

ATM 155-Mbps Multimode Fiber Universal Feature Card Planning and Installation Guide

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ATM 155-Mbps Multimode Fiber
Universal Feature Card

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Planning and Installation Guide



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Note

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Second Edition (September 1997)

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Contents

Safety Notices	v
Chapter 1. Overview	1-1
Who Should Read This Manual	1-1
ATM UFC Capabilities and Uses	1-2
Latest Information	1-7
Physical Characteristics	1-8
Chapter 2. Planning and Installation Preparations	2-1
LAN Switch Requirement	2-1
Planning the Cabling	2-1
Configuration Options	2-2
Base Switch Enhancements for an ATM UFC	2-3
Chapter 3. Installing the ATM UFC	3-1
Package Contents	3-1
Installation	3-1
Cabling	3-3
Testing the UFC	3-3
Chapter 4. Configuring the ATM UFC	4-1
Before You Begin	4-1
Quick Configuring the ATM UFC	4-3
Configuring Physical Port Parameters	4-4
Configuring LAN Emulation Clients	4-5
Chapter 5. Managing the ATM UFC	5-1
Management Using an SNMP-Based Manager	5-1
ATM UFC Status and Statistics	5-2
Viewing LEC Status and Statistics	5-5
Base Switch Statistics Panel Enhancements for the ATM UFC	5-8
Understanding the Logical Port Address and Route Descriptor Tables	5-9
Chapter 6. Troubleshooting	6-1
Obtaining Service	6-1
Trouble Indicators	6-1
Responding to a Problem	6-2
Performance Considerations	6-8
Support Information	6-8
Chapter 7. Downloading Software	7-1
Serial Port/TFTP Downloading with the Download Menu	7-1
Appendix A. Planning Charts	A-1
Appendix B. Advanced Configuration of a LEC	B-1
Appendix C. Notices and Warranty	C-1
Electronic Emission Notices	C-1
Trademarks	C-3

Warranty	C-4
List of Abbreviations	X-1
Glossary	X-3
Index	X-11

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Fare: Før du begynner å installere dette produktet, må du lese sikkerhetsinformasjonen i *Advarsel: Sikkerhetsinformasjon — Les dette først*, SD21-0030 som beskriver sikkerhetsrutinene for kabling og tilkobling av elektrisk utstyr.



Fare! Før du installerer dette produkt, skal du læse sikkerhedsforskrifterne i *NB: Sikkerhedsforskrifter—Læs dette først* SD21-0030. Vejledningen beskriver den fremgangsmåde, du skal bruge ved tilslutning af kabler og udstyr.



Gevaar: Voordat u begint met de installatie van dit produkt, moet u eerst de veiligheidsinstructies lezen in de brochure *PAS OP! Veiligheidsinstructies—Lees dit eerst*, SD21-0030. Hierin wordt beschreven hoe u elektrische apparatuur op een veilige manier moet bekabelen en aansluiten.




Gevaar Voordat u begint met het installeren van dit produkt, dient u eerst de veiligheidsrichtlijnen te lezen die zijn vermeld in de publikatie *Caution: Safety Information - Read This First*, SD21-0030. In dit boekje vindt u veilige procedures voor het aansluiten van elektrische apparatuur.





Vorsicht: Bevor mit der Installation des Produktes begonnen wird, die Sicherheitshinweise in *Achtung: Sicherheitsinformationen—Bitte zuerst lesen*, IBM Form SD21-0030. Diese Veröffentlichung beschreibt die Sicherheitsvorkehrungen für das Verkabeln und Anschließen elektrischer Geräte.





危険： 導入作業を開始する前に、安全に関する小冊子SD21-0030 の「最初にお読みください」(Read This First)の項をお読みください。この小冊子は、電気機器の安全な配線と接続の手順について説明しています。


 **Danger :** Avant d'installer le présent produit, consultez le livret *Attention : Informations pour la sécurité — Lisez-moi d'abord*, SD21-0030, qui décrit les procédures à respecter pour effectuer les opérations de câblage et brancher les équipements électriques en toute sécurité.


 **Danger:** Avant de procéder à l'installation de ce produit, lisez d'abord les consignes de sécurité dans la brochure *ATTENTION: Consignes de sécurité—A lire au préalable*, SD21-0030. Cette brochure décrit les procédures pour câbler et connecter les appareils électriques en toute sécurité.

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 **Perigo:** Antes de iniciar a instalação deste produto, leia as informações de segurança *Cuidado: Informações de Segurança — Leia Primeiro*, SD21-0030. Este documento descreve como efectuar, de um modo seguro, as ligações eléctricas dos equipamentos.

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 **Perigo:** Antes de começar a instalar este produto, leia as informações de segurança contidas em *Cuidado: Informações Sobre Segurança—Leia Isto Primeiro*, SD21-0030. Esse folheto descreve procedimentos de segurança para a instalação de cabos e conexões em equipamentos elétricos.

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注意：

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i eksploatacji.



Upozornění: než zahájíte instalaci tohoto produktu, přečtěte si
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informace“ č. 21-0030. Tato brožurka popisuje bezpečnostní
opatření pro kabeláž a zapojení elektrického zařízení.



Vigyázat: Mielőtt megkezdi a berendezés üzembe helyezését, olvassa el a
"Caution: Safety Information— Read This First, SD21-0030 könyvecskében leírt
biztonsági információkat. Ez a könyv leírja, milyen biztonsági intézkedéseket kell
megtenni az elektromos berendezés huzalozásakor illetve csatlakoztatásakor.



Pozor: Preden začnete z instalacijo tega produkta
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Opasnost: Prije nego što počnete sa instalacijom produkta, pročitajte naputak o pravilima o sigurnom rukovanju u Upozorenje: Pravila o sigurnom rukovanju - Prvo pročitaj ovo, SD21-0030. Ovaj privitak opisuje sigurnosne postupke za priključivanje kabela i priključivanje na električno napajanje.



Nebezpečnostvo: Pred inštaláciou výrobku si prečítajte bezpečnosté predpisy v Výstraha: Bezpečnosté predpisy - Prečítaj ako prvé, SD21-0030. V tejto brožúrke sú opísané bezpečnosté postupy pre pripojenie elektrických zariadení.

Chapter 1. Overview

This book explains how to plan for, install, administer and service the IBM ATM 155-Mbps Multimode Fiber Universal Feature Cards (UFCs) (hereafter referred to as the ATM UFC). There are two ATM UFCs — one for use with Token-Ring LANs (P/N 86H2762) and one for use with Ethernet LANs (P/N 41H6988). These UFCs are installed in LAN switches and provide an uplink to the ATM network for the LAN segments attached to the switch.

This book should be used with the planning, configuration, and management documentation shipped with the base switch. Place it in the base-switch documentation binder for easy cross-referencing. Some of the procedures in this book require you to refer to one of the following manuals:

- *8271 Nways Ethernet LAN Switch Models 108 and 216 Planning and Installation Guide, GA27-4984*
- *8271 LAN Switch Module Planning and Installation Guide, GA27-4162*
- *8272 Nways Token-Ring LAN Switch Models 108 and 216 Planning and Installation Guide, GA27-4982*
- *8272 LAN Switch Module Planning and Installation Guide, GA27-4163*
- *8270 Nways Token-Ring LAN Switch Model 800 Planning and Configuration Guide, GA27-4145*
- *The ATM Forum LAN Emulation Over ATM, Version 1.0, January, 1995*
- *Asynchronous Transfer Mode (ATM) Technical Overview, SG24-4625*

This manual provides the following types of information:

- General information regarding the ATM UFC, and its function as a LAN Emulation (LANE) uplink for the LAN switches (Chapter 1)
- Step-by-step installation instructions (Chapters 2, 3, and 7)
- Instructions and reference information for using the console configuration interface and performance tips for the ATM UFC. (Chapters 4, 5, and 8)
- ATM UFC troubleshooting (Chapter 6)

Who Should Read This Manual

Different sections of this manual are intended for different audiences.

Planning	Network planner or administrator
Installation	Technician or electrician
Configuration	Network administrator who knows the base switch and ATM
Troubleshooting	Service engineer or network administrator

ATM UFC Capabilities and Uses

The ATM UFC provides an ATM uplink for your IBM LAN switch.

This section will answer the following questions:

1. Which LAN switch models support the ATM UFC?
2. How many ports does the ATM UFC support?
3. What protocols does the ATM UFC support?
4. In which network configurations is the ATM UFC ideal?
5. Are there ATM UFC usage recommendations and restrictions?
6. When should one use multiple ATM UFCs?

Additionally, ATM UFC highlights can be found in Table 1-1 on page 1-5.

Supported LAN Switch Models

The ATM UFC can be installed in any of the following LAN switches:

- 8270 Nways Token-Ring LAN Switch Model 800
- 8271 Nways Ethernet LAN Switch Model 108
- 8271 Nways Ethernet LAN Switch Model 216
- 8271 LAN Switch Module
- 8272 Nways Token-Ring LAN Switch Model 108
- 8272 Nways Token-Ring LAN Switch Model 216
- 8272 LAN Switch Module

For Token-Ring LAN switches (8270 and 8272), the ATM UFC will automatically join ATM-based Token-Ring Emulated LANs (ELANs). For the Ethernet LAN switch (8271), the ATM UFC will automatically join ATM-based Ethernet LANs.

ATM Physical and Logical Ports

The ATM UFC's single physical port provides the following features:

- 155-Mbps data rate (OC-3)
- Multimode fiber (MMF) subscriber connector (SC)
- Constant Bit Rate (CBR), Variable Bit Rate (VBR), and Unspecified Bit Rate (UBR) (also known as Best Effort Rate) virtual channel connection (VCC) types
- 3072 VCCs
- ATM User-Network Interface (UNI) Specification, Versions 3.0 and 3.1

The single physical port allows multiplexing of data from multiple logical ports. An ATM UFC logical port is referred to as a *LAN Emulation Client (LEC)*. On one ATM UFC, up to 32 LECs can be configured, with a maximum of 8 LECs enabled at any one time. See "Usage Recommendations and Restrictions" on page 1-5 for important guidelines for assigning LECs to LAN switch domains.)

ATM-Based Protocol Support

The ATM UFC implements the industry-standard ATM-Forum LAN Emulation Over ATM: Version 1.0 Specification, generally referred to as *ATM LANE 1.0*. ATM LANE allows for the seamless flow of Token-Ring and Ethernet data over an ATM network, independent of higher layer protocols such as SNA, IP, and IPX**.

In addition, the ATM UFC supports the ATM-Forum LAN Emulation Client Management: Version 1.0 Specification, as well as other industry-standard network management information bases (MIBs). See Table 5-1 on page 5-1 for a complete list.

Environments

The ATM UFC is ideal for the following three environments:

1. ATM backbone for legacy LANs

As a first step in migrating from legacy LANs (Token Ring and Ethernet), many users will deploy ATM in the backbone or as the WAN technology to interconnect geographically dispersed legacy LANs. The LAN switch with an ATM UFC provides a seamless, switched network between legacy LANs communicating over ATM.

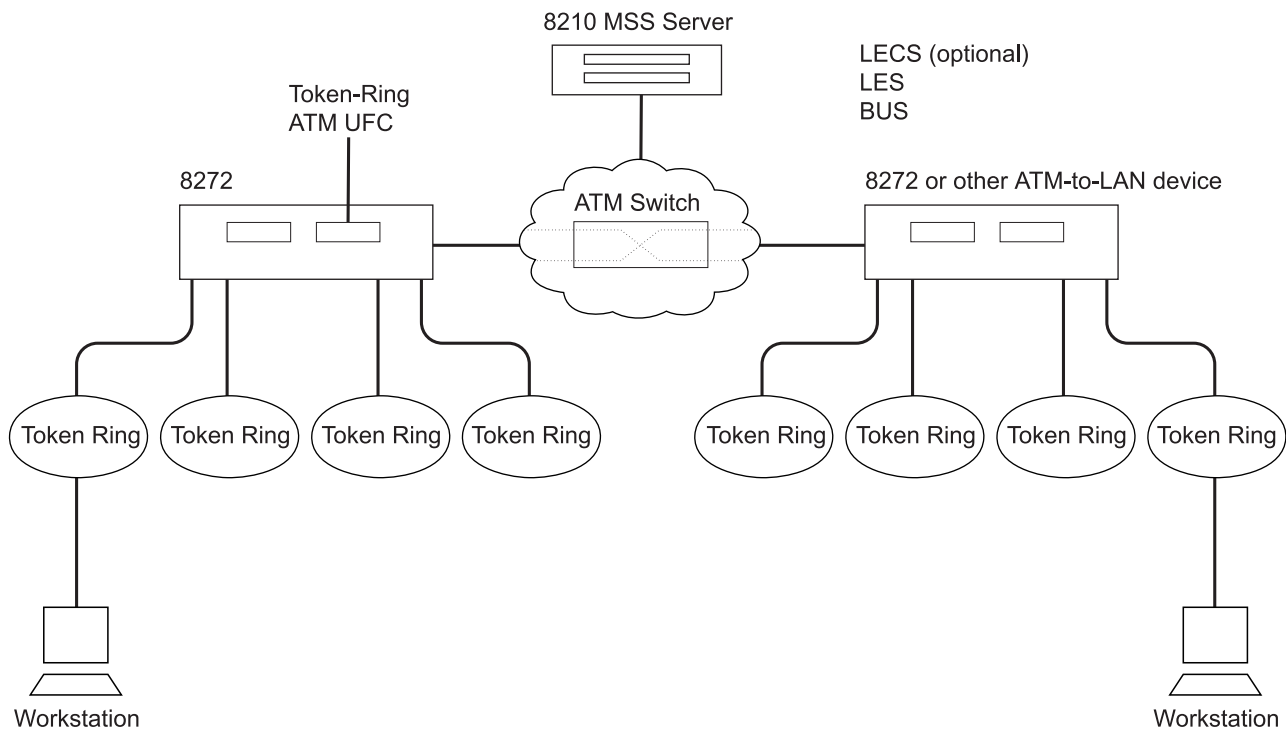


Figure 1-1. Connection to an ATM Backbone Using a Token-Ring ATM UFC

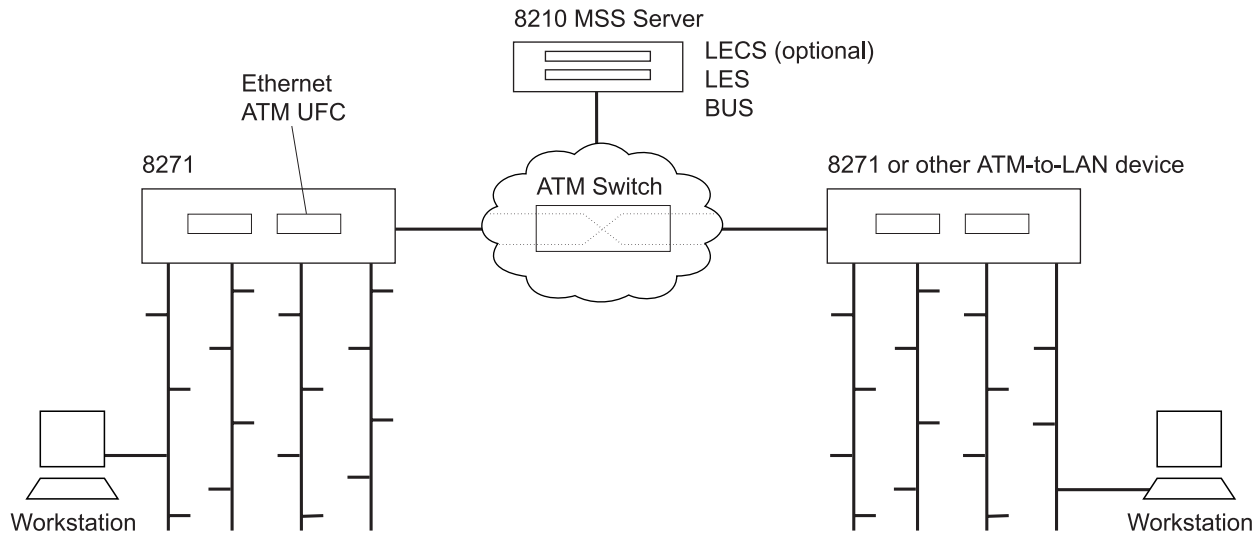


Figure 1-2. Connection to an ATM Backbone Using an Ethernet ATM UFC

2. LAN-to-ATM interoperability

As the next step of a legacy LAN-to-ATM migration, users will place high-speed or frequently accessed servers or both on the ATM network, to take advantage of ATM's scalability and Quality of Service (QoS) features. By using LANE over ATM, these ATM-based workstations will be able to use existing legacy LAN applications with minimal or no upgrade costs for moving to ATM. Again, a LAN switch with one or more ATM UFCs helps protect your legacy LAN investment by providing transparent LAN-to-ATM switching.

3. Switched Virtual Networking

For performance and cost reasons, users are moving from router-based networks to switched networks. To provide the performance of switches and the bandwidth management of routers, IBM has defined the Switched Virtual Networking (SVN) architecture.

SVN provides for:

- Bridging between heterogeneous, ELAN types (Token Ring, Ethernet, source-route bridging, transparent bridging, SRTB, and SRT)
- Sophisticated broadcast management (for instance, discarding redundant NetBIOS broadcasts and converting broadcast packets (ARP) into unicast packets)
- Routing between heterogeneous ATM encapsulation methods (ATM Forum LAN Emulation over ATM; IPX using Multiprotocol Encapsulation over ATM [MPOA, RFC 1483]; and Classical IP over ATM, [RFC 1577])
- Automatic protocol-specific and user-defined Virtual Local Area Networks (VLANs)
- Intra-subnet zero-hop routing and inter-subnet one-hop routing, together with ATM-based and LAN-based Forwarding Engines (FEs)

The LAN switch with an ATM UFC provides a low-cost access node for the highly efficient, high-bandwidth SVN architecture.

Table 1-1. ATM UFC Highlights

Feature	Description
Protocol support	ATM Forum LANE over ATM, Version 1.0 (both Ethernet and Token Ring)
Signaling	ATM Forum UNI Versions 3.0 and 3.1 (auto-detectable)
Maximum LECs	32 configurable per ATM UFC 8 simultaneously enabled per ATM UFC
Maximum VCCs	3072 per ATM UFC (distributed over all active LECs)
Maximum bit rate	155 Mbps (SDH STM-1, SONET STS-3 OC-3)
VCC types	As required by the ATM Forum <i>LAN Emulation over ATM</i> specification: Multicast-Send VCC: configurable as CBR, VBR, or UBR All other VCCs: UBR
Maximum ATM UFCs per LAN switch	8270: 2 (recommended) 8271-108: 1 8271-216: 2 8272-108: 1 8272-216: 2 8271 LAN Switch Module: 2 8272 LAN Switch Module: 2
Management	Console: The LAN switch console provides configuration and monitoring support for the ATM UFC. This console is accessible via the LAN switch serial port or Telnet. See Chapter 4, "Configuring the ATM UFC" and Chapter 5, "Managing the ATM UFC" for more details. SNMP: supported MIBs include RFCs 1213, 1493, 1573, and 1695. See Table 5-1 on page 5-1 for more information. Traps include Link Up and Link Down. RMON: available with the RMON UFC (Models 827x-216 and 8272-800 only).
Configuration	Auto-configuration: if a LECS is used (ELAN Name set to NULL) Quick Configuration: if an ELAN Name is required together with an LECS Advanced configuration: full-featured configuration of all ATM Forum parameters
Switching	Port-to-port hardware switching without embedded processor intervention. On-board processor is reserved for VCC establishment and maintenance.
Packaging	Modular, customer-replaceable unit.

Usage Recommendations and Restrictions

Be sure to follow these rules when installing the ATM UFC.

Rule 1: Never enable more than one LEC per ATM UFC assigned to the same domain.

A LAN switch domain can include only one enabled LEC from any ATM UFC.

The LAN switch allows multiple domains to be defined, where each domain groups ports together for switching. Ports not in the same domain cannot directly communicate with each other through a switch; a bridge, router, or gateway must be used for inter-domain communication. Thus, using multiple domains provides for enhanced security and congestion management.

An ATM-UFC LEC is assigned to a LAN switch domain to provide connectivity to the ATM network. In this sense, an ATM UFC is a logical port. When assigning enabled LECs to LAN switch domains, the enabled LECs of any one ATM UFC should each be assigned to different domains.

Note that this applies only to enabled LECs. Multiple, disabled LECs can be assigned to one domain. Furthermore, this restriction pertains only to the LECs of a single ATM UFC. LECs on multiple ATM UFCs can be assigned to the same domain for backup purposes. (See rule 3.)

The LAN switch generates an error message if a user attempts to enable more than one LEC per domain per ATM UFC and prohibits the action.

Rule 2: Never assign more than one LEC per ATM UFC to the same ELAN.

On any ATM UFC, only one LEC can join a particular ELAN.

Each LEC provides a LAN switch domain with a port onto a particular ELAN. Multiple domains cannot be attached to the same ELAN. If multiple domains need access to the same ELAN, this must be achieved through a bridge, router, or gateway.

The LAN switch generates an error message and prohibits the joining of more than one LEC from the same ATM UFC to the same ELAN.

Rule 3: Avoid ATM-to-ATM switching.

Avoid placing two LECs, on different ATM UFCs and joined to different ELANs, in the same LAN switch domain.

The LAN switch is not intended to be an ATM switch. By placing two different ATM-UFC LECs in the same domain and in different ELANs, these LECs can cause cross-UFC traffic that might impact user performance.

Note that this is different from placing two different ATM-UFC LECs in the same domain and in the same ELAN. If the two LECs share both a domain and an ELAN, then the LAN switch's Spanning Tree operation will automatically place one LEC in the frame-forwarding state and the other LEC in the frame-blocking state. This is a useful backup LEC configuration. See "Rationale for Multiple ATM UFCs" on page 1-7 for more information.

This rule, concerning multiple LECs on different ATM UFCs, is not prohibited by the LAN switch, but violating this guideline might severely impact overall switch performance.

Rationale for Multiple ATM UFCs

Given that one ATM UFC can support as many LECs as there are domains in a LAN switch, the question arises: Why use two ATM UFCs?

The first reason is to provide a backup LEC. By enabling two LECs on two different ATM UFCs to be members of both the same domain and the same ELAN, the LAN switch's 802.1d Spanning Tree operation will automatically use one LEC for forwarding frames and the other LEC for blocking frames (active standby). If the first LEC fails, the second one will automatically take over. Note that, in order for the backup LEC configuration to work, Spanning Tree **must** be enabled for the related LAN switch domain.

The second reason is to increase system resources. In some environments, the resources associated with a single ATM UFC (such as a maximum of 3072 VCCs per ATM UFC and a maximum data rate of 155 Mbps) might affect individual LEC performance. By moving one or more LECs to a second ATM UFC, you can significantly increase the resources available to each LEC.

Latest Information

The README.TXT file contains useful information that was not available at the time this book was printed. The file is on the diskette that was shipped with the ATM UFC.

Visit our home page for information about a variety of IBM Networking products:

<http://www.raleigh.ibm.com>

Physical Characteristics

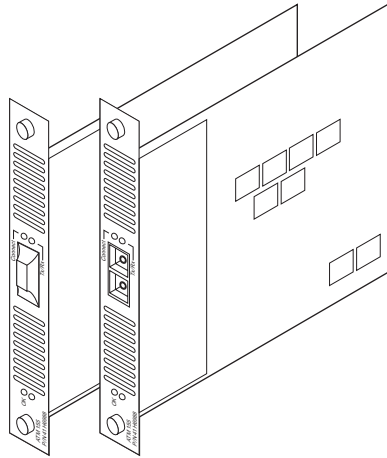


Figure 1-3. The IBM ATM UFC

Two port status LEDs and two UFC status LEDs indicate the operational status of the UFC and the port. See Figure 1-4 for the LED locations.

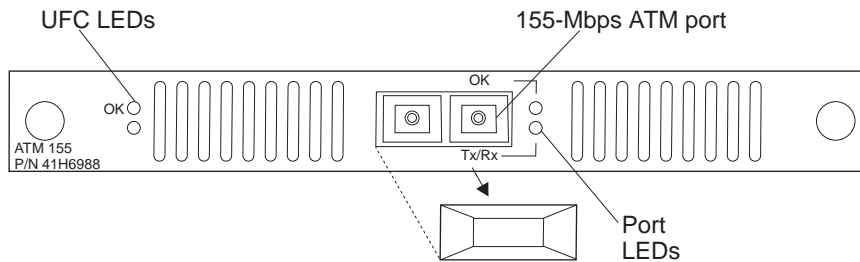


Figure 1-4. Locations of LEDs and Port for the ATM UFC (Ethernet)

Operating Environment and Physical Dimensions

Table 1-2. Operating Environment and Physical Dimensions

Temperature	10° to 40°C (50° to 104°F)
Relative humidity	8% to 80%
Maximum wet-bulb temperature	27°C (81°F)
Calorific value	7 kcal/hr (27 BTU/hr)
Electrical power	8 watts maximum (at 5 V dc \pm 5%)
Width	170 mm (6.7 in.)
Depth	214 mm (8.4 in.)
Height	25 mm (1 in.)

Replacement Part Numbers

Replacement part numbers for the ATM UFCs are shown in Table 1-3.

Table 1-3. Field Replacement Unit (FRU) Part Numbers

ATM UFC	FRU Part Number
Token Ring	86H2766
Ethernet	41H6992

Chapter 2. Planning and Installation Preparations

To use the LAN switch with an ATM UFC, you need the following components in your network:

- ATM switch
- LAN Emulation Configuration Server (LECS) (optional)
- LAN Emulation Server (LES)
- Broadcast and Unknown Server (BUS)
- Other LECs

The ATM UFC's LECs will join an ATM-based ELAN as a proxy LEC — supporting the LAN switch's downstream legacy LAN. To prepare your ELAN, your ATM switch, LECS, and LES may need to be specially configured to accommodate an ATM-UFC (or any other new) LEC. Refer to the planning and installation guides associated with these other ELAN components to determine whether a special configuration is necessary.

LAN Switch Requirement

You might need to update your base switch microcode to support the UFC before you configure the UFC port. To ensure that your base switch microcode supports the ATM UFC, complete the procedure on page 4-1 to download the level 3.0 main image of the base switch microcode.

Planning the Cabling

The 155-Mbps ATM connection is made using 62.5/125-micron multimode optical fiber, terminated with a subscriber connector (SC). (The SC is an industry-standard connector.) This meets the specifications in TIA/EIA/ANSI 568A. The maximum length is 2 km (1.24 miles). Refer to your LAN switch base manual for cabling information for other LAN ports.

You can order multimode fiber cables through your marketing representative. Orders can be placed through IBM Optical Link Products, Endicott, New York, at 1 800 426-6786.

The following table lists the types of optical fiber cable sold by IBM, and their part numbers.

Description	Part Number
MIC to SC, Cable ASM, 2-meter fiber	19G6707
MIC to SC, Cable ASM, 4-meter fiber	19G4797
MIC to SC, Cable ASM, 6-meter fiber	19G4798
MIC to SC, Cable ASM, 10-meter fiber	19G4799
MIC to SC, Cable ASM, 20-meter fiber	19G4800
MIC to SC, Cable ASM, 40-meter fiber	19G4801
MIC to SC, Cable ASM, custom lengths	19G4796
ST to SC, Cable ASM, 2-meter Fiber	19G6708
ST to SC, Cable ASM, 4-meter fiber	19G4817
ST to SC, Cable ASM, 6-meter fiber	19G4818
ST to SC, Cable ASM, 10-meter fiber	19G4819
ST to SC, Cable ASM, 20-meter fiber	19G4820
ST to SC, Cable ASM, 40-meter fiber	19G4821
ST to SC, Cable ASM, custom lengths	19G4816
SC to SC, Cable ASM, 2-meter fiber	19G6706
SC to SC, Cable ASM, 4-meter fiber	19G4864
SC to SC, Cable ASM, 6-meter fiber	19G4865
SC to SC, Cable ASM, 10-meter fiber	19G4866
SC to SC, Cable ASM, 20-meter fiber	19G4867
SC to SC, Cable ASM, 40-meter fiber	19G4868
SC to SC, Cable ASM, custom lengths	19G4863

Configuration Options

There are three configuration options available: no configuration, quick configuration, and advanced configuration.

No Configuration

The ATM UFC will automatically assign one LEC to the Default domain on the base switch. This LEC will have the following default parameters:

Domain Name	default
ELAN Name	<no ELAN name defined>
LES Address	Get from LECS (Automatic)
LEC End System Identifier (ESI)	<universally administered MAC address>

For this default configuration to work in your ATM network, you must:

1. Have an LECS implemented.
2. The LECS must be configured to accept JOIN requests from LECs that have no ELAN Name defined (NULL), and that match the LAN Type of the base switch (Token Ring or Ethernet).

Otherwise, you must configure the ATM UFC.

Quick Configuration

Because the ATM Forum has standardized parameter defaults, in most environments, you can use Quick Configure exclusively to configure LECs. Quick Configure accepts the default values for all the LEC connection parameters except Domain Name, ELAN Name, LES Address, and LEC ESI. Chapter 4, "Configuring the ATM UFC" describes how to set these parameter values.

Advanced Configuration

In customized LANE environments in which an LECS, LES, and BUS have been configured in non-standard ways, Advanced Configuration might be necessary. You need to consider the information in your LECS, LES, and BUS publications before choosing values for the Advanced Configuration parameters. See Appendix B, "Advanced Configuration of a LEC" for descriptions of these parameters and how to set them using the Console.

Base Switch Enhancements for an ATM UFC

No matter which configuration option you use (including No Configuration), there are parameters on your base switch whose values apply to an ATM UFC. These parameters are:

Table 2-1. Quick Configuration

Ethernet	Token-Ring	Explanation
Virtual Switch Configuration	Domain Configuration	LECs are assigned to virtual switch domains to provide connectivity from the switch to the ATM network.
Spanning Tree	Transparent Bridge Spanning Tree	If two ATM UFCs are installed, and two LECs are assigned to the same domain, Spanning Tree parameter values are used to determine which LEC forwards traffic and which blocks traffic.
Broadcast Suppression	N/A	Broadcast suppression can be used to control broadcast storms for the ATM physical port. Broadcast suppression cannot be defined on a LEC-by-LEC basis.

Notes:

1. See your base switch manual for more information about these features, and how to configure the associated parameters.
2. On base switch configuration panels, the LECs are identified by the LEC index (for example, 201 refers to slot 2, LEC 1). The ATM physical port follows the normal convention for UFC port numbering (for example, 2-1 refers to slot 2, port 1).

Chapter 3. Installing the ATM UFC

Package Contents

Along with this manual, your UFC package should contain:

- One UFC
- Two diskettes:
 - IBM 827x Microcode and SNMP MIB Release 3.0,
 - IBM ATM 155-Mbps Universal Feature Card Microcode and SNMP MIB Release 1.0
- Safety manual

If any item is missing or damaged, contact your place of purchase.

You might need to update your base switch microcode to support the UFC before you configure the UFC port. To ensure that your base switch microcode supports the ATM UFC, complete the procedure on page 4-1 to download the level 3.0 main image of the base switch microcode.

Note: Before using this information and the product it supports, be sure to read the general information under C-1.

Installation

Follow these steps to install a UFC:

- 1** You must power OFF the base machine. Unplug the power cord.
Attention: UFCs are not hot-pluggable. If you do not disconnect power from the base switch before removing or installing a UFC, you might damage the UFC or the base machine.
- 2** Remove the plate covering the UFC slot on the front of the base machine by removing the two thumbscrews holding it in place. Keep the plate and thumbscrews for use in the event that the UFC is removed.
- 3** Insert the card into the rails on each side of the UFC slot carefully and slide the card back until the connector on the card is seated in the connector at the back of the slot.

When the card is fully seated, the UFC faceplate will rest against the front of the base machine.
- 4** Secure the card with the two thumbscrews attached to it.

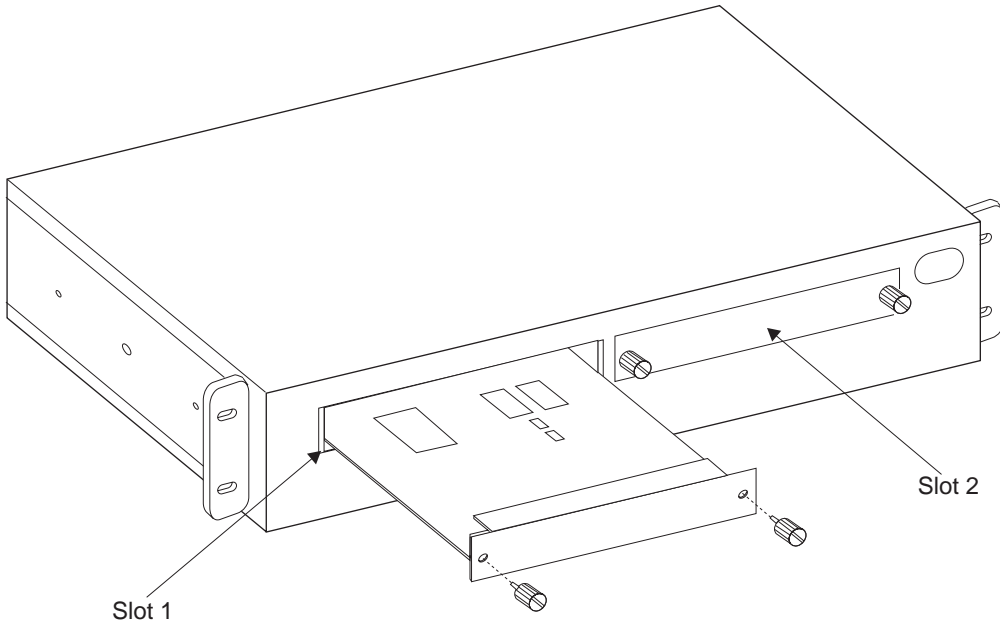


Figure 3-1. Installing a UFC in an 827x Model 216

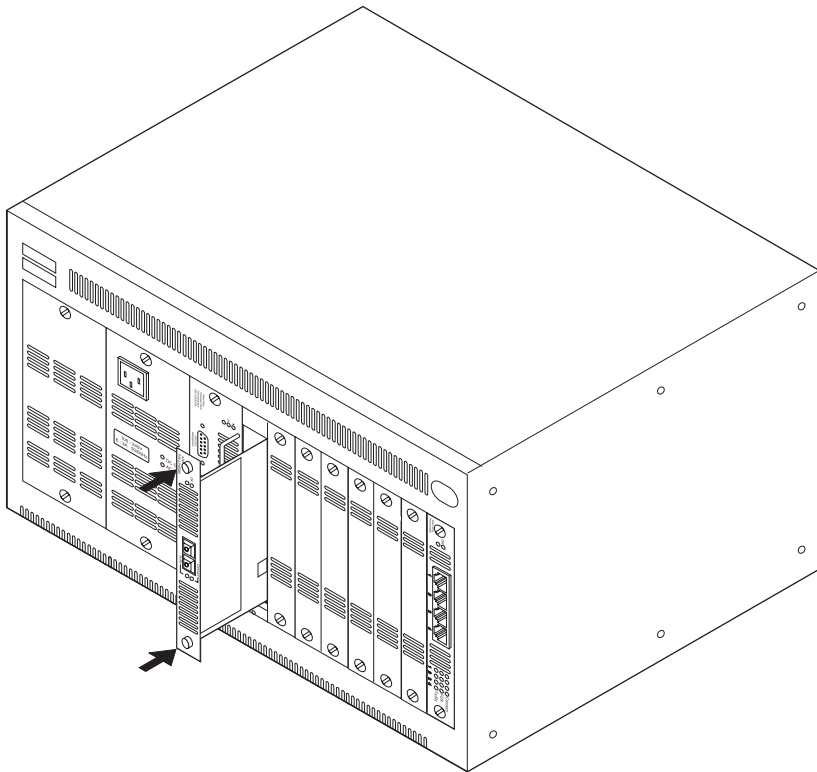


Figure 3-2. Installing a UFC in the 8270 Nways LAN Switch Model 800

Note: In the IBM 8270 Model 800, it is recommended that you install the UFC in slot 1.

Cabling

- 1** Using the Cabling Chart provided by your network administrator as a guide, connect the cable between the UFC and another device.
- 2** Label each end of the cable so that it will be easy to find the connected devices if you have to troubleshoot a network problem. You should also put the information in the Cable Destination area of the Service Information Card. Your cable label should include the following information:
 - The room location of the connected device
 - A unique cable identification number
 - The port number to which the cable is attached

Cabling Tips

Remember these tips when connecting cables:

- Make sure that you are using appropriate cable types and lengths.
- Avoid stretching or bending the cables excessively.
- Avoid trip hazards by routing the cables away from aisles and other areas where people walk. If such routes cannot be avoided, use floor cable covers or similar material to secure and protect the cables.
- Be sure that the cables connected to the UFC are supported so that the cable connectors are not excessively strained.

Testing the UFC

This section provides instructions for verifying operation of the UFC. See Table 3-1 on page 3-4 and Table 3-2 on page 3-4 for information about the LEDs.

- 1** Power ON the base machine (plug in the power cord or cords) so that diagnostics start. The LAN switch indicates that diagnostics are in progress by blinking the Fault and OK LEDs in unison. About 1 minute after power-on, the UFC Fault and OK LEDs will also blink in unison.
- 2** Verify that the base machine diagnostics have been completed successfully. This is indicated when the Fault and OK LEDs on the base box stop blinking and the OK LED stays on. Diagnostics can take up to 7 minutes to complete. If the base machine does not complete diagnostics successfully, use the troubleshooting procedures in the base machine documentation.
- 3** Verify that the Fault LED on the UFC is OFF. If it is OFF, continue with Chapter 4, “Configuring the ATM UFC.” If the UFC Fault LED is ON, power OFF the base machine, verify that the UFC has been correctly seated in the slot, and power ON the base machine.
- 4** If the UFC Fault LED remains on again, you might need a microcode update. See “Check Base Switch Microcode Level” on page 4-1. If you determine that you do not need new microcode, see Chapter 6, “Troubleshooting”.

Table 3-1. UFC Status LEDs and Their Meanings

LED	Position	State	Meaning
OK (green)	Top	On	The UFC is working correctly.
		Off	The UFC is not working correctly.
		Blinking	Diagnostics are in progress when blinking in unison with the Fault LED. Also blinks alone when downloading new code to the flash.
Fault (unlabeled) (amber)	Bottom	On	A UFC failure has occurred.
		Off	The UFC is working correctly.
		Blinking	Diagnostics are in progress when blinking in unison with the OK LED.

Table 3-2. Port Status LEDs and Their Meanings

LED	Position	State	Meaning
Connect (green)	Top	On	Optical connection OK
		Off	No optical connection
		Blinking	Administratively disabled
Activity (green)	Bottom	Blinking	Indicates activity where frequency of blinks correlates to relative traffic rates. (Note: High activity may make this LED appear solid green.)

Note: All four LEDs will be lit when the LAN switch reset button is pressed.

Chapter 4. Configuring the ATM UFC

Before You Begin

Obtain Configuration Parameters Worksheets

Your network administrator should provide you with some of the following configuration parameters worksheets:

Worksheet	For configuration procedures see
Quick Config Parameters Worksheet (required)	This chapter in this manual
Advanced Config Parameters Worksheet (optional)	Appendix B in this manual
Spanning Tree - Port (LEC) Priority and Path Cost Worksheet	Base switch manual, Chapter 4
Port Address Table Aging Worksheet (optional)	Base switch manual, Chapter 4
Broadcast Suppression Worksheet (Ethernet only) (optional)	Base switch manual, Chapter 4

Note: If the configuration parameters worksheets have not been filled out, you should be able to accomplish a simple quick configuration without worksheets using the procedure in this chapter.

Note: We recommend that you use the worksheets. Keep them for your records in case the ATM UFC needs to be reconfigured.

Establish an ATM Console Session

To change the ATM UFC parameters, you can gain access to the UFC console in any of the following ways:

- Direct console session through the EIA 232 management port
- Modem connection to the EIA 232 management port
- Telnet console session if the base switch is IP enabled

To set up a console session, refer to Chapter 4 in your base switch manual.

Check Base Switch Microcode Level

You might need to update your base switch microcode to support the UFC before you configure the UFC port. To ensure that your base switch microcode supports the ATM UFC, complete the following procedure to download the level 3.0 main image of the base switch microcode.

- 1** Start a console session using the procedure in your base machine documentation.

- 2** Go to the Switch Information panel, one of the selections on the Configuration panel (Ethernet models only) or the Statistics panel (Token-Ring models only).
- 3** Make sure that the value of the Interface Description entry for software is 9.1.0 (Revision A) or higher.
- 4** If the software level is 9.1.0 (Revision A) or higher, you do not need to update the base machine microcode.

If the software level is not 9.1.0 (Revision A) or higher, you must update the base machine microcode. To do so, see Chapter 7, “Downloading Software.”

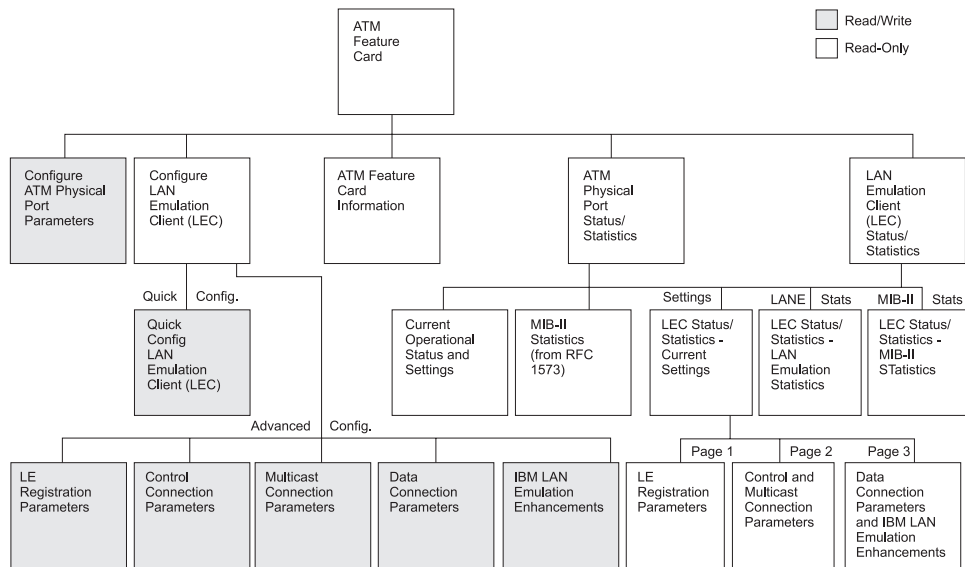


Figure 4-1. ATM UFC Menu Hierarchy

Quick Configuring the ATM UFC

Quick configuring the ATM UFC requires four steps:

- 1** Access the ATM UFC console.
 - a** Select **Special UFC Console** from the base switch main menu.
 - b** Ethernet users: Type the port number of the ATM physical port and press **Enter**.
Token-Ring users: Select the ATM UFC and press **Enter**.

```
ATM Feature Card                               Slot 1

ATM Feature Card Configuration
  Configure ATM Physical Port Parameters...

  Configure LAN Emulation Client (LEC)...

ATM Feature Card Status/Statistics
  ATM Feature Card Information...

  ATM Physical Port Status/Statistics...

  LAN Emulation Client (LEC) Status/Statistics...

Return To Previous Menu

HELP MESSAGES APPEAR HERE
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.
```

- 2** Configure the physical port parameters. See “Configuring Physical Port Parameters” on page 4-4.
- 3** Configure a LEC. Configure a LEC for each domain that you want to connect to the ATM network. See “Configuring LAN Emulation Clients” on page 4-5.
- 4** Reset the ATM UFC. The ATM physical port and any LECs configured will be reset automatically when you exit the ATM UFC console. However, you can reset them individually using the ATM UFC console.

Notes:

1. Resetting the ATM physical port will reset all LECs.
2. Resetting a LEC will also reset all of the base switch ports in the domain to which the LEC is assigned.

Configuring Physical Port Parameters

You do not need to configure the port for it to work in your network. Two physical port parameters can be changed. One is the UNI level (3.0, 3.1, or Auto-detect); the other is the Control Plane VCC Peak Rate for the port.

- 1 To change these parameters, go to the ATM UFC main menu, select **Configure ATM Physical Port Parameters...**, and press **Enter**.

Configure ATM Physical Port Parameters Slot 1

User-Network Interface (UNI) Level
Default Value: Auto-detect
Configured Value: Auto-detect

Control Plane VCC Peak Rate
Default Value: 8000 Kbps (5% of port's bandwidth)
Configured Value: 8000

Save and Return Cancel and Return Reset Port Enable Port Disable Port

For Quick Config, use the default values for UNI Level and Control Plane VCC Rate.

HELP MESSAGES APPEAR HERE
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

- 2 Configure the following parameters as necessary.

UNI Level

Auto-detect (monitors ATM traffic to determine UNI level)

UNI 3.0

UNI 3.1

The default setting is Auto-detect.

Control Plane VCC Peak Rate

Defines the maximum bandwidth available for control, signaling, and Interim Local Management Interface (ILMI) connections. The range is 0–155 000 Kbps. The default is 8000 Kbps (5% of the total ATM UFC bandwidth).

Configuring LAN Emulation Clients

- 1 To configure your LECs, go to the ATM Feature Card main menu, select **Configure LAN Emulation Client (LEC)...**, and press **Enter**.

```
Configure LAN Emulation Client (LEC) Slot 1
LEC
Index Domain Name      Domain Ports  Emulated LAN Name      Status
101  default            1 3 4 5 7 8  <no ELAN name defined> down
102  default                                     Adm. Disabled
103  default                                     Adm. Disabled
104  default                                     Adm. Disabled
105  default                                     Adm. Disabled
106  default                                     Adm. Disabled
107  default                                     Adm. Disabled
108  default                                     Adm. Disabled
109  default                                     Adm. Disabled
110  default                                     Adm. Disabled
111  default                                     Adm. Disabled
112  default                                     Adm. Disabled
113  default                                     Adm. Disabled

Return  More  Quick Config  Advanced Config  Reset  Enable  Disable

HELP MESSAGES APPEAR HERE
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.
```

- 2 Select **Quick Config** at the bottom of the **Configure LAN Emulation Client (LEC)** panel. At the prompt, type the LEC index as it appears in the table, and press **Enter**.

```
Quick Config LAN Emulation Client (LEC) Slot 1
LEC Index 101

Domain Name      default
ELAN Name        <no ELAN name defined>
LES Address      Get from LECS (Automatic)
ESI              112233445566 (universally admin)

For Quick Config, specify the Domain Name that the LEC is
assigned to, and specify the ELAN Name as it is configured on
the LE Servers. To change LEC connection parameters, or to
restore default LEC connection parameters, use Advanced Config.

Save and Return  Cancel and Return

HELP MESSAGES APPEAR HERE
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.
```

- 3 Configure the following parameters as needed.

Domain name

The LEC must be assigned to the domain that you configured on the base switch console to provide connectivity from the domain ports to the ATM network.

To assign the LEC to a domain, select **Domain Name** and press **Enter**. Then, select the desired domain name and press **Enter**.

Note: You might see an informational message that all physical ports in the old and new domains will be reset. Press **Esc** to clear the message.

ELAN Name

The name of the ATM ELAN to which the LEC will connect. The ELAN name can be up to 32 characters. No ELAN name specified is correct for certain LECS, LES, and BUS configurations.

To specify the ELAN Name, select **ELAN Name** and press **Enter**. Then, type the name at the prompt and press **Enter**. This parameter is case-sensitive.

LES address

If your ATM network implements an ATM Forum-compliant LECS, you do not need to configure the LES address (choose the default, Get From LECS- Automatic).

If your ATM network does not implement LECS, then select **LES address** and press **Enter**. Select **User-defined** and press **Enter**. Type the LES ATM address at the prompt and press **Enter**.

End System Identifier (ESI)

The ESI is the MAC address portion of the LEC's ATM address. You can use the default, universally administered MAC address as the ESI or configure a locally administered ESI. To configure the ESI, select **End System Identifier (ESI)** and press **Enter**. Select **Locally administered MAC address** and press **Enter**. Type the ESI at the prompt and press **Enter**.

When you have finished configuring the necessary parameters, select **Save and Return** and press **Enter**.

Note: You might see an informational message that the LEC must be reset for changes to take effect. Press **Esc** to clear the message.

4 Enable the LEC.

By default, all LECs except LEC 101 are administratively disabled. To enable a LEC, select **Enable** from the Configure LAN Emulation Client (LEC) panel and press **Enter**. Type the LEC index as you see it in the table, and press **Enter**. Type **Y** at the confirmation prompt and press **Enter**.

Note: You might see an informational message that the LEC you are enabling is in the same domain as another enabled LEC. Two enabled LECs on the same ATM UFC are not permitted in one domain. You can disable the other LEC, or select a new domain for this LEC. Press **Esc** to clear the message.

See Appendix B, "Advanced Configuration of a LEC" for Advanced Configuration instructions.

Chapter 5. Managing the ATM UFC

Managing the ATM UFC involves interpreting status and statistics information and changing configuration parameters when needed. Statistics gathering and reconfiguration can be accomplished in two ways: SNMP-based tools, and through the ATM UFC and base switch console.

This chapter describes the resources provided with the ATM UFC to enable SNMP management. Also, this chapter describes the statistics and information available from the ATM UFC console. Chapter 4, Appendix C, and your base switch manual describe how to change configuration parameters.

Management Using an SNMP-Based Manager

Each ATM UFC kit has a diskette containing the private MIBs necessary for managing an ATM UFC with an SNMP-based network manager, such as Nways Campus Manager LAN for AIX, Nways Manager for Windows, or Nways Campus Manager LAN for HP-UX.

Four of the five MIBs are standard MIBs. The ATM UFC SNMP agent implements some elements of each of these five MIBs, which are listed in Table 5-1 along with the Internet RFCs that define them. These standard MIBs are included with most SNMP management applications.

MIB	RFC
Management Information Base for Network Management of TCP/IP-based Internets: MIB-II	1213
Evolution of Interfaces Group of MIB-II	1573
Definitions of Managed Objects for ATM Management (aka. AToM MIB)	1695
Definitions of Managed Objects for Bridges	1493
Note: You can obtain a softcopy of an RFC through an Internet mail gateway service (ATTMAIL, MCIMAIL, CompuServe, BITNET, and so on) as follows: Address: mailserv@ds.internic.net Subject: (this field is ignored) Include in the body: DOCUMENT-BY-NAME: RFC <i>number</i> .txt where <i>number</i> is the number of the RFC you are requesting. You can also obtain RFCs from the following Internet URL: ftp://ds1.internic.net/rfc	

If your network is SNMP managed, give this diskette to the network management operator so that it can be compiled into the SNMP-based network manager.

Note: If you are using SNMP management, once you have entered the initial IP address and SNMP configuration parameters from the console, you can use either the console or an SNMP managing entity with the MIBs loaded to view or change all parameters or management information except Spanning Tree parameters.

If you are not currently using an SNMP manager, store the diskette for future use.

ATM UFC Status and Statistics

This section describes the status and statistics information accessible from the main menu.

ATM Feature Card Information		Slot 1
Description	155-Mpbs Feature Card	
Part Number	41H6988	
Serial Number	0000001	
EC Number	1.0	
FRU Number	41H6992	
Manufacturer ID	RTP	
ROM Version	1.0	
UFC S/W Version	1.0	
Base S/W Version	3.0	
Return		
HELP MESSAGES APPEAR HERE		
Use cursor keys to choose item. Press <ENTER> to confirm choice.		
Press <CTRL><N> to return to Main Menu.		

Part Number

41H6988 for Ethernet, 85H5076 for Token Ring

Serial Number

Installed at the manufacturer

EC Number

Engineering change number

FRU Number

41H6992 for Ethernet
85H6609 for Token Ring

Manufacturer ID

Installed at the manufacturer

ROM Version

Boot level (1.0)

Software Version

UFC: 1.0, Base: 3.0

Viewing Physical Port Current Operational Status and Settings

This panel includes information regarding setting up network characteristics for normal operation, finding current operational parameters, and keeping track of inventories and network topologies.

From the ATM Feature Card menu, select **ATM Physical Port Status/Statistics...** and then select **Current Operational Status and Settings....** Press **Enter**.

```
ATM Physical Port Status - Current Operational Status and Settings Slot 1

Port Status
Port Operational Status          Down
Port Administrative Status       Disabled

ATM Switch Connected to this port
IP Address of ATM Switch         0.0.0.0
ATM Network Prefix of ATM Switch 00000000000000000000000000000000

Current Values for ATM Physical Port Parameters
Base MAC Address (Base ESI)     112233445566
User-Network Interface Level    Auto Detect
Control Plane VCC Peak Rate     8000 Kbps (5% of port's bandwidth)

Return

HELP MESSAGES APPEAR HERE
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.
```

Port Operational Status

Up = port has successfully connected to the upstream ATM switch;
Down = port has not successfully connected to the upstream ATM switch.

Port Administrative Status

Enabled = administratively enabled;
Disabled = administratively disabled.

You can enable or disable the port by selecting **Configure ATM Physical Port Parameters** from the ATM UFC main menu.

IP Address of ATM Switch

IP address of the upstream ATM switch, if the ATM switch is enabled for IP.

ATM Network Prefix of ATM Switch

The 26-character (13-byte) network prefix for the upstream ATM switch.
This prefix, combined with a LECS ESI, is the LEC ATM address.

Base MAC Address (Base ESI)

The base MAC address of the ATM UFC in canonical format. All universally administered LEC ESIs (MAC addresses) are derived from this base address.

User-Network Interface Level

The current setting for UNI level.

Control Plane VCC Peak Rate

The current setting for control plane VCC peak rate. Control plane VCC peak rate is the maximum amount of bandwidth available for control, signaling, and ILMI connections.

Viewing MIB-II Statistics (from RFC 1573)

This section includes statistics listed in RFC 1573.

From the ATM Feature Card menu, select **ATM Physical Port Status/Statistics...** and then **MIB-II Statistics (from RFC 1573)...** Press **Enter**.

ATM Physical Port Statistics - MIB-II Statistics (from RFC 1573) Slot 1		
	Received or Inbound Packets	Transmitted or Outbound Packets
Total Octets (bytes)	10204036	10210200
Unicast Packets	9030105	9010301
Non-unicast Packets	932100	928041
Discarded Packets	432	221
Error Packets	72	102
Unknown Protocol Packets	408	220
Multicast Packets	4210	3819
Broadcast Packets	8910	10201
Return	Reset Statistics	

HELP MESSAGES APPEAR HERE
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

This panel represents the sum of status counters for all enabled LECs that communicate through the ATM physical port connection. A similar panel is available for each LEC individually.

Total Octets (bytes)

The total number of protocol data unit (PDU) octets (received, transmitted) on all of the VCCs associated with this emulated network interface. This includes octets from circuits that have been torn down since this LEC joined the ELAN.

Unicast Packets

The number of data packets delivered by this LEC to a higher layer, which were not addressed to a multicast or broadcast LAN destination.

Non-unicast Packets

The sum of all multicast and broadcast packets.

Discarded Packets

The number of inbound or outbound LANE PDU packets that were chosen to be discarded even though no errors had been detected, to prevent their being delivered to a higher layer protocol or to the control entity in the LEC. One possible reason for discarding such a packet could be to free

buffer space. This count also includes packets discarded for echo-suppression reasons, which might limit its utility for detecting data-loss problems.

Error Packets

The number of inbound or outbound LANE PDU packets that contained errors preventing them from being deliverable to a higher layer protocol or to the control entity in the LEC.

Unknown Protocol Packets

The number of LANE PDU packets this client received from the LAN UNI (LUNI) that were discarded because of an unknown or unsupported LAN Emulation Control, IEEE 802.3, Ethernet or IEEE 802.5 protocol.

Multicast Packets

The total number of data packets that higher-level protocols asked the LEC to transmit, and which were addressed to a multicast LAN Destination, including those that were discarded or not sent. This includes both Group and Functional MAC addresses.

Broadcast Packets

The total number of data packets that higher-level protocols asked the LEC to transmit, and which were addressed to the broadcast MAC address, including those that were discarded or not sent.

Viewing LEC Status and Statistics

From the ATM Feature Card menu, select **LAN Emulation Client (LEC) Status/Statistics**.

LAN Emulation Client (LEC) Status/Statistics				Slot 1
LEC				
Index	Domain Name	Domain Ports	Emulated LAN Name	Status
101	default	1 3 4 5 7 8	<no ELAN name defined>	down
102	default			Adm. Disabled
103	default			Adm. Disabled
104	default			Adm. Disabled
105	default			Adm. Disabled
106	default			Adm. Disabled
107	default			Adm. Disabled
108	default			Adm. Disabled
109	default			Adm. Disabled
110	default			Adm. Disabled
111	default			Adm. Disabled
112	default			Adm. Disabled
113	default			Adm. Disabled
Return	More	Settings	LANE Stats	MIB-II Stats
HELP MESSAGES APPEAR HERE Use cursor keys to choose item. Press <ENTER> to confirm choice. Press <CTRL><N> to return to Main Menu.				

The table on this panel provides the following information for each LEC:

LEC Index

The LEC index is the logical port number for a LEC. The first number refers to the slot in the base switch that the ATM UFC is in. The second two numbers (01-32) are the LEC numbers.

Domain Name

The name of the domain to which the LEC is assigned.

Domain Ports

The base switch physical ports that are assigned to the domain.

Emulated LAN Name

The name of the ELAN that the LEC joins to provide connection to the ATM network.

Status

- up

The LEC is administratively enabled and successfully connected to the LES/BUS.

- down

The LEC is administratively enabled but has not successfully connected to the LES/BUS.

- Adm. Disabled

The LEC is administratively disabled. To enable the LEC, selecting **Configure LAN Emulation Client (LEC)** from the ATM UFC main menu.

Additional statistics are available for each LEC by selecting the items at the bottom of the table:

- More

Choose this to view additional LECs not displayed on the panel.

- Settings

Choose this and type the LEC index to display the operational status and current parameter settings for the LEC. The parameters listed on the three panels are described in Appendix B, "Advanced Configuration of a LEC."

Note: From the settings panel, you can choose to view the three pages of the LEC settings. Also, you can select **Next LEC** to see the settings for the next LEC (for example, choose **Next LEC** to display LEC 102 if you are currently viewing LEC 101).

LANE Stats

Select **LANE Stats** and then type the LEC index to view the following statistics:

LEC Status/Statistics - LAN Emulation Statistics		Slot 1
LEC Index 101		
LE Address Resolution Frames	Received	Transmitted
Total LE_ARP Requests	N/A	4
Total LE_ARP Replies	3	N/A
<hr/>		
Total Control Frames	8	7
LE Virtual Connection Failures		
Total Switched Virtual Connection (SVC) Failures		2
Return	Reset Statistics	Next LEC
<p>HELP MESSAGES APPEAR HERE Use cursor keys to choose item. Press <ENTER> to confirm choice. Press <CTRL><N> to return to Main Menu.</p>		

Total LE_ARP Requests

The number of LE_ARP requests transmitted to the LES from the LEC since last reset. LE_ARP requests are required to learn new addresses in the ATM network.

Total LE_ARP Replies

The number of replies received from the LES or from other LECs in response to LE_ARP requests since the last reset.

Total Control Frames

The total number of control frames transmitted by the LEC and received by the LEC since the last reset. Control frames include

- Configuration direct VCC frames
- Control direct VCC frames
- Control distribute VCC frames (received only)

Total Switch Virtual Connection (SVC) Failures

The number of SVCs that have failed since the last reset. These include control and data VCCs.

MIB-II Stats

Select **MIB-II Stats** and type the LEC index to view the MIB-II statistics (from RFC 1573) for an individual LEC. These statistics are described in detail in "Viewing MIB-II Statistics (from RFC 1573)" on page 5-4.

Base Switch Statistics Panel Enhancements for the ATM UFC

There are a number of enhancements to the statistics panels on your base switch to accommodate the logical ports (or LECs) of the ATM UFC. Also, there are other statistics panels that you can view for the ATM physical port. Table 5-2 and Table 5-3 identify the specific panels that contain ATM port information and what type of port information (logical or physical) is provided. Refer to your base switch documentation for instructions on how to access these panels.

Table 5-2. Ethernet Switches

Panel	Logical Port (LEC)	Physical Port
Port N Statistics	NO	YES
Master Address Table	YES	YES
Domain Address Table	YES	YES
Port N Address Table	YES	YES
Current Spanning Tree Information	NO	YES
IEEE 802.3 Statistics	YES	NO

Table 5-3. Token-Ring Switches

Panel	Logical Port (LEC)	Physical Port
Module Information	YES	NO
Port Status	YES	NO
Transparent Bridge Spanning Tree Information	NO	YES
Master Address Table	YES	YES
Master Route Descriptor Table	YES	YES
Domain Address Table	YES	YES
Domain Route Descriptor Table	YES	YES
Port N Address Table	YES	YES
Port N Route Descriptor Table	YES	YES
Port N Statistics	YES	YES

Notes:

1. On the base switch, LECs are generically referred to as logical ports. Logical ports on the base switch console use the same numbering as LECs (the LEC index). The LEC index is *xyy*, where *x* refers to the UFC slot number, and *yy* refers to the LEC number (for example, 212 is a LEC 12 on an ATM UFC in UFC slot 2)
2. The ATM physical port is numbered like any other UFC port. The ATM physical port number is *x-1*, where *x* refers to the UFC slot number (for example, 3-1 is an ATM physical port in UFC slot 3).

Understanding the Logical Port Address and Route Descriptor Tables

Most of the statistics panels mentioned in the previous tables are displayed and described in your base switch manual. However, the View_logical_port option on the Master Address, Domain Address, Master Route Descriptor, and Domain Route Descriptor tables is explained here.

Master Address Table					
MAC Address	Local Port	Logical Ports in Slot 1			
		0	1	2	3
0004AC 1AE2D3	1-1	X.			
0004AC 2AD43C	201	XX			
0004AC 2AE2F5	3-2	X.			
0004AC 3AD443	201	XX			
0004AC 4A22AF	4-4	X.			
800143 1AD43C	201	XX			
800143 2AE2D3	202	X.			
800143 5AD43C	201	XX			

Return More Search

HELP MESSAGES APPEAR HERE
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

This is an example of the layout of an address/route descriptor table for logical ports (LECs). In the first column is the MAC address (or route descriptor). In the second column is the Local Port (or port of exit) where traffic to the MAC address (or route descriptor) should go. The third column is a list of all of the logical ports (LECs) that are configured on an ATM UFC. An X indicates that the logical port is holding the MAC address (or route descriptor) in its MAC address (or route descriptor) table. You can also select the Search item below the table to search for a specific MAC address (or route descriptor).

Note: The Address and Route Descriptor tables for logical ports (LECs) will not display any information until actual traffic is forwarded on the switch.

Chapter 6. Troubleshooting

This chapter contains procedures to help you troubleshoot problems with the ATM UFC and its connections to other devices.

Obtaining Service

There are no serviceable parts on the ATM UFC. UFCs are individually replaceable, if they become defective. See "Support Information" on page 6-8 for information concerning service for the product.

Trouble Indicators

This section focuses on analyzing and responding to potential problems associated with the introduction of the ATM UFC in your network.

In general, ATM-UFC-associated problems can be detected in four different ways:

1. LAN switch ATM-UFC LED patterns
2. End-station connectivity problems
3. LAN switch console messages, status, and counters
4. SNMP traps, status, and counters

Table 6-1 on page 6-2 defines the indicators more specifically.

For general information on troubleshooting in a network with a LAN switch, refer to Chapter 6, "Troubleshooting," in your base switch book.

Responding to a Problem

Once a problem has been detected, use Table 6-2 on page 6-3 to assess how best to proceed. The table allows you to use LED, console, and SNMP information to categorize the trouble and select a troubleshooting procedure.

Use Figure 6-1 on page 6-5 to help with configuration or topology errors. If these methods fail, see “Support Information” on page 6-8 for service information.

Table 6-1. Trouble Indicators

Group	Specific area of problem
LED patterns (see Table 6-2 on page 6-3 for details)	Card LEDs (OK and Fault) Port LEDs (Connect and Activity)
Connectivity problems	Session failures and link time-outs PING/APING failures WAN and LAN protocol analyzer traces
LAN switch console (accessed via a LAN switch serial port or Telnet), see Figure 4-1 on page 4-2	UFC Configuration and Statistics submenus ATM Physical Port Status/Statistics LEC Status/Statistics Statistics submenus Port Statistics Diagnostic Test Results Message Log Information
SNMP-based information	Traps Link Down Absence of Link Up MIB objects ifOperStatus, ifIn and ifOut counts atmInterface counts lecLastFailure objects, lecSvcFailures, lecServerVccTable

Table 6-2 (Page 1 of 2). Troubleshooting Overview: Indicators, Descriptions, and Procedures

ATM UFC LEDs	ATM PORT LEDs	Alternate Trouble Indicators	Trouble Description	Troubleshooting Procedures
OK=off Fault=off	Connect=off Activity=off	1. Switch LEDs: fault (lowest) LED on or both LEDs off. 2. Console: POST failed.	Box fault	See base book, Chapter 6.
OK=blinking Fault=blinking	Connect=on Activity=on	Not an error state. Card microcode load and diagnostics are in progress.	Card load (non-error)	If after 30 seconds the LEDs do not change to another pattern, see Appendix C, "Notices and Warranty."
OK=off Fault=on	Connect=on Activity=on	No code/code loaded; not running.	Card load error	Reload the microcode. See "Check Base Switch Microcode Level" on page 4-1.
OK=off Fault=on	Connect=off Activity=off	1. UFC LEDs: fault LED on. 2. Console: ATM UFC Diagnostic Test failed.	Card fault	Replace the UFC. Unplug the base box and see Chapter 3, "Installing the ATM UFC" on page 3-1.
OK=on Fault=off	Connect=off Activity=off	UFC LEDs: OK on and Connect off.	Optical error	1. Swap cable, card, and check the remote port, one at a time. 2. If (1) fails, replace the UFC. Unplug the base box and see Chapter 3, "Installing the ATM UFC" on page 3-1.
OK=on Fault=off	Connect=on Activity=off	UFC LEDs: OK on and Connect on solid; Activity off.	ILMI error	1. Swap cable, card, and check the remote port, one at a time. 2. Check remote station's ILMI activity (if possible). 3. If (1) and (2) fail, replace the UFC. Unplug the base box and see Chapter 3, "Installing the ATM UFC" on page 3-1.
OK=on Fault=off	Connect=on Activity=blinking or solid	1. Connectivity problem. 2. Console messages, status, or counts. 3. SNMP traps, status, or counts.	Configuration or topology error	See Figure 6-1 on page 6-5.

Table 6-2 (Page 2 of 2). Troubleshooting Overview: Indicators, Descriptions, and Procedures

ATM UFC LEDs	ATM PORT LEDs	Alternate Trouble Indicators	Trouble Description	Troubleshooting Procedures
OK=blinking Fault=off	Connect=on or off Activity=on or off or blinking	Not an error state. Card microcode is being updated.	Card update (non-error)	If after 10 minutes the LEDs do not change to another pattern, replace the UFC. See Chapter 3, "Installing the ATM UFC" on page 3-1.
<p>Note: As part of the ATM UFC's normal start up procedure, it will pass through each of the above states from all LEDs off to the Activity LED blinking. This procedure takes approximately 30 seconds.</p>				

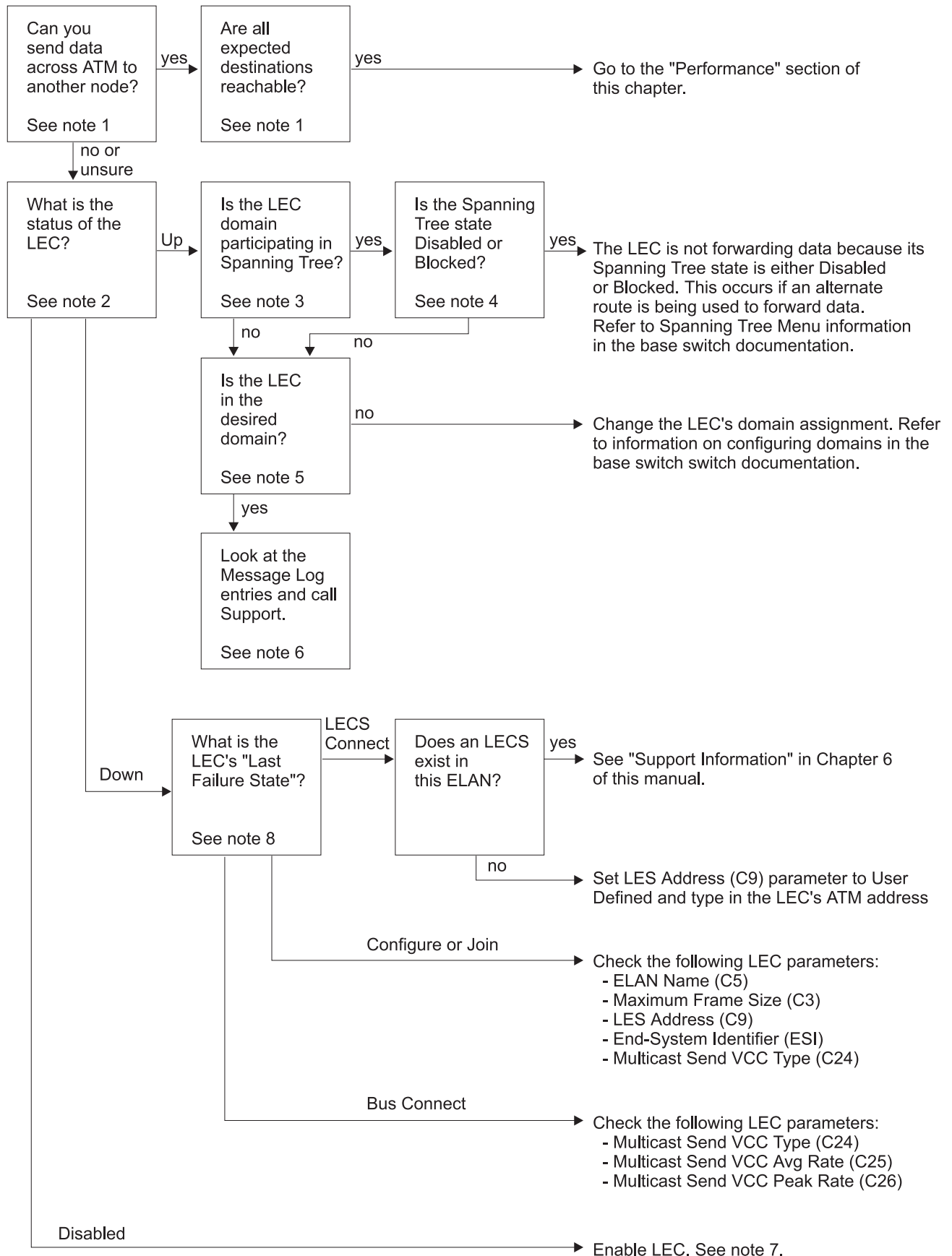


Figure 6-1. Troubleshooting Configuration or Topology Errors Using the Console or SNMP-Based Management

In the following notes, you are instructed to access various base switch and ATM configuration, status, and statistics panels through the base switch console. You should refer to the base switch documentation and this manual for details on the sequence of menus and panels that lead you to the specified panel.

Notes:

1. Validating source-to-destination connectivity

There are many applications to assess source-to-destination connectivity. The most popular include TCP/IP PING, SNA APING, and a WAN or LAN protocol analyzer.

2. Determining LEC status

A LEC can have one of three states: disabled, down, or up.

Using the LAN switch console: Access the LEC Status/Statistics panel.

The fifth column displays the LEC Status information.

Using SNMP-based management: Access LEC status by retrieving the following MIB object: RFC 1573 ifOperStatus, which has the values up (1), down (2), testing (3), unknown (4), and dormant (5).

3. Determining Spanning Tree participation

Either the entire domain is or is not participating in Spanning Tree.

Using the LAN switch console: Determine Spanning Tree participation by accessing the Spanning Tree panel.

The item called Participate in Spanning Tree can be set to Yes (Ethernet), 802.1d (Token Ring), or No.

Using SNMP-based management: Use the following switch-dependent objects:

For Ethernet, using the IBM-8271 MIB access `ibm8271eEsDmnInfoStp`, where 1=on and 2=off.

For Token Ring, using the IBM-8272 MIB access `ibm8272TsDmnStp`, where 1=on and 2=off.

4. Determining a LEC's Spanning Tree state

A LEC's Spanning Tree state can have one of the following values: Disabled (DSB), Blocked (BLK), Listening (LSN), Learning (LRN), and Forwarding (FWD).

Using the LAN switch console: Determine a LEC Spanning Tree's state by accessing the following panel:

If Ethernet, access Current Spanning Tree Information.

If Token Ring, access Transparent Bridge Spanning Tree Information.

The third column, PortSTS, displays the LEC Spanning Tree state.

Using SNMP-based management: Access a LEC Spanning Tree's state through RFC 1493's `dot1dStpPortState`, which has the values disabled (1), blocking (2), listening (3), learning (4), forwarding (5), and broken (5).

5. Determining the LEC domain

In order to forward traffic from another port, a LEC has to share the same domain as the other port.

Using the LAN switch console: Determine a LEC domain assignment by accessing the following panel:

If Ethernet, access Virtual Switch Port Configuration.

If Token Ring, access Domain Configuration.

Using SNMP-based management: Access a LEC domain assignment through:

For Ethernet, using the IBM-8271 MIB, access `ibm8271eEsDmnPortPorts`.

For Token Ring, using the IBM-8272 MIB, access `ibm8272TsDmnPorts`.

Both of these are bit-encoded fields, with the most-significant bit representing port 1 and a binary 1 indicating that the port is in this domain.

6. Accessing the Message Log

The Message Log entries contain significant events, warnings, and error information.

Using the LAN switch console: View the Message Log contents in the Message Log Information panel.

Using SNMP-based Management: Message Log information is not accessible via SNMP. Look for traps originating from the LAN switch.

7. Enabling a LEC

Using the LAN switch console: Access the Configure LAN Emulation Client (LEC) panel.

Move to the Enable action to select and enable a LEC. Note that only a certain number of LECs can be enabled at one time; thus, you might have to disable one LEC before enabling another.

Using SNMP-based management: There are two alternatives for enabling a LEC using SNMP:

Using SNMP MIB-II (RFC 1573), set `ifAdminStatus` to up (1).

For the 8271 only, using the IBM-8271-MIB, set `ibm8271eEsPortOprStatus` to enabled (1).

8. Accessing a LEC Last Failure State

The Last Failure State describes in which LEC state an error occurred. For the ATM UFC, a LEC Last Failure State can be set to `lecsConnect`, `configure`, `join`, or `busConnect`.

Using the LAN switch console: View the Last Failure State by accessing LEC_Status/Statistics panel, and then selecting the LANE_Stats action. The LastFailureState is the second-to-last variable.

Using SNMP-based management: Access a LEC Last Failure State through the ATM LAN-EMULATION-CLIENT-MIB `lecLastFailureState` object.

Performance Considerations

Most possible performance bottlenecks in a LAN-to-ATM environment (such as that which uses the LAN switch ATM UFC) are outside the ATM UFC itself and prevent the UFC from achieving the maximum throughput allowed by the physical medium. With this in mind, this section gives a structured approach for analyzing problems within the UFC's environment.

UFC-related LAN-to-ATM performance bottlenecks can usually be isolated in one of four areas:

- End-station protocols and applications
- Emulated and VLAN topology and characteristics
- LAN switch configuration
- ATM Feature Card configuration

Remember each of these areas when thinking about performance issues, since a bottleneck in one area might prevent another area from achieving its ideal throughput or latency. For instance, if you use IPX with Burst Mode set off, trying to perfect the performance related to LE_FLUSH time-outs might be misguided.

Support Information

Web Sites

For additional information about IBM LAN products and support, look at the following Web site:

<http://www.raleigh.ibm.com/829/829serv.html>

Take a look at our home page for information about a variety of IBM Networking products:

<http://www.raleigh.ibm.com>

Phone Numbers

In the United States, call 1-800-772-2227. In Canada, call 1-800-565-3344.

Chapter 7. Downloading Software

The LAN switch has intelligent processors both inside the base box and on the ATM UFC. ATM software runs on both of these processors. This chapter explains how to download software on the ATM UFC. To update base box software, see the base unit planning and installation guide.

This chapter provides information on the download procedure that sends software upgrades to the base switch flash EEPROM using TFTP, or via the serial port.

Serial Port/TFTP Downloading with the Download Menu

This section provides information on initiating the download procedure with the Download Menu.

Follow these steps to begin a software upgrade:

- 1** If you are downloading via the serial port, insert the upgrade diskette in your workstation drive. Make sure that your terminal supports Xmodem protocol.
- 2** If you are downloading via TFTP, copy the IBM binary file `afcf1ash.elf` from the disk provided to the TFTP server and prepare the TFTP server.
- 3** If you have not already done so, start a console session and advance to the Main Menu.
- 4** Select **Download** on the Main Menu.

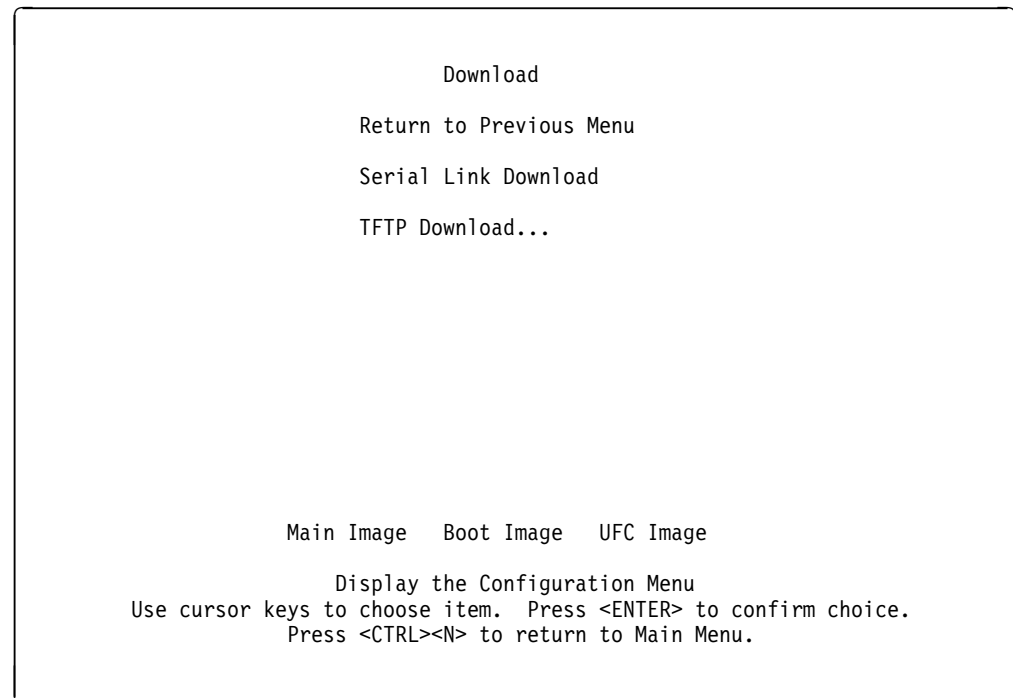


Figure 7-1. Download Menu (8271 example)

- 5** When the Download Menu appears (see Figure 7-1), select **Serial Link Download** or **TFTP Download...**
- 6** If you chose Serial Link Download, go to step 8.
- 7** If you chose TFTP Download, go to step 12.
- 8** Confirm the download when you are prompted to do so by the following message:
Please confirm new code download via serial port (Y or N):
- 9** The following messages appear:
Console: Beginning Xmodem download of UFC image
Console: Waiting for a binary image file....
- 10** Use a terminal emulator program on your PC to download the binary file using Xmodem protocol.
The download takes approximately 5 minutes at 19200 baud.
When the download is complete, the following messages appear:
Console: Beginning Xmodem download of main image
Console: Waiting for binary file.... Done
Console: Preparing Flash....Done.
Console: Saving Main Image into Flash...Done

Please confirm switch reset (Y or N):
- 11** Confirm the reset; the procedure is complete.
- 12** Select **Download Image**, then select **UFC Image** and enter the port number for the UFC when prompted. Fill in the other fields on this menu and then select **Execute Network Download**.
- 13** Confirm the download when you see the message:
Please confirm new code download via network (Y or N):

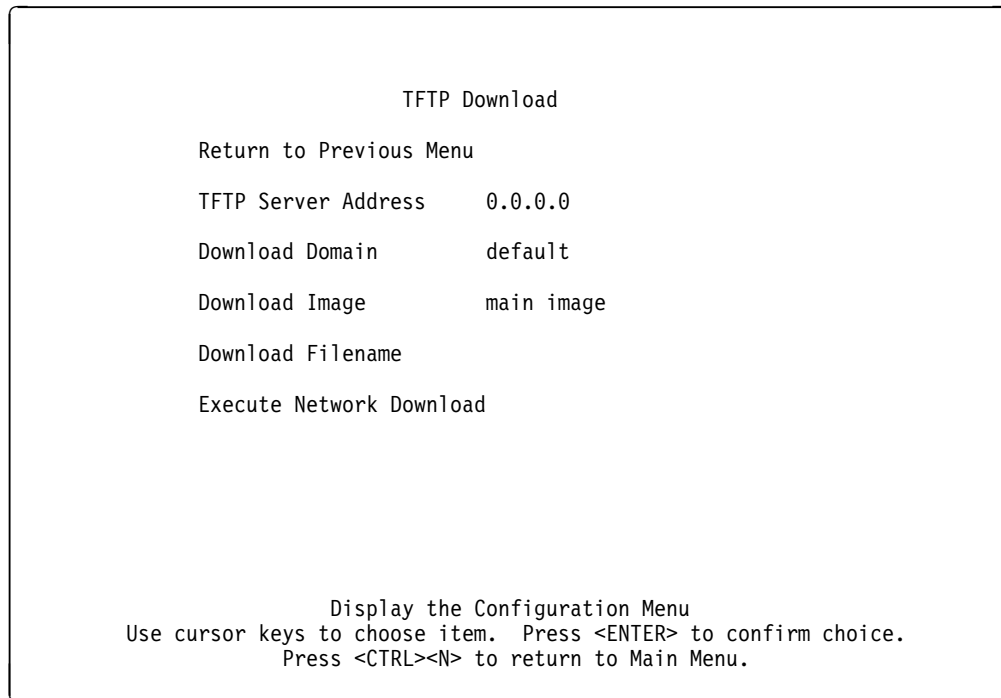


Figure 7-2. TFTP Download Menu

14 Press **Enter** when you see the message:

Network download to UFC complete. Reset ports to activate new software.
Press <Enter> to continue.....

15 Reset the port, as instructed, to activate the new code.

Additional Information

New code does not take effect when loaded onto the ATM UFC until the ATM UFC is reset.

The image transfer can be terminated before it is completed, either by pressing a key on the console or disconnecting your console connection or your TFTP connection. If you do this, however, it is very likely that the code image in the ATM UFC will be destroyed. The ATM UFC must have a code image stored in flash to become operational.

If the TFTP server which contains the ATM UFC image is on the ATM network, you can download code through the ATM adapter. This is possible even if you are loading new code onto the same ATM UFC that supports your ATM device (server). It will not be possible, however, if the code image on the ATM UFC has been completed, preventing the ATM UFC from being operational. If the latter occurs, you can still load new code onto the ATM UFC either over the console connection (serial download) or through a LAN port (TFTP download).

For both serial and TFTP download, you might experience several apparent pauses during the image file transfer for reasons not related to network congestion or file server workload. These are due to the time needed to prepare the ATM UFC flash for new code (erasing the old image) or writing the new image to flash.

Appendix A. Planning Charts

The planning charts on the following pages can be photocopied and used for planning the installation and configuration of your ATM UFC. You should fill out one table for each switch you are planning.

<i>Table A-1. Physical Port Configuration</i>	
Port	(slot) ___ - 1 (port)
UNI Level	Circle one: AUTO DETECT UNI 3.0 UNI 3.1
Control Plane VCC Peak Rate	Range: 0–155 000 Default: 8000

Quick Configuration Parameters Worksheet

<i>Table A-2. Quick Configuration of LAN Emulation Client (LEC)</i>						
LEC Index	Domain Name	ELAN Name	LES ATM Address			LEC ESI
			Network Prefix	ESI	Sel	
(3)	(16)	(32 characters)	(26 characters)	(12)	(2)	(12)
_01						
_02						
_03						
_04						
_05						
_06						
_07						
_08						

Note: The LES ATM Address fields are optional. You must specify the address if your LECS is not ATM Forum-compliant, or if you are not using a LECS. You can use the default value (from ILMI) when using an ATM Forum-compliant LECS.

Advanced Configuration Parameters Worksheet

<i>Table A-3. Advanced Configuration</i>				
Parameter	LEC _ _ _	LEC _ _ _	LEC _ _ _	LEC _ _ _
Domain Name				
ELAN Name (C5)				
Maximum Frame Size (C3)				
LES Address				
End-System Identifier (ESI)				
Control Time-Out (C7)				
Maximum LE_ARP Retry Count (C13)				
LE_ARP Entry Aging Time (C17)				
LE_ARP Entry Forward Delay Time (C18)				
Expected LE_ARP Response Time (C20)				
Maximum Unknown Frame Count (C10)				
Maximum Unknown Frame Time (C11)				
Multicast Send VCC Type (C24)				
Multicast Send VCC Avg Rate (C25)				
Multicast Send VCC Peak Rate (C26)				
Flush Response Time-Out (C21)				
Maximum Path Switching Delay (C22)				
Idle VCC Time-Out (C12)				
Connection Completion Timer (C28)				
Data Direct VCC after BUS Failure				

Note: If advanced configuration is used, you can choose not to use Table A-2 of the Quick Configuration parameters worksheet.

Spanning Tree—Port (LEC) Priority and Path Cost Worksheet

Refer to Chapter 4 of the base switch manual.

Record in the table the cost of each port.

Range: 1 to 65 535

Default: 6

Record in the table the priority for each port.

Range: 0 to 255

Default: 128

Port (LEC)	_01	_02	_03	_04	_05	_06	_07	_08
Cost:								
Priority:								

Port (LEC)	_09	_10	_11	_12	_13	_14	_15	_16
Cost:								
Priority:								

Port (LEC)	_17	_18	_19	_20	_21	_22	_23	_24
Cost:								
Priority:								

Port (LEC)	_25	_26	_27	_28	_29	_30	_31	_32
Cost:								
Priority:								

Path Cost = 1000/LAN speed in Mbps

Appendix B. Advanced Configuration of a LEC

Because the ATM Forum has standardized parameter defaults, in most environments, you can use Quick Configure exclusively to configure LECs. Quick Configure accepts the default values for all the LEC connection parameters except Domain Name, ELAN Name, LES Address, and LEC End System Identifier (ESI). Chapter 4, "Configuring the ATM UFC" describes how to set these parameter values.

Advanced Configuration

In customized LANE environments in which an LECS, LES, and BUS have been configured in non-standard ways, Advanced Configuration might be necessary. You need to consider the information in your LECS/LES/BUS publications before choosing values for the Advanced Configuration parameters.

From the main ATM Feature Card menu, select **Configure LAN Emulation Client (LEC)...**, and then select **Advanced Config** at the bottom of the panel.

```
Advanced Configuration of a LAN Emulation Client (LEC)      Slot 1
                    LEC Index 101

NOTE: Changes made to configured LEC parameters are saved to non-volatile
      RAM using the Save and Return command on the following panels.
      However, LECs must be Reset before the changes take effect.

      LE Registration Parameters...
      Control Connection Parameters...
      Multicast Connection Parameters...
      Data Connection Parameters...
      IBM LAN Emulation Enhancements...

Return

                        HELP MESSAGES APPEAR HERE
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.
```

The following list provides specific information about these advanced configuration options.

LE Registration Parameters

The LANE registration parameters define LEC information to the LES. A LEC must register all LAN destinations for which it is responsible, or join as a proxy to other MAC addresses.

Control Connection Parameters

These parameters apply to Control VCCs, which link LECs to LECSs, and carry control frames and LE_ARP traffic.

Multicast Connection Parameters

These parameters determine connections for sending data to the BUS and for distributing data from the BUS. The LEC must maintain these connections in order to participate in the ELAN.

Data Connection Parameters

These connections carry data frames and refer to the connection of LECs to each other and to the BUSs.

IBM LAN Emulation Enhancements

Provides for data direct VCC after BUS failure.

LAN Emulation Registration Parameters

```
Advanced Configuration of a LEC - LE Registration Parameters      Slot 1
                          LEC Index 101

Domain Name                default
ELAN Name (C5)             <no ELAN name defined>
Maximum Frame Size (C3)    1516
LES Address (C9)           Get from LECS (Automatic)
End-System Identifier (ESI) 112233445566 (universally administered)

Save and Return    Cancel and Return

NOTE: The "(Cxx)" notation above is an ATM Forum LEC variable designation.

                          HELP MESSAGES APPEAR HERE
                          Use cursor keys to choose item. Press <ENTER> to confirm choice.
                          Press <CTRL><N> to return to Main Menu.
```

Domain Name

Refers to the name assigned to each LEC.

Emulated LAN Name

Refers to the name of the ELAN to which the LEC belongs. The name is automatically provided when the LEC connects with the ELAN.

Maximum Frame Size

The maximum frame size the LEC will send or receive on the Multicast VCC or Multicast Forward VCC. This parameter must be set to either 1516 or 4544 (Token Ring only) octets. Do not change this parameter without terminating the LEC and returning it to its original configuration. The default value is 1516 octets.

LES Address

ATM address for the LES that is assigned to the LEC. This address is determined when the LEC starts up.

End-System Identifier (ESI)

The ESI is the MAC address portion of the LEC's ATM address. You can use the default, universally administered MAC address as the ESI or

configure a locally administered ESI. To configure the ESI, select **End System Identifier (ESI)** and press **Enter**. Select **Locally administered MAC address** and press **Enter**. Type the ESI at the prompt and press **Enter**.

LEC Control Connection Advanced Parameters

Advanced Configuration of a LEC - Control Connection Parameters Slot 1 LEC Index 101		
Control Connection Parameter	Current Value	Default Value
Control Timeout (C7)	120	120 sec.
Maximum LE_ARP Retry Count (C13)	1	1 retry
LE_ARP Entry Aging Time (C17)	300	300 sec.
LE_ARP Entry Forward Delay Time (C18)	15	15 sec.
Expected LE_ARP Response Time (C20)	1	1 sec.

Save and Return Cancel and Return Restore Defaults

NOTE: The "(Cxx)" notation above is an ATM Forum LEC variable designation.

HELP MESSAGES APPEAR HERE
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

Control Timeout

This parameter determines the time period for most request/response control frame interactions.

Minimum=10 seconds
Maximum=300 seconds
Default=120 seconds

Maximum LE_ARP Retry Count (C13)

A LEC must not retry an LE_ARP_REQUEST for a given frame's LAN destination more than Maximum Retry Count times, after the first LE_ARP_REQUEST for the same frame's LAN destination.

Minimum=0
Maximum=2
Default=1

LE_ARP Entry Aging Time (C17)

The maximum time that a LEC will maintain an entry for a local MAC address in its LE_ARP cache.

Minimum=10 seconds
Maximum=300 seconds
Default=300 seconds

LE_ARP Entry Forward Delay Time (C18)

The maximum time that a LEC will maintain an entry for a non-local MAC address in its LE-ARP cache.

Minimum=4 seconds
Maximum=30 seconds
Default=15 seconds

Expected LE_ARP Response Time (C20)

The maximum time that the LEC expects a LE_ARP_REQUEST or LE_ARP_RESPONSE cycle to take. This parameter is used for retries and verifies.

Minimum=1 second
Maximum=30 seconds
Default=1 second

LEC Advanced Multicast Connection Parameters

Advanced Configuration of a LEC - Multicast Connection Parameters Slot 1
LEC Index 101

Multicast Connection Parameters	Current Value	Default Value
Maximum Unknown Frame Count (C10)	1	1 frame
Maximum Unknown Frame Time (C11)	1	1 sec.
Multicast Send VCC Type (C24)	Best Effort	Best Effort
Multicast Send VCC Avg Rate (C25)	5000	5000 cps
Multicast Send VCC Peak Rate (C26)	25000	25000 cps

Save and Return Cancel and Return Restore Defaults

NOTE: The "(Cxx)" notation above is an ATM Forum LEC variable designation.

HELP MESSAGES APPEAR HERE
Use cursor keys to choose item. Press <ENTER> to confirm choice.
Press <CTRL><N> to return to Main Menu.

Maximum Unknown Frame Count (C10)

See the definition for *Maximum Unknown Frame Time*.

Minimum=1
Maximum=10
Default=1

Maximum Unknown Frame Time (C11)

Within the period of time defined by the Maximum Unknown Frame Time, a LEC will send no more than Maximum Unknown Frame Count frames to the BUS for a given unicast LAN Destination.

Minimum=1 second
Maximum=60 seconds
Default=1 second

Multicast Send VCC Type (C24)

The signaling parameter that should be used by the LEC when establishing a Multicast Send VCC. This is the method to be used by the

LEC when specifying traffic parameters when it sets up the Multicast Send VCC for this ELAN.

Generally, this parameter must be set to whatever the BUS supports. If the BUS supports more than one option, then selecting VBR or CBR instead of Best Effort might improve performance with regard to the guaranteed forwarding of broadcast frames and frames whose destinations are unknown.

Multicast Send VCC Avg Rate (C25)

Signaling parameter that should be used by the LEC when establishing the Multicast Send VCC. Forward and Backward Sustained Cell Rate to be requested by LEC when setting up Multicast Send VCC, if using VBR codings.

Multicast Send VCC Peak Rate (C26)

Signaling parameter that should be used by the LEC when establishing the Multicast Send VCC. Forward and Backward Peak Cell Rate to be requested by the LEC when setting up the Multicast Send VCC when using either VBR or CBR.

LEC Advanced Data Connection Parameters

Advanced Configuration of a LEC - Data Connection Parameters		Slot 1
LEC Index 101		
Path Switching Parameters	Current Value	Default Value
Flush Response Timeout (C21)	4	4 sec.
Maximum Path Switching Delay (C22)	6	6 sec.
Data Direct VCC (DD_VCC) Parameters		
Idle VCC Timeout (C12)	1200	1200 sec.
Connection Completion Timer (C28)	4	4 sec.
Save and Return	Cancel and Return	Restore Defaults
NOTE: The "(Cxx)" notation above is an ATM Forum LEC variable designation.		
HELP MESSAGES APPEAR HERE		
Use cursor keys to choose item. Press <ENTER> to confirm choice.		
Press <CTRL><N> to return to Main Menu.		

Flush Response Timeout (C21)

The time limit to wait to receive an LE_FLUSH_RESPONSE after the LE_FLUSH_REQUEST has been sent before taking recovery action.

Minimum=1 second
 Maximum=4 seconds
 Default=4 seconds.

Maximum Path Switching Delay (C22)

The time since sending a frame to the BUS after which the LEC can assume that the frame has been either discarded or delivered to the recipient. This may be used to bypass the Flush protocol.

Maximum=1 second
Minimum=8 seconds
Default=6 seconds.

Idle VCC Timeout (C12)

This value is the VCC inactivity timer; that is, after this period of time expires, if the VCC has not had activity on it, the VCC is torn down. The range of values is 0 minutes to unlimited time, with a default of 20 minutes. In practice, many users will find that 20 minutes is excessive and uses up more VCCs than necessary, potentially exhausting the VCC-related resources of either their LAN switch ATM UFC or the attached ATM switch. For this reason, for environments where a large number of VCCs are used (that is, hundreds of ATM-attached destinations will be communicated with), it is recommended that this value be set to between 1 and 10 minutes.

Nonetheless, one must be sensitive to the environment. If a quick setup time (the amount of time needed to establish a VCC) is more critical than freeing little-used VCCs, then defining this value at 20 minutes or more might be necessary.

A LEC should release any Data Direct VCC that has not been used to transmit or receive any data frames for the length of the VCC Time-out Period. This parameter is meaningful for only SVC Data Direct VCCs.

Maximum=Unlimited
Minimum=Unspecified
Default=20 minutes

Connection Completion Timer (C28)

In Connection Establishment this is the time period in which data or a READY_IND message is expected from a Calling Party.

Minimum=1 second
Maximum=10 seconds
Default=4 seconds

LEC Advanced LAN Emulation Enhancements

Advanced Configuration of a LEC - LAN Emulation Enhancements		Slot 1
LEC Index 101		
LAN Emulation Enhancements	Current Value	Default Value
Data Direct VCC Keep Alive Timeout	4 sec	34 sec
Save and Return	Cancel and Return	Restore Defaults
HELP MESSAGES APPEAR HERE		
Use cursor keys to choose item. Press <ENTER> to confirm choice.		
Press <CTRL><N> to return to Main Menu.		

The Data Direct VCC Keep Alive Timeout allows a user to specify the length of time that the ATM feature will maintain its data direct VCCs to other LAN emulation clients after it detected that the LES/BUS is no longer available. This IBM enhancement allows transmission of traffic to stations that were previously learned to continue during temporary disruption of the LES/BUS connection.

The ATM Forum specifies that data direct VCCs should be taken down immediately when the LES/BUS connection becomes unavailable. To be 100% ATM Forum compliant, specify zero seconds for this timeout. If your network contains alternate paths, the timeout must be set small enough to avoid loops. A rule-of-thumb is to set the timeout smaller than the Spanning Tree Maximum Age parameter.

The ATM UFC is primarily managed using SNMP. The standard bridge, LAN media, and emerging ATM MIBs are supported. Any TCP/IP-based communication with the ATM UFC needs to be in the context of LAN Emulation, rather than RFC 1577, Classical IP over ATM.

Appendix C. Notices and Warranty

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Verantwortlich für die Konformitätserklärung nach Paragraph 5 des EMVG ist die IBM Deutschland Informationssysteme GmbH, 70548 Stuttgart.

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Warranty

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Warranty Period*: One Year

**Contact your place of purchase for warranty service information.*

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List of Abbreviations

APING	APPN Ping	NetBIOS	Network Basic Input/Output System
ARP	Address Resolution Protocol	OC3	Optical Carrier 3
ASM	assembly	PAD	Packet Assembler and Disassembler
ATM	Asynchronous Transfer Mode	PDU	Protocol Data Unit
BTU	British Thermal Unit	PING	Packet Internet Groper
BUS	Broadcast and Unknown Server	QoS	Quality of Service
CBR	Constant Bit Rate	RFC	Request for Comments
EC	Engineering Change	RMON	Remote Monitor
EEPROM	Electrically Erasable Programmable Read-Only Memory	ROM	Read-Only Memory
ELAN	Emulated Local Area Network	SC	subscriber connector
ESI	End System Identifier	SDH	Synchronous Digital Hierarchy
FE	Forwarding Engine	SEL	selector byte
FRU	Field-Replaceable Unit	SNA	Systems Network Architecture
ID	identifier	SNMP	Simple Network Management Protocol
ILMI	Interim Local Management Interface	SONET	Synchronous Optical Network
IP	Internet Protocol	SRT	Source-Route Transparent
IPX	Internet Packet Exchange	SRTB	Source-Route Transparent Bridging
LAN	Local Area Network	STM-1	Synchronous Transport Module 1
LANE	LAN Emulation (ATM Forum LAN Emulation)	STS	Synchronous Transfer Signals
LEC	LAN Emulation Client	SVN	Switched Virtual Network
LECS	LAN Emulation Configuration Server	TCP/IP	Transmission Control Protocol/Internet Protocol
LED	Light-Emitting Diode	TFTP	Trivial File Transfer Protocol
LES	LAN Emulation Server	UBR	Unspecified Bit Rate
LLC	Logical Link Control	UDP	User Datagram Protocol
MAC	Medium Access Control	UFC	Universal Feature Card
MIB	Management Information Base	UNI	User-Network Interface
MIC	media interface connector	VBR	Variable Bit Rate
MPOA	MultiProtocol over ATM	VCC	Virtual Channel Connection
MSS	Multiprotocol Switched Services	VLAN	Virtual Local Area Network
MTU	Maximum Transmission Unit	WAN	Wide Area Network

Glossary

This glossary includes terms and definitions from the *IBM Dictionary of Computing* (New York; McGraw-Hill, Inc., 1994).

- The symbol (A) identifies definitions from the *American National Standard Dictionary for Information Systems*, ANSI X3.172-1990, copyright 1990 by the American National Standards Institute (ANSI). Copies can be purchased from the American National Standards Institute, 1430 Broadway, New York, New York 10018.
- The symbol (E) identifies definitions from the ANSI/EIA Standard-440-A, *Fiber Optic Terminology*.
- The symbol (I) identifies definitions from published parts of 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).

- The symbol (T) identifies definitions from draft international standards, committee drafts, and working papers being developed by ISO/IEC JTC1/SC1.

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 was defined in its correct 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 related terms that have a related, but not synonymous, meaning.

A

active. (1) Able to communicate on the network. (2) Operational. (3) Pertaining to a node or device that is connected or is available for connection to another node or device. (4) Currently transmitting or receiving.

adapter. In a communicating device, a circuit card that, with its associated software and/or microcode, enables the device to communicate over the network.

address. (1) A character or group of characters that identifies a register, a particular part of storage, or some other data source or destination. (A) (2) To refer to a device or an item of data by its address. (I) (A) (3) In word processing, the location, identified by an address code, of a specific section of the recording medium or storage. (T) (4) A name, label, or number identifying a location in storage, a device in a system or network, or any other data source. (5) In data communication, the unique code assigned to each device or workstation connected to a network.

address resolution. A method for mapping network layer addresses onto media-specific addresses. See *Address Resolution Protocol (ARP)*.

Address Resolution Protocol (ARP). A protocol that dynamically maps between Internet addresses, baseband adapter addresses, X.25 addresses, and token-ring adapter addresses on a local area network.

AIX operating system. IBM's implementation of the UNIX operating system. The RS/6000 system, among others, runs the AIX operating system. See *UNIX operating system*.

ARP. Address Resolution Protocol.

Asynchronous. Pertaining to two or more processes that do not depend upon the occurrence of a specific event such as a common timing signal. (T)

B

backbone. (1) In a local area network multiple-bridge ring configuration, a high-speed link to which the rings are connected by means of bridges or routers. A backbone can 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.

bandwidth. (1) The difference, expressed in hertz, between the highest and the lowest frequencies of a range of frequencies. For example, analog transmission by recognizable voice telephone requires a bandwidth of about 3000 hertz (3 kHz). (2) 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 Input/Output System (BIOS). Code that controls basic hardware operations, such as interactions with diskette drives, hard disk drives, and the keyboard.

baud. (1) A unit of signaling speed equal to the number of discrete conditions or signal events per second; for example, one baud equals one-half dot cycle per second in Morse code, one bit per second in a train of binary signals, and one 3-bit value per second in a train of signals each of which can assume one of eight different states. (A) (2) 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)

best-effort delivery. Unreliable connectionless delivery of datagrams in a network. Reliability at link levels is not provided.

BIOS. Basic Input/Output System.

broadband local area network (LAN). A local area network (LAN) in which information is encoded, multiplexed, and transmitted through modulation of carriers. (T)

broadcast. (1) Transmission of the same data to all destinations. (T) (2) Simultaneous transmission of the same data to more than one destination. (3) A packet delivery system where a copy of a given packet is given to all hosts attached to the network. Broadcast can be implemented in hardware (Ethernet, for example) or software. Contrast with *multicast*.

buffer. (1) A portion of storage used to hold input or output data temporarily. (2) A routine or storage used to compensate for a difference in data rate or time of occurrence of events, when transferring data from one device to another. (A)

C

cable segment. A section of cable between components or devices on a network. A segment can consist of a single patch cable, multiple patch cables connected together, or a combination of building cable and patch cables connected together. See *LAN segment, ring segment*.

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. (3) The task of defining the hardware and software characteristics of a system or subsystem. (4) See also *system configuration*.

configuration management. The monitoring and control of information required to identify physical and logical network resources, their states, and their interdependencies. Services include customization, network resource inventory, and assistance to other network management disciplines.

configuration parameters. Variables in a configuration definition, the values of which characterize the relationship of a product, such as a bridge, to other products in the same network.

congestion. See *network congestion*.

D

data transfer rate. The average number of bits, characters, or blocks, per unit time passing between corresponding equipment in a data transmission system. (I) See *actual data transfer rate*, *effective transfer rate*. The rate is expressed in bits, characters, or blocks per second, minute, or hour.

default. Pertaining to an attribute, value, or option that is assumed when none is explicitly specified. (I)

default value. A value assumed when no value has been specified.

destination. Any point or location, such as a node, station, or particular terminal, to which information is to be sent.

destination address. A field in the medium access control (MAC) frame that identifies the physical location to which information is to be sent. Contrast with *source address*.

device identifier (ID). An 8-bit identifier that uniquely identifies a physical I/O device.

diagnostics. The process of investigating the cause or the nature of a condition or problem in a product or system.

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. (3) Nonoperational or nonfunctional.

domain. (1) That part of a computer network in which the data processing resources are under common control. (T) (2) In the Internet, a part of a naming hierarchy in which the domain name consists of a sequence of names (labels) separated by periods

(dots). (3) In OSI, an administrative partition of a complex distributed system.

DOS. Disk Operating System.

E

error. A discrepancy between a computed, observed, or measured value or condition and the true, specified, or theoretically correct value or condition. (I) (A) Contrast with *failure* and *fault*.

Ethernet. (1) 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 collision detection and transmission. Ethernet uses carrier sense multiple access with collision detection (CSMA/CD). (2) A passive coaxial cable whose interconnections contain devices or components, or both, that are all active. It uses CSMA/CD technology to provide a best-effort delivery system.

F

failure. (1) The termination of the ability of a functional unit to perform its required function. (I) (A) (2) An uncorrected hardware error. Failures are either recoverable or not recoverable by the software or the operator. The operator is always notified when failures occur. Contrast with *error*.

fault. An accidental condition that causes a functional unit to fail to perform its required function. (I) (A)

field. On a data medium or a storage, a specified area used for a particular class of data; for example, a group of character positions used to enter or display wage rates on a screen. (T)

File Transfer Protocol (FTP). The Internet protocol (and program) used to transfer files between hosts. It is an application layer protocol in TCP/IP that uses Telnet and TCP protocols to transfer bulk-data files between machines or hosts.

forward. A switch feature that temporarily redirects incoming calls. The incoming calls are redirected from the originally dialed phoneset to another destination. The other destination has previously been defined to the switch by the party associated with the phoneset.

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. Synonymous with *schema*. (T) (2) A

data structure that consists of fields, predetermined by a protocol, for the transmission of user data and control data. The composition of a frame, especially the number and types of fields, may vary according to the type of protocol. Synonymous with *transmission frame*. (T) (3) The unit of transmission in some local area networks, including the IBM Token-Ring Network; it includes delimiters, control characters, information, and checking characters. (4) In SDLC, the vehicle for every command, every response, and all information that is transmitted using SDLC procedures. (5) A packet that is transmitted over a serial line or LANs. See also *packet*.

FTP. File Transfer Protocol.

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.

I

IBM Disk Operating System (DOS). A disk operating system based on MS-DOS** that operates with all IBM-compatible personal computers.

identifier (ID). (1) One or more characters used to identify or name a data element and possibly to indicate certain properties of that data element. (A) (2) A sequence of bits or characters that identifies a program, device, or system to another program, device, or system.

IEEE. Institute of Electrical and Electronics Engineers.

IETF. Internet Engineering Task Force.

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.

Internet Engineering Task Force (IETF). One of the task forces of the Internet Architecture Board (IAB) responsible for solving short-term engineering needs of the Internet.

Internet Packet Exchange (IPX). The routing protocol used to connect Novell's servers or any workstation or router that implements IPX with other workstations.

Although similar to TCP/IP, it uses different packet formats and terminology. See also *TCP/IP* and *Xerox Network Services (XNS)*.

Internet Protocol (IP). (1) A protocol that routes data through a network or interconnected networks. IP acts as an interface between the higher logical layers and the physical network. However, this protocol does not provide error recovery, flow control, or guarantee the reliability of the physical network. IP is a connectionless protocol. (2) A protocol used to route data from its source to its destination in an Internet environment.

IP. Internet Protocol.

IP address. A 32-bit address assigned to devices or hosts in an IP internet that maps to a physical address. The IP address is composed of a network and host portion.

IPX. Internet Packet Exchange.

L

latency. The time interval between the instant at which an instruction control unit initiates a call for data and the instant at which the actual transfer of data begins. Synonymous with *waiting time*. (T) See also *ring latency*.

local. Pertaining to a device accessed directly without use of a telecommunication line. Synonym for *channel-attached*. Contrast with *remote*.

logical link control (LLC). (1) The data link control (DLC) LAN sublayer that provides two types of (DLC) operation. 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 the establishment of a link prior to the exchange of information. Connection-oriented service provides sequenced information transfer, flow control, and error recovery. (2) A sublayer of the OSI link layer that defines formats and protocols for exchanging frames between LLC sublayers attached to a local area network. It has provisions that ensure that error-free, nonduplicated, properly ordered frames are delivered to the appropriate data-link user. See also *bridge* and *medium access control (MAC)*.

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.

M

MAC. Medium access control.

MAC protocol. See *medium access control (MAC) protocol*.

management information base (MIB). A collection of objects that can be accessed by means of a network management protocol.

medium access control (MAC). (1) The sublayer of the data link control layer that supports media-dependent functions and uses the services of the physical layer to provide services to the logical link control sublayer. The MAC sublayer includes the medium-access port. See *logical link control (LLC)*. (2) For local area networks, the method of determining which device has access to the transmission medium at any time.

medium access control (MAC) protocol. (1) 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) See also *logical link control protocol*. (2) The LAN protocol sublayer of data link control (DLC) protocol that includes functions for adapter address recognition, copying of message units from the physical network, and message unit format recognition, error detection, and routing within the processor.

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)

memory. All of the addressable storage space in a processing unit and other internal storages that is used to execute instructions. (T)

MIB. (1) Management information base. (2) MIB module.

MTU. Maximum transmission unit.

multicast. (1) Transmission of the same data to a selected group of destinations. (T) (2) A special form of broadcast where copies of the packet are delivered to only a subset of all possible destinations. Contrast with *broadcast*.

N

NetBIOS. Network Basic Input/Output System. An operating system interface for application programs used on IBM personal computers that are attached to the IBM Token-Ring Network. See also *BIOS*.

node. (1) In a network, a point at which one or more functional units connect channels or data circuits. (I) (2) In network topology, the point at an end of a branch. (T) (3) The representation of a state or an event by means of a point on a diagram. (A) (4) In a tree structure, a point at which subordinate items of data originate. (A) (5) An endpoint of a link or a junction common to two or more links in a network. Nodes can be processors, communication controllers, cluster controllers, or terminals. Nodes can vary in routing and other functional capabilities.

O

OC3. Optical Carrier 3, where 3 means 3 times the basic STS-1 (51.84 Mbps) building block rate.

P

packet internet groper (PING). 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. The term, PING, is used as a verb.

parameter. (1) A variable that is given a constant value for a specified application and that may denote the application. (I) (A) (2) An item in a menu or for which the user specifies a value or for which the system provides a value when the menu is interpreted. (3) Data passed between programs or procedures.

PING (packet internet groper). 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. The term, ping, is used as a verb.

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. Synonymous with *socket*. (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. A single DLC process can control one or more ports. (4) An abstraction used by transport protocols to distinguish among multiple destinations within a host machine.

port number. The identification of an application entity to the transport service in IP.

POST. Power-on self-test.

power-on self-test (POST). A series of diagnostic tests that are run automatically by a device when the power is switched on.

protocol. (1) A set of semantic and syntactic rules that determines the behavior of functional units in achieving communication. (l) (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.

protocol data unit (PDU). (1) 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) (2) 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)

R

random access memory (RAM). (1) A storage device in which data can be written and read. (2) A storage device into which data is entered and from which data is retrieved in a nonsequential manner. (3) Deprecated term for *direct access storage device*. (T)

read-only memory (ROM). (1) A storage device in which data, under normal conditions, can only be read. (T) (2) Memory in which stored data cannot be modified by the user except under special conditions.

reset. On a virtual circuit, re-initialization of data flow control. At reset, all data in transit are eliminated.

ring latency. In a token-ring network, the time, measured in bit times at the data transmission rate, required for a signal to propagate once around the ring. Ring latency includes the signal propagation delay through the ring medium, including drop cables, plus the sum of propagation delays through each data station connected to the token-ring network. (T)

ring segment. A ring segment is any section of a ring that can be isolated (by unplugging connectors) from the rest of the ring. A segment can consist of a single lobe, the cable between access units, or a combination of cables, lobes, and/or access units. See *cable segment*, *LAN segment*.

ROM. Read-only memory. (A)

route. (1) The path that network traffic uses to get from source to destination. (2) 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.

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.

S

segment. (1) In the IBM Token-Ring Network, a section of cable between components or devices. A segment can 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) The unit of transfer between TCP functions in different machines. Each segment contains control and data fields whereby the current byte stream position and actual data bytes are identified along with a checksum to validate received data. (3) In an OS/2 program, a variable-length area of contiguous storage addresses not exceeding 64 KB. See also *data segment*, *cable segment*, *LAN segment*, *ring segment*.

Simple Network Management Protocol (SNMP).

(1) An IP network management protocol that is used to monitor routers and attached networks. (2) A TCP/IP-based protocol for exchanging network management information and outlining the structure for communications among network devices. SNMP is an application layer protocol. Information on devices managed is defined and stored in the application's Management Information Base (MIB).

SNMP. Simple Network Management Protocol.

source address. A field in the medium access control (MAC) frame that identifies the location from which information is sent. Contrast with *destination address*.

Source-Route Bridging. 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 RI field is inserted into the MAC header by the originating (source) node. The information in the routing information field is derived from explorer packets generated by the source host. See *explorer packet*.

Spanning Tree. The method by which bridges automatically develop a routing table and update that table in response to changing topography to ensure that there is only one route between any two LANs in the bridged LAN. This method prevents packet looping, where a packet returns in a circuitous route back to the sending router.

switch. (1) On an adapter, a mechanism used to select a value for, enable, or disable a configurable option or feature.

T

TCP. Transmission Control Protocol.

TCP/IP. Transmission Control Protocol/Internet Protocol.

Telnet. In TCP/IP, an application protocol that allows a user at one site to access a remote system as if the user's display station were locally attached. Telnet uses the Transmission Control Protocol as the underlying protocol.

throughput. (1) A measure of the amount of work performed by a computer system over a given period of time, for example, number of jobs per day. (l) (A) (2) A measure of the amount of information transmitted over a network in a given period of time. For example, a network's data transfer rate is usually measured in bits per second.

time-out. (1) An event that occurs at the end of a predetermined period of time that began at the occurrence of another specified event. (l) (2) A time interval allotted for certain operations to occur: for example, response to polling or addressing before system operation is interrupted and restarted. (3) A parameter related to an enforced event designed to occur at the conclusion of a predetermined elapsed time. A time-out condition can be canceled by the receipt of an appropriate time-out cancellation signal.

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 sequence from node to node. A node that is ready to send can capture the token and insert data for transmission. (3) A group of interconnected token rings.

topology. The physical or logical arrangement of nodes in a computer network. Examples are ring topology and bus topology.

Transmission Control Protocol (TCP). (1) A communications protocol used in Internet and in any network that follows the U.S. Department of Defense standards for inter-network protocol. TCP provides a reliable host-to-host protocol between hosts in packet-switched communications networks and in interconnected systems of such networks. It assumes that the Internet protocol is the underlying protocol.

(2) A transport protocol in the Internet suite of protocols that provides reliable, connection-oriented, full-duplex data stream service.

Transmission Control Protocol/Internet Protocol (TCP/IP).

(1) A set of protocols that allow cooperating computers to share resources across a heterogeneous network. (2) A set of communication protocols that support peer-to-peer connectivity functions for both local and wide area networks.

transmission frame. (1) In data transmission, data transported from one node to another in a particular format that can be recognized by the receiving node. In addition to a data or information field, a frame has some kind of delimiter that marks its beginning and end and usually control fields, address information that identifies the source and destination, and one or more check bits that allow the receiver to detect any errors that occur after the sender has transmitted the frame. (2) In synchronous data link control (SDLC), the vehicle for every command, every response, and all information that is transmitted using SDLC procedures. Each frame begins and ends with a flag. (3) In high level data link control (HDLC), the sequence of contiguous bits bracketed by and including opening and closing flag (01111110) sequences. (4) In a token-ring network, a bit pattern containing data that a station has inserted for transmission after capturing a token.

transmit. To send information from one place for reception elsewhere. (A)

transmitter. (1) A circuit used in data communication applications to send information from one place for reception elsewhere. (2) The device in which the transmission circuits are housed. (3) In fiber optics, see *optical transmitter*.

transparent. (1) Pertaining to operations or data that are of no significance to the user. (2) In data transmission, pertaining to information not recognized by the receiving program or device as transmission control characters.

U

UDP. User Datagram Protocol.

UNIX operating system. An operating system developed by Bell Laboratories that features multiprogramming in a multiuser environment. The UNIX operating system was originally developed for use on minicomputers, but has been adapted for mainframes and microcomputers.

Note: The AIX operating system is IBM's implementation of the UNIX operating system.

V

virtual circuit. (1) A logical connection established between two DTEs. (2) 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*.

(3) In a packet-switching data network, a logical end-to-end transmission channel—as opposed to a physical connection—that connects X.25 users. Virtual circuits allow physical transmission facilities to be shared by many users simultaneously. (4) Synonym for *virtual connection*.

Index

A

abbreviations list X-1
advanced configuration 2-3
advanced configuration instructions B-1
ATM capabilities 1-2
ATM UFC installation 3-1
audience 1-1

C

cabling 3-3
cabling planning for the ATM UFC 2-1
configuration instructions, advanced B-1
configuration instructions, quick 4-1
configuration, advanced 2-3
configuration, quick 2-2, 4-1, 4-3
configuring 5-1
 using SNMP-based manager 5-1
configuring the base switch using SNMP 5-1

D

downloading software 7-1
 serial port 7-1
 TFTP 7-1

E

environments 1-3

F

features, product 1-8

G

general information 1-1

I

installation preparation 2-1

L

LEDs
 status 3-4

M

managing the ATM UFC 5-1
MIBs (management information bases) 5-1
 standard 5-1

microcode 4-1
microcode level 2-1

N

network management 5-1
network management station 5-1

P

package contents 3-1
part numbers 1-9
performance 6-8
physical characteristics 1-8
planning charts A-1
problem determination 6-2

Q

quick configuration 2-2, 4-1, 4-3

R

README.TXT file 1-7
related publications 1-1

S

safety notices v
simple network management protocol (SNMP)
 See SNMP (simple network management protocol)
SNMP (simple network management protocol) 5-1
support information 6-8
supported LAN switch models 1-2

T

TFTP, downloading 7-1
trademarks C-3
troubleshooting 6-1

U

usage restrictions 1-5
using multiple ATM UFCs 1-7

W

warranty C-4
worksheets A-1



Part Number: 02L1363

