bandwidth acceptable for a data-direct VCC (in Kbps) [0]?
15000
ATM-I/F 0 QoS>
```

**peak-cell-rate**
Sets the desired peak cell rate for Data Direct VCCs. See “Peak Cell Rate (peak-cell-rate)” on page 28-2 for a more detailed description of this parameter.

**Valid Values:**
An integer value in the range 0 to the line speed of ATM device in Kbps

**Default Value:**
Line speed of LEC ATM Device in Kbps.

**Example:**

```
ATM-I/F 0 QoS Config> set peak-cell-rate
Data-Direct VCC Peak Cell Rate in Kbps [1]? 25000
ATM-I/F 0 QoS Config>
```

**qos-class**
Sets the desired QoS Class for Data Direct VCCs. See “QoS Class (qos-class)” on page 28-4 for a more detailed description of this parameter.

**Valid Values:**
0: for Unspecified QoS Class

1: for Specified QoS Class 1

2: for Specified QoS Class 2

3: for Specified QoS Class 3

4: for Specified QoS Class 4

**Default Value:**
0 (Unspecified QoS Class)

**Example:**

```
ATM-I/F 0 QoS Config> se qos
Desired QoS Class for Data Direct VCCs [0]? 1
ATM-I/F 0 QoS Config>
```

**sustained-cell-rate**

Sets the desired sustained cell rate for Data Direct VCCs. See "Sustained Cell Rate (sustained-cell-rate)" on page 28-3 for a more detailed description of this parameter.

**Valid Values:**

An integer value in the range 0 to the minimum of max-reserved-bandwidth and peak-cell-rate; specified in Kbps

**Default Value**

None

**Example:**

```
ATM-I/F 0 QoS Config> se sus
Data-Direct VCC Sustained Cell Rate in Kbps [1]? 10000
ATM-I/F 0 QoS Config>
```

**traffic-type**

Sets the desired traffic for Data Direct VCCs. See "Traffic Type (traffic-type)" on page 28-2 for a more detailed description of this parameter.

**Valid Values:**

BEST_EFFORT or RESERVED_BANDWIDTH

**Default:** BEST EFFORT.

**Example:**

```
ATM-I/F 0 QoS> set traffic-type
  Choose from:
     (0): Best-Effort
     (1): Reserved Bandwidth
Traffic Type of VCCs [1]? 0
ATM-I/F 0 QoS>
```

## Remove

Use the **remove** command to remove the QoS configuration of this ATM Interface.

**Syntax:**

**remove**

**Example:**

```
ATM-I/F 0 QoS> remove
WARNING: This option deletes the QoS configuration.
         To re-configure use any of the SET options.
Should the ATM Interface QoS configuration be deleted? [No]: yes
Deleted QoS SRAM record successfully
ATM-I/F 0 QoS>
```

## Accessing the QoS Monitoring Commands

Use the **feature** command from the GWCON process to access the Quality of Service monitoring commands. Enter the **feature** followed by the feature number (6) or short name (QOS). For example:

```
+feature qos
Quality of Service (QoS) - User Monitoring
QoS+
```

Once you access the QoS monitoring prompt, you can select the monitoring of a particular LE Client. To return to the GWCON prompt at any time, enter the exit command at the QoS monitoring prompt.

Alternatively, you can access the QoS Monitoring of an LE Client as follows:

1. At the GWCON prompt (+), enter the network command and the LE Client interface number.
2. At the LE Client monitoring prompt enter **qos-information**.

   **Example:**

   ```
   +network 3
   ATM Emulated LAN Monitoring
   LEC+qos information
   LE Client QoS Monitoring
   LEC 3 QoS+
   ```

## Quality of Service Monitoring Commands

This section summarizes the QoS monitoring commands. Enter these commands at the QoS+ prompt.

*Table 28-4. Quality of Service (QoS) 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 2-3. |
| LE-CLIENT | Gets you to the `LE Client QoS console +` prompt for the selected LE client. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## LE Client QoS Monitoring Commands

This section summarizes the LE Client QoS monitoring commands. Enter the commands from the `LEC num QoS+` prompt.

*Table 28-5. LE Client QoS 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 2-3. |
| List | Lists the current LE Client QoS information. Options include: configuration parameters, TLVs, VCCs, and statistics. |
| Exit | Returns you to the previous command level. See "Exiting a Lower-Level Environment" on page 2-3. |

## List

Use the **list** command to list the QoS related information of this LE Client.

**Syntax:**

**list** configuration-parameters

data-direct-VCCs (Detailed Information)

statistics

tlv-information

vcc-information

**configuration-parameters**
Lists the QoS configuration parameters. Because parameters can be configured for an LE Client, ATM Interface or the ELAN, these parameters are displayed along with a resolved set of parameters that are used by the LE Client.

**le-client** The parameters configured for this LE Client which are obtained from the SRAM records. If the SRAM records contain an invalid set of parameters then this column will not display any parameters values.

**ATM Interface**
The parameters configured for the ATM Interface used by this LE Client. These parameters are obtained from the local SRAM records. If the SRAM records contain an invalid set of parameters then this column will not display any parameter values.

**From LECS**
The parameters received by this LE Client from the LE Configuration Server. The parameters are received as individual TLVs in the LE_CONFIGURE_RESPONSE control message.

**used** The resolved set of traffic parameters which are used by for its Data Direct VCCs. If none of the entities is configured with QoS parameters, then the USED parameters represent the default parameters. If parameters are configured for at least one entity, then they are resolved as follows:

- If only the LE Client or the ATM Interface is configured with parameters and either the accept-parms-from-lecs is FALSE or no parameters were received from the LECS, then the configured LE Client or the ATM Interface parameters are used.
- If both the LE Client and the ATM Interface have configured parameters, then the LE Client parameters are used.
- If the accept-parms-from-lecs is TRUE and parameters were received from the LECS, then the LE Client parameters (or the default if the LE Client is not configured) are combined with those received from the LECS to form a complete set of the first six QoS parameters described in “QoS Configuration Parameters” on page 28-1.

- If the set of the first six QoS parameters described in “QoS Configuration Parameters” on page 28-1 contains an invalid combination then the parameters from the LECS are rejected. Note that the two flags negotiate-qos and validate-pcr-of-best-effort-vccs are validated independently.

**Example:**

```
LEC 1 QoS+ list configuration parameters


                ATM LEC Configured QoS  Parameters
                ==================================

      QoS                                     |   LEC      ATM-IF    FROM

   PARAMETER                            USED  |   SRAM     SRAM      LECS

 ---------------------------------------------------------------------------
 Max Reserved Bandwidth (cells/sec) :    23584 |    23584        0     none
                        (Kbits/sec) :    10000 |    10000        0     none
 VCC Type ......................... :   ResvBW |   ResvBW   BstEft        0
 Peak Cell Rate ........(cells/sec) :    18867 |    18867   365566   365566
                        (Kbits/sec) :     8000 |     8000   155000   155000
 Sustained Cell Rate ...(cells/sec) :    18867 |    18867   365566     none
                        (Kbits/sec) :     8000 |     8000   155000     none
 QoS Class ........................ :        4 |        4        0     none
 Max Burst Size ............(cells) :       95 |       95        0     none
                           (frames) :        1 |        1        0     none
 Validate PCR of Best-Effort VCCs . :       NO |       NO      n/a     none
 Enable QoS Negotiation ........... :      YES |      YES      n/a     none
 Accept QoS Parameters from LECS .. :      YES |      YES      n/a      n/a
 ---------------------------------------------------------------------------
(BstEft = Best Effort, ResvBW = Reserved Bandwidth)
(n/a = not applicable, none = no value is specified)

LEC 1 QoS+
```

**data-direct-vccs (Detailed Information)**

This option lists the Data Direct VCC information of this LE Client. Similar information is also listed using **list vcc-information**.

**Example:**

```
LEC 1 QoS+ list data direct vccs

          LEC Data Direct VCCs - QoS Information
          ======================================

Conn Handle = 80, VPI = 0, VCI = 546
        Connection Type = RETRIED CONNECTION PARAMETERS
          TrafficType    = BEST EFFORT VCC
          PCR            = 58962 (25 Mbps)
          SCR            = 58962 (25 Mbps)
          QoS Class      = 0
          Max Burst Size = 0

Conn Handle = 78, VPI = 0, VCI = 544
        Connection Type = PARAMETERS SET BY DESTINATION
          TrafficType    = RESERVED BANDWIDTH VCC
          PCR            = 58962 (25 Mbps)
          SCR            = 16509 (7 Mbps)
          QoS Class      = 1
          Max Burst Size = 95

LEC 1 QoS+
```

**statistics** Counters are maintained for the following statistics:

**Successful QoS Connections**

Number of RESERVED-BANDWIDTH connections established by the LE Client.

**Successful Best-Effort Connections**
: Number of BEST-EFORT connections established by the LE Client.

**Failed QoS Connections**
: Number of RESERVED-BANDWIDTH connection requests made by the LE Client that failed.

**Failed Best-Effort Connections**
: Number of BEST-EFFORT connection requests made by the LE Client that failed.

**QoS Negotiation Applied**
: Number of times the QoS negotiation extension was applied. Parameters are negotiated if the LE Client receives the destination LE Client's parameters in an LE_ARP_RESPONSE control message.

**PCR Proposal (IBM) Applied**
: Number of times the IBM Peak Cell Rate Proposal was applied. This proposal recommends using specific rate parameters if signaling at 100 Mbps or 155 Mbps for BEST-EFFORT connections. This allows other participating IBM products (for example, 25-Mbps ATM adapters) to reject a connection based on the signaled peak cell rates.

**QoS Connections Accepted**
: Number of RESERVED-BANDWIDTH connections accepted by this LE Client.

**Best-Effort Connections Accepted**
: Number of BEST-EFFORT connections accepted by this LE Client.

**QoS Connections Rejected**
: Number of RESERVED-BANDWIDTH connection requests received by this LE Client that were rejected.

**Best-Effort Connections Rejected**
: Number of BEST-EFFORT connection requests received by this LE Client that were rejected.

**Rejected due to PCR Validation**
: Number of BEST-EFFORT connections rejected by the LE Client due to validation of Peak Cell Rate when the validate-pcr-of-best-effort-vccs parameter is TRUE.

**Example:**

```
LEC 1 QoS+ li stat

QoS Statistics: of Data Direct Calls Placed by the LEC
------------------------------------------------------
    Successful QoS Connections          = 0
    Successful Best-Effort Connections  = 1
    Failed QoS Connections              = 1
    Failed Best-Effort Connections      = 1
    Qos Negotiation Applied             = 0
    PCR Proposal (IBM) Applied          = 0

QoS Statistics: of Data Direct Calls Received by the LEC
--------------------------------------------------------
    QoS Connections Accepted            = 1
    Best-Effort Connections Accepted    = 0
    QoS Connections Rejected            = 0
    Best-Effort Connections Rejected    = 0
    Rejected due to PCR Validation      = 0

LEC 1 QoS+
```

**tlv-information**

Lists the IBM Traffic Information TLV that this LE Client registered with the LE Server. The TLV is registered only if the LE Client is participating in QoS Negotiation.

**Example:**

```
LEC 1 QoS+ list tlv

  Traffic Info TLV of the LEC (registered with the LES)
  =====================================================
    TLV Type .........................= 268458498
    TLV Length .......................= 24
    TLV Value:
           Maximum Reserved Bandwidth = 23584 cells/sec (10 Mbps)
           Data Direct VCC Type...... = RESERVED BANDWIDTH VCC
           Data Direct VCC PCR....... = 18867 cells/sec (8 Mbps)
           Data Direct VCC SCR....... = 18867 cells/sec (8 Mbps)
           Data Direct VCC QoS Class  = 4
           Maximum Burst Size         = 95 cells (1 frames)

LEC 1 QoS+
```

**vcc-information**

Lists all active VCCs of the LE Client. The information includes the traffic parameters of the connections. For BEST-EFFORT connections, the Sustained Cell Rate is displayed to be the same as the Peak Cell Rate, QoS Class and the Maximum Burst Size are displayed as 0.

The Parameter Descriptor entries are:

**SrcParms**

Parameters of a connection established by this LE Client.

**DestParms**

Parameters of a connection received by this LE Client.

**NegoParms**

Parameters of a connection established by the LE Client for which the QoS Negotiation was used.

**RetryParms**

Parameters of a connection established by this LE Client after failing at least once.

**Example:**

```
LEC 1 QoS+ li vcc

                             LEC VCC Table
                             =============

                                                                     Burst
Conn   Conn                Conn          VCC    PCR    SCR   QoS   Size    Parameters
Index  Handle VPI    VCI   Type  Status  Type  (kbps) (kbps) Class (cells) Descriptor
-------------------------------------------------------------------------------------
   2)      69    0   535  Cntrl  Ready  BstEft 155000 155000    0       0  SrcParms
   3)      71    0   537  Cntrl  Ready  BstEft      0      0    0       0  DestParms
   4)      72    0   538  Mcast  Ready  BstEft 155000 155000    0       0  SrcParms
   5)      74    0   540  Mcast  Ready  BstEft      0      0    0       0  DestParms
   6)      78    0   544  Data   Ready  ResvBW  25000   7000    1      95  DestParms

LEC 1 QoS+
```

# Appendixes

# Appendix A. Quick Configuration Reference

**Important**

If you are attempting to configure or monitor your IBM 8210 and your service terminal is unreadable, see “Service Terminal Display Unreadable” in IBM Nways Multiprotocol Switched Services (MSS) Server Module Service and Maintenance Manual.

## Quick Configuration Tips

### 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 8210 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

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 screen.

## 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 redisplay 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, and then IPX.

## 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 redisplay 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 8210 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 8210 sends the addresses in LSB (least significant bit), or canonical, format. |
| `Token-Ring SNAP MSB` | The IBM 8210 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 8210 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

Ifc   IPX Net (hex)   Encapsulation       IPXWAN

0     1               TOKEN-RING MSB      Not Configured
1     2                                   Enabled
2     3                                   Enabled

  Host Number for Serial Lines: 000000000001
  IPXWAN Node ID = 4
  IPX Router Name = ipx_router-4
Save this configuration? (Yes, No): [Yes]
```

6. Enter **y** to save the IPX configuration and continue with quick configuration. Enter **n** to redisplay the IPX configuration prompts.

   If you enter **y**, the following message appears:

```
IPX configuration saved
```

## Restarting the IBM 8210

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 8210 with the new configuration. To change or view the current configuration, enter **qc**.

# Appendix B. Abbreviations

| | |
|---|---|
| **AAL** | ATM Adaptation Layer |
| **AAL-5** | ATM Adaptation Layer 5 |
| **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 |
| **ATM** | Asynchronous Transfer Mode |
| **ATMARP** | ARP in Classical IP |
| **ATP** | AppleTalk Transaction Protocol |
| **AUI** | attachment unit interface |
| **AVI** | ATM virtual interface |
| **ayt** | are you there |
| **BAN** | Boundary Access Node |
| **BBCM** | Bridging Broadcast Manager |
| **BCM** | BroadCast Manager |
| **BECN** | backward explicit congestion notification |
| **BGP** | Border Gateway Protocol |
| **BGP** | Border Growth Protocol |

| | |
|---|---|
| **BNC** | bayonet Niell-Concelman |
| **BNCP** | Bridging Network Control Protocol |
| **BOOTP** | BOOT protocol |
| **BPDU** | bridge protocol data unit |
| **bps** | bits per second |
| | bandwidth reservation |
| **BSD** | Berkeley software distribution |
| **BTP** | BOOTP relay agent |
| **BTU** | basic transmission unit |
| **BUS** | Broadcast and Unknown Server |
| **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 |
| **CIPC** | Classical IP Client |
| **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 Local Area Network |
| **ELAP** | EtherTalk Link Access Protocol |
| **ELS** | Event Logging System |
| **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 |
| **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 |
| **IETF** | Internet Engineering Task Force |
| **Ifc#** | interface number |
| **IGP** | interior gateway protocol |
| **ILMI** | Interim Local Management Interface |
| **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 |
| **LAN** | local area network |
| **LAPB** | link access protocol-balanced |
| **LAT** | local area transport |
| **LCP** | Link Control Protocol |
| **LE** | LAN Emulation |
| **LEC** | LAN Emulation Client |

| | |
|---|---|
| **LED** | light-emitting diode |
| **LECS** | LAN Emulation Configuration Server |
| **LES** | LAN Emulation Server |
| **LES-BUS** | LAN Emulation Server - Broadcast and Unknown Server |
| **LF** | largest frame; line feed |
| **LIS** | Logical IP subnet |
| **LLC** | logical link control |
| **LLC2** | logical link control 2 |
| **LMI** | local management interface |
| **LRM** | LAN reporting mechanism |
| **LS** | link state |
| **LSA** | link state advertisement |
| **LSB** | least significant bit |
| **LSI** | LANE 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 |
| **MOSDDT** | Micro Operating System Dynamic Debugging Tool |
| **MOSPF** | Open Shortest Path First with multicast extensions |
| **MSB** | most significant bit |
| **MSDU** | MAC service data unit |
| **MSS** | Multiprotocol Switched Services |
| **MTU** | maximum transmission unit |
| **nak** | not acknowledged |
| **NBMA** | Non-Broadcast Multiple Access |
| **NBP** | Name Binding Protocol |

**NBR** neighbor

**NCP** Network Control Protocol

**NCP** Network Core Protocol

**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

**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

**QoS** Quality of Service

**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 |
| **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 |
| **SDU** | Service Data Unit |
| **SGID** | server group id |
| **seqno** | sequence number |
| **SGMP** | Simple Gateway Monitoring Protocol |
| **SL** | serial line |
| **SLIP** | Serial Line IP |
| **SMP** | standby monitor present |
| **SMTP** | Simple Mail Transfer Protocol |
| **SNA** | Systems Network Architecture |
| **SNAP** | Subnetwork Access Protocol |
| | SubNetwork Attachment Point |
| **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

**SVN** Switched Virtual Networking

**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

**TLV** Type/Length/Value

**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

**UNI** User-Network Interface

**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 |
| **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 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.

**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**. Asynchonous 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)

**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

**BCM**. BroadCast Manager, an IBM extension to LAN Emulation designed to limit the effects of broadcast frames.

**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).

**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)

**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)

**Border Gateway Protocol (BGP)**. An Internet Protocol (IP) routing protocol used between domains and autonomous systems. Contrast with *Exterior Gateway Protocol (EGP)*.

**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*.

**BUS**. Broadcast and Unknown Server, a LAN Emulation Service component responsible for the delivery of multicast and unknown unicast frames.

# 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)

**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)*.

**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.

**CIP**. Classical IP.

**CIPC**. Classical IP Client.

**Classical IP**. An IETF standard for ATM-attached hosts to communicate using IP over ATM.

**Classical IP Client**. A Classical IP component that represents users of the Logical IP Subnet.

**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 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*.

**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)*.

# 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. (I) (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. (I)

**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. (I)

**data terminal equipment (DTE)**. That part of a data station that serves as a data source, data sink, or both. (I) (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)

**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.

**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.

**ELAN**. Emulated Local Area Network, a LAN segment implemented with ATM technology.

**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.

**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.

**ESI**. End System Identifier, a 6-byte component of an ATM address.

**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. Contrast with *Border Gateway Protocol (BGP)*.

## F

**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.

**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 *pacing*.

**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.

## 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.

**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.

**hysteresis**. The amount the temperature must change past the set alert threshold before the alert condition is cleared.

# I

**I frame**. Information frame.

**IETF**. Internet Engineering Task Force, an organization that produces Internet specifications.

**ILMI**. Interim Local Management Interface, SNMP-based procedures for managing the User-Network Interface (UNI).

**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 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.

**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.

**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)*.

**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.

**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).

# L

**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.

**LEC**. LAN Emulation Client.

**LECS**. LAN Emulation Configuration Server.

**LES**. LAN Emulation Server.

**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-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).*

**LIS**. Logical IP Subnet, an IP subnet implemented with ATM technology Virtual Networking (SVN) framework.

**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 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 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.

**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.

**MSS**. Multiprotocol Switched Services, a component of IBM's Switched Virtual Networking (SVN) framework.

**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.

**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 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*.

**Next Hop Resolution Protocol (NHRP)**. A routing protocol, specified in Internet Draft Version 10 which has been submitted for RFC status. The Next Hop Resolution Protocol defines a method for a source station to determine the Non-Broadcast Multi-Access (NBMA) address of the “NBMA next hop” towards a destination. The NBMA next hop may be the destination itself or the router in the NBMA network that is “nearest” to the destination. The source station can then establish an NBMA virtual circuit directly with the destination or the router and reduce the number of routing hops through the NBMA network.

**network user address (NUA)**. In X.25 communications, the X.121 address containing up to 15 binary code digits.

**NHRP**. Next Hop Resolution Protocol

**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*.

**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.

# 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

**pacing**. (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 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.

**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)

# Q

**Quality of Service (QoS)**. The user-oriented performance of an end-to-end service which is accessed using performance parameters. In ATM networks, the following performance parameters determine the QoS of an end-to-end ATM connection: cell loss ratio, cell transfer delay, and cell delay variation.

# 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.

**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 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.

**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

**SDU**. Service Data Unit, data as it appears at the interface between a layer and the layer immediately above.

**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.

**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 IP 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.

**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).

**SLIP**. Serial Line IP, an IETF standard for running IP over serial communication links.

**SNA management services (SNA/MS)**. The services provided to assist in management of SNA networks.

**SNAP**. (1) SubNetwork Access Protocol. (2) SubNetwork Attachment Point.

**socket**. An endpoint for communication between processes or application programs.

**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 Attachment Point (SNAP)**. An LLC header extension that identifies the protocol type of a frame.

**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)

**SVN**. Switched Virtual Networking, the name of IBM's framework for building and managing switch-based networks.

**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)*.

**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 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

**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 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. (I) (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.

**TLV**. Type/Length/Value, a generalized information element in a LAN Emulation packet.

**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.

**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. The Japanese version (J1) transmits 1.544 Mbps.

# U

**UNI**. User-Network Interface, the interface between user equipment and an ATM switch network.

**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.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.

**VCC**. Virtual Channel Connection, a connection between parties.

**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 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 Local Area Network (VLAN)**. A logical grouping of one or more LANs based on protocol and subnet and used to isolate network traffic within these groups.

**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.

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