ForeRunnerLE ATM Workgroup Switch Installation Manual

MANU0155-03 - Rev. A - 10/23/97

Software Version 5.0.x

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Legal Notices

FCC CLASS A NOTICE

WARNING: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void this user's authority to operate this equipment.

NOTE: The *ForeRunnerLE* 155 ATM Workgroup Switch has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of the equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

DOC CLASS A NOTICE

This digital apparatus does not exceed Class A limits for radio noise emission for a digital device as set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n'emet pas de bruits radioelectriques depassant les limites applicables aux appareils numeriques de la class A prescrites dans le reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

VCCI CLASS 1 NOTICE

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従って、住宅地域またはその隣接した地域で使用すると、ラジオ、テレビジョン受信機等に受信障害を与えることがあります。
取扱説明書に従って正しい取り扱いをして下さい。

This equipment is in the Class 1 category (Information Technology Equipment to be used in commercial and / or industrial areas) and conforms to the standards set by the Voluntary Control Council For Interference by Information Technology Equipment aimed at preventing radio interference in commercial and / or industrial areas.Consequently, when used in a residential area or in an adjacent area thereto, radio interference may be caused to radios and TV receivers, etc. Read the instructions for correct handling.

CE *NOTICE*

Marking by the symbol **CE** indicates compliance of this system to the EMC (Electromagnetic Compatibility) directive of the European Community and compliance to the Low Voltage (Safety) Directive. Such marking is indicative that this system meets or exceeds the following technical standards:

- EN 55022 - “Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment.”
- EN 50082-1 - “Electromagnetic compatibility - Generic immunity standard Part 1: Residential, commercial, and light industry.”
- IEC 1000-4-2 - “Electromagnetic compatibility for industrial-process measurement and control equipment Part 2: Electrostatic discharge requirements.”
- IEC 1000-4-3 - “Electromagnetic compatibility for industrial-process measurement and control equipment Part 3: Radiate electromagnetic field requirements.”
- IEC 1000-4-4 - “Electromagnetic compatibility for industrial-process measurement and control equipment Part 4: Electrical fast transient / burst requirements.”

SAFETY CERTIFICATIONS

ETL certified to meet Information Technology Equipment safety standards UL 1950, CSA 22.2 No. 950, and EN 60950.

Table of Contents

Preface

This manual provides the technical information needed to install the *ForeRunnerLE*™ ATM Workgroup Switch and the accompanying *ForeThought*™ software. This document also provides safety instructions, general product information, diagnostic information, and troubleshooting information. This document was created for users with various levels of experience. If you have any questions or problems with the installation, please contact FORE Systems' Technical Support.

Chapter Summaries

Chapter 1 - Getting Started - Provides a hardware overview and a description of the initial installation of a *ForeRunnerLE* ATM Workgroup Switch.

Chapter 2 - Switch Configuration - Provides information about basic configuration procedures that you must perform before using your switch.

Chapter 3 - Software Upgrade Instructions - Describes how to upgrade switch software, how to change between multiple versions of software, and how to boot over the serial port.

Chapter 4 - Troubleshooting - Provides basic troubleshooting information that will help to indicate and identify common problems in establishing ATM networks.

Appendix A - AMI Overview - Provides a brief overview of the ATM Management Interface (AMI) and contains descriptions of the root level AMI commands.

Related Manuals

References are made in this manual to the *ForeRunner ATM Switch Configuration Manual*, and the *ATM Management Interface (AMI) Manual*, the *AMI Configuration Commands Reference Manual*, and the *ATM Switch Diagnostics and Troubleshooting Manual*. These manuals are shipped with the ASX-200WG, ASX-200BX, and ASX-1000. If you do not already have these manuals, they can be obtained by contacting FORE Systems Technical Support.

Technical Support

In the U.S.A., you can contact FORE Systems' Technical Support by any one of four methods:

1. If you have access to the Internet, you may contact FORE Systems' Technical Support via e-mail at:

   support@fore.com

2. You may FAX your questions to "support" at:

   412-742-7900

3. You may send questions, via U.S. Mail, to:

   FORE Systems, Inc.
   1000 FORE Drive
   Warrendale, PA 15086-7502

4. You may telephone your questions to "support" at:

   800-671-FORE or **412-635-3700**

Technical support for non-U.S.A. customers should be handled through your local distributor.

No matter which method is used for technical support, please be prepared to provide your support contract ID number, the serial number(s) of the product(s), and as much information as possible describing your problem / question.

Typographical Styles

Throughout this manual, all specific commands meant to be entered by the user appear on a separate line in bold typeface. In addition, use of the `Enter` or `Return` key is represented as `<ENTER>`. The following example demonstrates this convention:

`cd /usr <ENTER>`

File names that appear within the text of this manual are represented in the following style: "...the `fore_install` program installs this distribution."

Command names that appear within the text of this manual are represented in the following style: "...using the **`flush-cache`** command clears the bridge cache."

Subsystem names that appear within the text of this manual are represented in the following style: "...to access the **`bridge`** subsystem..."

Parameter names that appear within the text of this manual are represented in the following style: "...using *`<seg-list>`* allows you to specify the segments for which you want to display the specified bridge statistics."

Any messages that appear on the screen during software installation and network interface administration are shown in `Courier` font to distinguish them from the rest of the text as follows:

```
.... Are all four conditions true?
```

Important Information Indicators

To call your attention to safety and otherwise important information that must be reviewed to insure correct and complete installation, as well as to avoid damage to the *ForeRunnerLE* Switch or your system, FORE Systems utilizes the following *WARNING/CAUTION/NOTE* indicators.

WARNING statements contain information that is critical to the safety of the operator and/or the system. Do not proceed beyond a ***WARNING*** statement until the indicated conditions are fully understood or met. This information could prevent serious injury to the operator, damage to the *ForeRunnerLE* Switch, the system, or currently loaded software, and will be indicated as follows:

WARNING!

Hazardous voltages are present. If the instructions are not heeded, there is a risk of electrical shock and danger to personal health.

CAUTION statements contain information that is important for proper installation/operation. **CAUTION** statements can prevent possible equipment damage and/or loss of data and will be indicated as follows:

CAUTION

You risk damaging your equipment and/or software if you do not follow these instructions.

NOTE statements contain information that has been found important enough to be called to the special attention of the operator and will be set off from the text as follows:

If you have retrieved a software file with a .tar extension, do NOT untar it. The **`operation upgrade`** command in the ATM Management Interface (AMI) will expect the upgrade file to be in tarfile format.

Safety Agency Compliance

This preface provides safety precautions to follow when installing a FORE Systems, Inc., product.

Safety Precautions

For your protection, observe the following safety precautions when setting up your equipment:

- Follow all warnings and instructions marked on the equipment.
- Ensure that the voltage and frequency of your power source matches the voltage and frequency inscribed on the equipment's electrical rating label.
- Never push objects of any kind through openings in the equipment. Dangerous voltages may be present. Conductive foreign objects could produce a short circuit that could cause fire, electric shock, or damage to your equipment.

CAUTION

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

ATTENTION

Il y a danger d'explosion s'il y a remplacement incorrect de la batterie. Remplacer uniquement avec une batterie du meme type ou d'un type equivalent recommande par le constructeur. Mettre au rebut les batteries usagees conformement aux instructions du fabricant.

Symbols

The following symbols appear in this book:

WARNING!

Hazardous voltages are present. If the instructions are not heeded, there is a risk of electrical shock and danger to personal health.

CAUTION

You risk damaging your equipment and/or software if you do not follow these instructions.

Modifications to Equipment

Do not make mechanical or electrical modifications to the equipment. FORE Systems, Inc., is not responsible for regulatory compliance of a modified FORE product.

Placement of a FORE Systems Product

CAUTION

To ensure reliable operation of your FORE Systems product and to protect it from overheating, openings in the equipment must not be blocked or covered. A FORE Systems product should never be placed near a radiator or heat register.

Power Cord Connection

WARNING!

FORE Systems products are designed to work with single-phase power systems having a grounded neutral conductor. To reduce the risk of electrical shock, do not plug FORE Systems products into any other type of power system. Contact your facilities manager or a qualified electrician if you are not sure what type of power is supplied to your building.

WARNING!

Your FORE Systems product is shipped with a grounding type (3-wire) power cord. To reduce the risk of electric shock, always plug the cord into a grounded power outlet.

CHAPTER 1 Getting Started

This chapter provides a hardware overview of the *ForeRunnerLE* 155 ATM Workgroup Switch and how to unpack and install the switch. It details the hardware requirements necessary to use the switch and also provides information on the contents of the switch package.

1.1 Introduction

The *ForeRunnerLE* 155 ATM Workgroup Switch delivers high-performance switching capacity and speed for ATM applications. A non-blocking switching capacity of 2.5 Gbps is continually available on the *ForeRunnerLE*. The switch provides up to 16 ports of connectivity, each running at speeds of 155 Mbps.

Interconnecting multiple *ForeRunnerLE* switches is simple. Once a new *ForeRunnerLE* switch is added to the network, all other switches recognize its presence and dynamically establish connections to ports on the new switch. Furthermore, scaling the network is accomplished without costly and time consuming address reconfiguration and LAN segmentation.

Before installing a *ForeRunnerLE* switch, there are several important factors that must be taken into consideration, depending on the type of installation site. The following sections discuss in detail how to install a *ForeRunnerLE* switch and any prerequisites to the installation.

It is important to read through the ENTIRE installation procedure before attempting to supply power to the unit.

1.1.1 Unpacking the Unit

Upon receipt of, and before unpacking your *ForeRunnerLE* switch, inspect the package for any damage that may have occurred during shipping. If the package shows any signs of external damage or rough handling, notify your carrier's representative.

When unpacking your *ForeRunnerLE* switch, be sure to keep all original packing materials. They may be needed for storing, transporting, or returning the product.

CAUTION

All products returned to FORE Systems, under warranty, must be packed in their original packing materials.

1.1.2 Inventorying the Unit

A complete inventory of the *ForeRunnerLE* switch package should be performed before any power is supplied to the unit. The package should contain the following:

- 1 *ForeRunnerLE* ATM Switch
- 1 *ForeRunnerLE ATM Workgroup Switch Installation Manual* (this manual)
- 1 power cord
- 1 serial cable
- 1 product registration card
- 4 rubber feet

A mounting kit may be purchased separately which should contain the following:

- 2 rack-mount brackets
- 6 flat-head screws
- 2 stacking brackets
- 4 pan-head screws
- 4 rubber feet

If any of the items listed above are missing or damaged, please contact FORE Systems' Technical Support immediately.

1.2 Switch Hardware Configuration

The *ForeRunnerLE* 155 switch, as shown in Figure 1.1, is a self-contained ATM switch that provides a serial connection for local console management access. The *ForeRunnerLE* 155 hardware consists of a single switch board with integrated network ports, an integrated Intel i960 processor, an internal power supply, and internal fans all housed in a horizontal enclosure. These components work together to provide ATM switching capabilities, as well as distributed connection setup and management.

Figure 1.1 - *ForeRunnerLE* 155 ATM Workgroup Switch

1.2.1 Switch Board

The switch board (also referred to as the "switch fabric") contains the VPI/VCI lookup tables and routing circuitry to ensure that a cell received from an input port is correctly switched to one or more output ports. The switch board includes the following features: a reset button, two status LEDS (S1 and S2), an RS-232 serial port, and four interface groups, each consisting of up to four network ports. The switch board also has an interface, controlled by the integral switch control processor (SCP), that is functionally equivalent to an ATM host interface.

1.2.1.1 Reset Button

The reset button allows you to reset the switch control software on the SCP. Using the reset button "soft boots" the SCP and runs the initial power-on diagnostics. All open ATM Management Interface (AMI) sessions are ended by the SCP, and all ports lose any active sessions and initially go off-line after a reset. The ports then return to the configuration stored in the CDB. Because the reset button is small (to avoid accidental resets), it is recommended that you use a straightened paper clip to push the reset button.

1.2.1.2 Status LEDs

There are two status LEDs on the front panel labelled S1 and S2. S1 is the power status LED and S2 is the software status LED. The LED colors and the meanings of the colors are described in Table 1.1 and Table 1.2.

Table 1.1 - S1 Status LED

Color	Meaning
Green (solid)	There is power to the *ForeRunnerLE* switch.
Extinguished	There is no power to the *ForeRunnerLE* switch.

Table 1.2 - S2 Status LED

Color	Meaning
Green (solid)	The switch software is functioning normally.
Red (blinking)	Once the switch software begins to boot, the LED blinks red briefly, then is extinguished. Once the switch finishes booting, the LED illuminates green.

If the S2 LED continuously blinks red and never turns green after a reboot, the non-volatile SRAM is corrupt. If this occurs, call FORE Systems' Technical Support for assistance.

1.2.1.3 RS-232 Serial Port

The RS-232 serial port provides terminal access for any VT100 (or similar) terminal or terminal emulation package to the *ForeRunnerLE* switch. The serial port has a standard DB-9 male connector as shown in Figure 1.2. The pinout of the *ForeRunnerLE* switch's serial port is the same as that of a standard serial port (COM port) of a laptop or desktop PC.

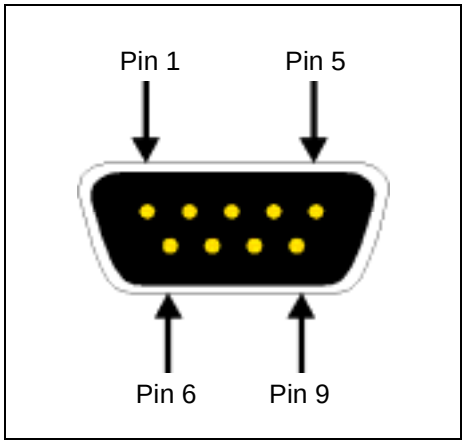


Figure 1.2 - RS-232 Serial Port Pinouts

The serial cable supplied with your *ForeRunnerLE* switch is a null modem, DB-9, female/female cable. The pinout for this cable is shown in Figure 1.3.

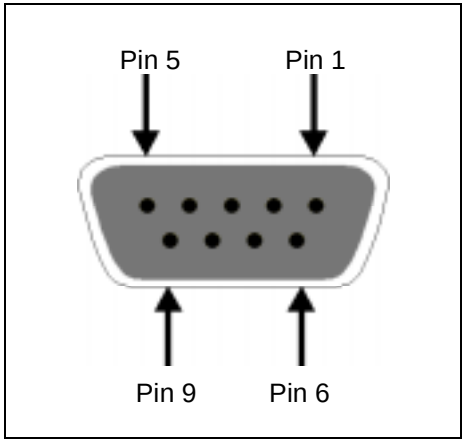
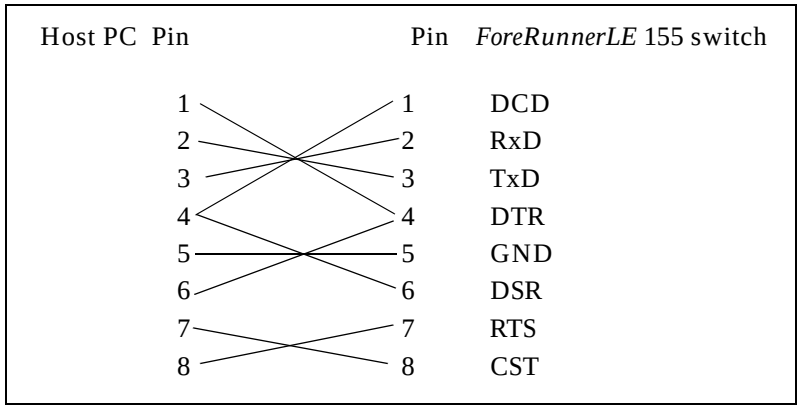


Figure 1.3 - Null Modem Serial Cable Pinouts

The null modem cable makes the following pin connections between the host PC or terminal and the *ForeRunnerLE* 155 switch:

- Pin 1 and pin 6 to pin 4 from the PC to the *ForeRunnerLE* 155 switch.
- Pin 4 to pin 1 and pin 6 from the PC to the *ForeRunnerLE* 155 switch.
- Pin 2 to pin 3 in both directions.
- Pin 5 to pin 5.
- Pin 7 to pin 8 in both directions.
- Pin 9 is not used.



1.2.1.4 Interface Groups

The *ForeRunnerLE* switch includes four interface groups, each consisting of up to four integrated network ports. Interface groups A, B, and C contain the physical input/output network ports to the switch board. Interface D contains the optional Port Expansion Module.

1.2.1.4.1 Port Expansion Module

The Port Expansion Module (PEM) provides additional ATM connections on the *ForeRunnerLE* switch. These ports offer the same features as the ports in interface groups A, B, and C, except that the ports in the PEM are the only ports that can export a clock source for distributed timing. See the *AMI Configuration Commands Reference Manual* for more information.

1.2.1.4.2 Port Timing

The ports in interface groups A, B, C, and D (PEM) use the on-board crystal oscillator as their timing source by default. However, if the PEM is installed, the user may use AMI to configure the timing source to be recovered from one of the PEM ports.

1.2.1.4.3 Port Numbering

The individual ports in an interface group are numbered by Board, Interface Group, and Port.

Board — The number of the switch board that contains the port. `Board` is always `1` in a *ForeRunnerLE* switch, since it contains only one switch board.

Interface Group — The interface group (A, B, C, or D) in the switch board that contains the port.

Port — The physical port (1 - 4) on the interface group.

For example, according to this notation, the third port in interface group C would be 1C3.

1.2.1.4.4 Port LEDs

Each port on the *ForeRunnerLE* has a single receive LED. The LED colors and the meanings of the colors are described in Table 1.3.

Table 1.3 - Port Receive LEDs

Color	Meaning
Green (blinking)	The port is receiving cell traffic.
Red (solid)	The port is experiencing a loss of carrier.
Yellow (blinking)	The port is receiving SONET alarms.

1.3 Hardware Specifications

1.3.1 *ForeRunnerLE* 155 ATM Workgroup Switch Specifications

The *ForeRunnerLE* 155 ATM Workgroup Switch has the following specifications:

Table 1.4 - *ForeRunnerLE* 155 ATM Workgroup Switch Specifications

Features	Specification
Switching Fabric	2.5 Gbps, non-blocking
Number of Ports	12 interface ports up to 4 PEM ports
Traffic Policing	UPC, dual leaky bucket support
Switch Transit Delay	< 10 microseconds
Connection Setup Time	< 10 milliseconds, 100 calls / second
Control Processor	i960 CF switch control processor
Maximum Port Speed	622 Mbps (OC-12c / STM-4c)
Serial Interface	DB-9 male connector
Power (nominal)	Input range from 85 - 132VAC to 170 - 264VAC @ 47 - 63Hz, 38 amps maximum
Dimensions	H: 2.95" (7.49 cm), W: 17.5" (44.45 cm), D: 11.82" (30.02 cm)
Weight	14.30 lbs (6.50 kg) maximum
Standards Compliance	ITU I.361 ATM Layer, ATM Forum UNI v3.x
Emissions	FCC Part 15, Class A; CISPR 22, Class A; VCCI Class 1
Safety	US: UL 1950; Canada: CSA 22.2; No. 950-M89; Europe: EN 60950
Operating Temperature	0°C to 40°C up to 10,000 ft
Operating Humidity	15 - 85% relative humidity, non-condensing
Storage Temperature	-40°C to 70°C
Storage Humidity	10 to 95% relative humidity, non-condensing

1.3.2 155 Mbps OC-3c/STM-1 MM Specifications

The following specifications apply to the 155 Mbps OC-3c/STM-1 port interfaces and to the 155 Mbps OC-3c/STM-1 PEM:

Table 1.5 - 155 Mbps OC-3c Interface and PEM Specifications

Description	Specification
Port Capacity	Four SONET/SDH ports per module
Data Rate	155.52 Mbps
Output Buffer	32,768 cell capacity - Series LE
Media	Multimode fiber
Maximum Line Length	~2 km
Connectors	SC
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-3c/STM-1
Clock Accuracy	±20 ppm
Timing	Per-port network timing
Loopbacks	Transmit and receive loopbacks
Power	-14 to -20 dBm transmit, -14 to -30 dBm receive, 0 to 10 dB path attenuation
Core Diameter	62.5 µm
Fiber Diameter	125 µm
Wavelength	1310 nm
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence (HCS) errors
Compliance	ATM Forum STS-3c UNI v3.1, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ITU-T G.957, GR-253-CORE

1.3.3 155 Mbps STS-3c/STM-1 UTP Specifications

The following specifications apply to the 155 Mbps STS-3c/STM-1 UTP port interfaces and to the 155 Mbps STS-3c/STM-1 UTP PEM:

Table 1.6 - 155 Mbps UTP Interface and PEM Specifications

Description	Specification
Port Capacity	Four SONET/SDH ports per module
Data Rate	155.52 Mbps
Output Buffer	32,768 cell capacity - Series LE
Media	Category 5 Unshielded Twisted Pair (UTP)
Maximum Line Length	100 m
Connectors	RJ-45
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-3c/STM-1
Clock Accuracy	±20 ppm
Timing	Per-port network timing
Loopbacks	Transmit and receive loopbacks
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence (HCS) errors
Compliance	ATM Forum STS-3c UNI v3.1, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ATM Forum AF-PHY-0015.000

1.3.3.1 155 Mbps UTP Pinouts

The 155 Mbps UTP port interfaces have a standard RJ-45 female connector and have the pinout specifications as listed in the table below:

Table 1.7 - UTP Pinout Specifications

Pin Number	Signal Mnemonic	Signal Name
1	RX+	Receive Data +
2	RX-	Receive Data -
3		Not Used
4		Not Used
5		Not Used
6		Not Used
7	TX+	Transmit Data +
8	TX-	Transmit Data -

1.3.4 622 Mbps OC-12c/STM-4c MM Specifications

The following specifications apply to the 622 Mbps OC-12c/STM-4c MM PEM:

Table 1.8 - 622 Mbps OC-12c MM PEM Specifications

Description	Specification
Port Capacity	One SONET/SDH port per module
Data Rate	622.08 Mbps
Output Buffer	32,768 cell capacity - Series LE
Media	Multimode fiber
Maximum Line Length	500 m
Connectors	SC
Line encoding	Non-Return to Zero (NRZ)
Framing	STS-12c/STM-4c
Clock Accuracy	±20 ppm
Timing	Primary and secondary reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Power	-20 to -14 dBm transmit power, -26 to -14 dBm receive sensitivity, 0 to 6 dB path attenuation for 62.5 µm fiber, 0 to 2 dB path attenuation for 50 µm fiber
Core Diameter	62.5 µm, 50 µm
Fiber Diameter	125 µm
Wavelength	1270 - 1380 nm
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Bit Interleaved Parity (Line BIP-24, Section BIP-8, Path BIP-8) errors, Header Check Sequence (HCS) errors, cells received (RxCells), cells transmitted (TxCells)
Compliance	ATM Forum AF-PHY-0046.000, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ITU-T G.957, GR-253-CORE

1.3.5 155 Mbps OC-3c/STM-1 2MM STS-3c/STM-1 2UTP PEM

The 155 Mbps OC-3c/STM-1 2MM STS-3c/STM-1 2UTP PEM contains two 155 Mbps STS-3c/STM-1 UTP ports (ports 1 and 2) and two SONET/SDH multimode ports (ports 3 and 4).

The following specifications apply to ports 1 and 2:

Table 1.9 - 155 Mbps UTP Interface and PEM Specifications

Description	Specification
Data Rate	155.52 Mbps
Output Buffer	32,768 cell capacity - Series LE
Media	Category 5 Unshielded Twisted Pair (UTP)
Maximum Line Length	100 m
Connectors	RJ-45
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-3c/STM-1
Clock Accuracy	±20 ppm
Timing	Per-port network timing
Loopbacks	Transmit and receive loopbacks
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence (HCS) errors
Compliance	ATM Forum STS-3c UNI v3.1, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ATM Forum AF-PHY-0015.000

The following specifications apply to ports 3 and 4:

Table 1.10 - 155 Mbps OC-3c Interface and PEM Specifications

Description	Specification
Data Rate	155.52 Mbps
Output Buffer	32,768 cell capacity - Series LE
Media	Multimode fiber
Maximum Line Length	~2 km
Connectors	SC
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-3c / STM-1
Clock Accuracy	±20 ppm
Timing	Per-port network timing
Loopbacks	Transmit and receive loopbacks
Power	-14 to -20 dBm transmit, -14 to -30 dBm receive, 0 to 10 dB path attenuation
Core Diameter	62.5 µm
Fiber Diameter	125 µm
Wavelength	1310 nm
Statistics / Alarms	SONET / SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence (HCS) errors
Compliance	ATM Forum STS-3c UNI v3.1, ITU-T I.432, ANSI T1E1.2 / 93-020, T1S1 / 92-185, ITU-T G.957, GR-253-CORE

1.3.6 155 Mbps OC-3c/STM-1 2MM 2SM PEM

The 155 Mbps OC-3c/STM-1 2MM 2SM PEM contains two SONET/SDH multimode ports (ports 1 and 2) and two SONET/SDH single mode ports (ports 3 and 4).

The following specifications apply to ports 1 and 2:

Table 1.11 - 155 Mbps OC-3c MM Interface and PEM Specifications

Description	Specification
Data Rate	155.52 Mbps
Output Buffer	32,768 cell capacity - Series LE
Media	Multimode fiber
Maximum Line Length	~2 km
Connectors	SC
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-3c/STM-1
Clock Accuracy	±20 ppm
Timing	Per-port network timing
Loopbacks	Transmit and receive loopbacks
Power	-14 to -20 dBm transmit, -14 to -30 dBm receive, 0 to 10 dB path attenuation
Core Diameter	62.5 µm
Fiber Diameter	125 µm
Wavelength	1310 nm
Statistics/Alarms	SONET/SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence (HCS) errors
Compliance	ATM Forum STS-3c UNI v3.1, ITU-T I.432, ANSI T1E1.2/93-020, T1S1/92-185, ITU-T G.957

The following specifications apply to ports 3 and 4:

Table A.12 - 155 Mbps OC-3c SM PEM Specifications

Description	Specification
Data Rate	155.52 Mbps
Output Buffer	32,768 cell capacity - Series LE
Media	Intermediate reach single mode fiber - Series LE
Maximum Line Length	~14 km
Connectors	SC
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-3c / STM-1
Clock Accuracy	±20 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Power - Intermediate Reach	-8 to -15 dBm transmit power, -8 to -34 dBm receive sensitivity, 0 to 19 dB path attenuation
Core Diameter	10 µm
Fiber Diameter	125 µm
Wavelength	1310 nm
Statistics / Alarms	SONET / SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Yellow Alarm, Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence errors (HCS)
Compliance	ANSI T1E1.2 / 94-002-R2

A.3.7 622 Mbps OC-12c/STM-4c SM PEM

The following specifications apply to the 622 Mbps OC-12c / STM-4c SM PEM:

Table A.13 - 622 Mbps OC-12c SM PEM Specifications

Description	Specification
Port Capacity	One SONET / SDH port per module
Data Rate	622.08 Mbps
Output Buffer	32,768 cell capacity - Series LE
Media	Single mode fiber
Maximum Line Length	~15 km
Connectors	SC
Line Encoding	Non-Return to Zero (NRZ)
Framing	STS-12c / STM-4c
Clock Accuracy	±20 ppm
Timing	Primary and secondary 8kHz reference from internal (default) or network
Loopbacks	Transmit and receive loopbacks
Power - Intermediate Reach	-8 to -15 dBm transmit power, -8 to -28 dBm receive sensitivity, 0 to 13 dB path attenuation
Core Diameter	10 µm
Fiber Diameter	125 µm
Wavelength	1310 nm
Statistics / Alarms	SONET / SDH statistics include Loss of Signal (LOS), Loss of Frame (LOF), Loss of Pointer (LOP), Far End Block Errors (FEBE), Alarm Indication Signal (AIS), Far End Receive Failure (FERF), Yellow Alarm, Bit Interleaved Parity errors (Line BIP-24, Section BIP-8, Path BIP-8), Header Check Sequence errors (HCS), cells received (RxCells), cells transmitted (TxCells)
Compliance	AF-PHY-0046.000

1.4 *ForeRunnerLE* 155 Installation

Before you install the switch and plug it in, FORE Systems strongly recommends that you let the unit adjust to room temperature after unpacking the unit from its shipping container.

1.4.1 Electrical Considerations

The following items should be considered when setting up the switch:

CAUTION

Consideration should be given to the connection of the equipment to the supply circuit and the effect that the overloading of circuits could have on overcurrent protection and supply wiring. Appropriate consideration of equipment nameplate ratings should be used when addressing this concern.

CAUTION

Reliable grounding of rack-mounted equipment should be maintained. Particular attention should be given to supply connections other than direct connections to the branch (i.e., use of power strips).

CAUTION

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of used batteries according to the manufacturer's instructions.

1.4.2 Placement of a *ForeRunnerLE* 155

The *ForeRunnerLE* 155 can be installed as a stand-alone unit placed on the desktop, as a rack-mounted unit, or as a stacked unit. The rack-mounting and stacking hardware are included in the optional mounting kit.

1.4.2.1 Using the Switch as a Stand-Alone Unit

If wish to use your *ForeRunnerLE* 155 as a stand-alone unit placed on the desktop, you should affix the four rubber feet to the bottom of the unit using the following procedure:

1. Carefully place the *ForeRunnerLE* unit upside down on a clean, flat, sturdy work surface.
2. Peel the backing off the rubber feet and secure one to each of the four corners on the bottom of the unit.
3. Once the feet are secure, place the unit right side up.

Once you have positioned the switch, allowing for proper air flow, you may apply power to the unit by plugging it in. At this point, you are ready to configure the switch. You may skip this rest of this chapter and go to Chapter 2 for information about configuring the switch.

1.4.2.2 Rack-mounting the Switch

The following items should be addressed when installing this switch in a 19-inch rack-mount:

WARNING!

When rack-mounting equipment, make sure that a hazardous condition is not created due to uneven weight distribution.

CAUTION

To prevent damage to your equipment, FORE Systems recommends that the maximum operating temperature not exceed 40°C @ 5,000 ft. Consideration must be made if the switch is to be installed in a closed or multi-unit rack assembly, because the ambient temperature of the rack environment may be greater than the room ambient temperature.

CAUTION

Take care not to block the air vents of the switch, as this would compromise the amount of air flow required for proper cooling.

1.4.2.2.1 Required Tools

A set of rack-mount brackets and 6 flat-head screws are supplied with the mounting kit. You will need to supply a screwdriver.

1.4.2.2.2 Installing the Rack-mount Brackets

To install the rack-mount brackets, use the following procedure:

1. Carefully place the *ForeRunnerLE* unit on a clean, flat, sturdy work surface with the front of the unit facing forward.
2. Insert and tighten three of the provided screws to secure the bracket marked HWSH2061-1 to the left side of the unit and insert and tighten the other three screws to secure the bracket marked HWSH2061-2 to the right side of the unit as shown in Figure 1.4.

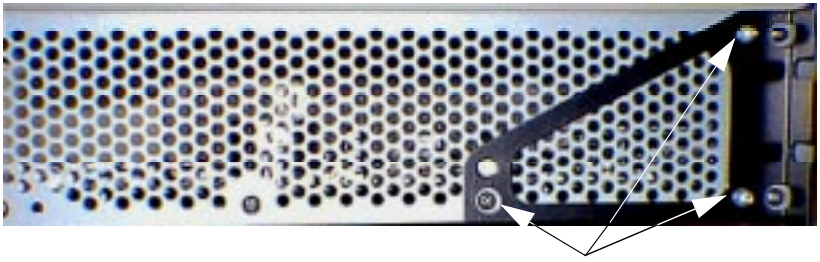


Figure 1.4 - Attaching a Rack-mount Bracket

CAUTION

When attaching the rack-mount brackets, the use of screws other than those provided could result in damage to the unit.

3. Once the brackets are secure, choose a rack position for the *ForeRunnerLE* and secure the switch to the rack. It should be placed right side up in the rack with the front of the unit facing forward.

CAUTION

When it is mounted in the equipment rack, do not use the *ForeRunnerLE* chassis to support other equipment. This could overload the mounting brackets and cause damage to the unit.

Once you have positioned the switch, allowing for proper air flow, you may apply power to the unit by plugging it in. At this point, you are ready to configure the switch. You may skip this rest of this chapter and go to Chapter 2 for information about configuring the switch.

1.4.2.3 Stacking the Switch

The following item should be addressed when stacking this switch:

CAUTION

Take care not to block the air vents of the switch, as this would compromise the amount of air flow required for proper cooling.

CAUTION

When stacking the *ForeRunnerLE* switches, do not stack more than four units high. Before stacking the switches, ensure that the surface will hold the combined weight of the stacked units.

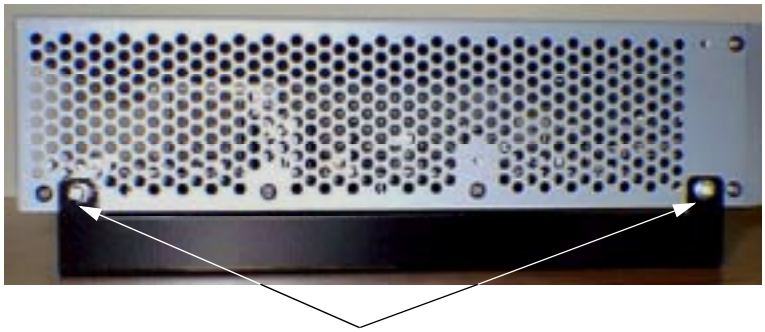
1.4.2.3.1 Required Tools

A set of stacking brackets and 4 pan-head screws are supplied with the stacking kit. You will need to supply a screwdriver.

1.4.2.3.2 Installing the Stacking Brackets

To install the stacking brackets, use the following procedure:

1. Carefully place the *ForeRunnerLE* unit on a clean, flat, sturdy work surface with the front of the unit facing forward.
2. Slide one of the brackets under the right end of the enclosure so that the holes on the bracket line up with the holes on side the enclosure. The stacking brackets are interchangeable (either bracket may be used on either side) and are marked HWSH0110.
3. Insert and tighten two of the provided screws to secure the bracket to the right side of the unit as shown in Figure 1.5.
4. Slide the other bracket under the left end of the enclosure so that the holes on the bracket line up with the holes on side the enclosure.
5. Insert and tighten the other two provided screws to secure the bracket to the left side of the unit.



Insert the screws in these holes and tighten to secure the bracket.

Figure 1.5 - Attaching a Stacking Bracket

CAUTION

When attaching the stacking brackets, the use of screws other than those provided could result in damage to the unit.

6. Once the brackets are secure, peel the backing off the rubber feet and secure two feet to the bottom of each of the stacking brackets in the locations designated on the brackets.
7. Carefully place the unit on top of another LE 155 switch with the front of the unit facing forward.

Once you have positioned the switch, allowing for proper air flow, you may apply power to the unit by plugging it in. At this point, you are ready to configure the switch. Proceed to Chapter 2 for information about configuring the switch.

CHAPTER 2 Switch Configuration

After installing your *ForeRunnerLE* 155 switch, it will begin sending traffic. However, there are a few basic configurations you need to make before you can begin to utilize it fully. Before performing the configurations in this chapter, read through Appendix A, "AMI Overview" to get a better idea of how to open an AMI session on the switch and how to use AMI in general.

The following list provides a brief overview of basic switch configuration, with more detail of each provided in the following sections:

- **Section 2.1 -** Overview of IP Addressing
- **Section 2.2 -** Configuring FORE IP
- **Section 2.3 -** Configuring Classical IP
- **Section 2.4 -** Configuring LAN Emulation

Although this chapter describes FORE IP first, then Classical IP, and then LANE, it does not matter in which order or in which combination you choose to configure your switch.

2.1 Overview of IP Addressing

If you wish to use SNMP functions, the minimum configuration for a *ForeRunnerLE* 155 switch is to assign an IP address to its network interfaces. This allows you to communicate with the switch from any workstation connected to your ATM LAN. IP addresses must be assigned to the network interfaces in order to perform any SNMP functions. By setting the IP address of the FORE IP (`asx0`) interface or one of the Classical IP (`qaa0`, `qaa1`, `qaa2`, or `qaa3`) interfaces, in-band (over ATM) access to the switch control processor (SCP) is enabled.

2.1.1 Logical IP Subnets

An important concept in IP ATM networks is that of a Logical IP Subnet (LIS). An LIS is a group of hosts configured to be members of the same IP subnet (that is, they have the same IP network and subnetwork numbers). It is possible to maintain several overlaid LISes on the same physical ATM network. Therefore, placing a host on a specific subnet is a logical choice rather than a physical one.

The number of LISes, and the division of hosts into each LIS, is purely an administrative issue. Limitations of IP addressing, IP packet filtering, and administrative boundaries may guide a manager into establishing several LISes onto a single ATM network. Keep in mind that communication between LISes must occur through IP routing.

The IP subnet mask is a pattern of 32 bits that is combined with an IP address to determine which bits of an IP address denote the network number and which denote the host number on that particular network.

2.1.2 Network Classes

There are three classes of networks in the Internet, based on the number of hosts on a given network.

- Class A - These are large networks with addresses in the range 1-126 and with a maximum of 16,387,064 hosts.
- Class B - These are medium networks with addresses in the range 128-191 and with a maximum of 64,516 hosts.
- Class C - These are small networks with addresses in the range 192-254 with a maximum of 254 hosts.

Addresses are given as dotted decimal numbers in the following format:

nnn.nnn.nnn.nnn

In a Class A network, the first of the numbers is the network number, the last three numbers are the local host address. The default subnet mask is 255.0.0.0.

In a Class B network, the first two numbers are the network, the last two are the local host address. The default subnet mask is 255.255.0.0.

In a Class C network, the first three numbers are the network address, the last number is the local host address. The default subnet mask is 255.255.255.0.

2.2 Configuring FORE IP

To configure FORE IP on the *ForeRunnerLE* 155 switch, perform the following steps:

1. Configure the IP address of the `asx0` interface (the FORE IP interface).
2. Configure the FORE IP subnet mask.
3. Change the state of the FORE IP interface.

Each of these steps is described in detail with examples in the following subsections.

2.2.1 Configuring the FORE IP Address

To configure the FORE IP address, use the following AMI command on the switch:

`configuration ip address` *<interface> <address>*

To use FORE IP on the switch, you must use `asx0` as the *<interface>*. The *<address>* would be one that is appropriate for your network. For example, you would enter something similar to the following:

```
configuration ip address asx0 198.25.22.46
```

Next, you must configure the subnet mask.

2.2.2 Configuring the FORE IP Subnet Mask

To configure the IP subnet mask, use the following AMI command:

`configuration ip mask` *<interface> <mask>*

Again, since you are configuring FORE IP, the *<interface>* must be `asx0`. The subnet *<mask>* must be entered in dotted decimal notation. For example, you would enter something similar to the following:

```
configuration ip mask asx0 255.255.255.0
```

Next, you must change the state of the interface.

2.2.3 Changing the State of the FORE IP Interface

By default, the only interface on a switch which is up, or active, is the switch's local interface, lo0. This interface is always up to allow AMI to run on the switch. All of the other interfaces are down, or not active. Once you have configured the FORE IP address and the subnet mask, you must change the state of the FORE IP interface to be up, or active. This state can be changed using the following AMI command:

configuration ip admin *<interface>* (**up** | **down**)

Again, since you are configuring FORE IP, the *<interface>* must be asx0. For example, you would enter the following:

configuration ip admin asx0 up

At this point, FORE IP is running on the switch. To configure Classical IP, follow the examples shown in the next section.

2.3 Configuring Classical IP

To configure Classical IP on the *ForeRunnerLE* 155 ATM switch, perform the following steps:

1. Configure the IP address of one of the qaa interfaces (the Classical IP interface).
2. Configure the FORE IP subnet mask.
3. Change the state of the FORE IP interface.

Each of these steps is described in detail with examples in the following subsections.

For more information about Classical IP, see Chapter 2 in the *ForeRunner ATM Switch Configuration Manual*.

2.3.1 Configuring a Classical IP Address

To configure a Classical IP address, use the following AMI command on the switch:

configuration ip address *<interface> <address>*

To use Classical IP on the switch, the *<interface>* must be one of the qaa interfaces. If you are configuring only one Classical IP interface, you should use qaa0. The *<address>* would be one that is appropriate for your network. For example, you would enter something similar to the following:

```
configuration ip address qaa0 198.25.22.48
```

Next, you must configure the subnet mask.

2.3.2 Configuring the Classical IP Subnet Mask

To configure the Classical IP subnet mask, use the following AMI command:

configuration ip mask *<interface> <mask>*

Again, since you are configuring Classical IP, the *<interface>* must be the qaa interface to which you assigned the address in Section 2.3.1. The subnet *<mask>* must be entered in dotted decimal notation. For example, you would enter something similar to the following:

```
configuration ip mask qaa0 255.255.255.0
```

Next, you must change the state of the interface.

2.3.3 Changing the State of the Classical IP Interface

Once you have configured the Classical IP address and the subnet mask, you must change the state of the Classical IP interface to be up, or active. This state can be changed using the following AMI command:

configuration ip admin *<interface>* (**up**|**down**)

Again, since you are configuring Classical IP, the *<interface>* must be the qaa interface to which you assigned the address in Section 2.3.1. For example, you would enter the following:

configuration ip admin qaa0 up

Be sure that the adapter interface to the switch has been configured. For information about configuring this interface, refer to the User's Manual that came with your particular adapter.

2.3.4 Configuring the ARP Server

If you wish to use a workstation or a switch other than this switch as the ARP server, then you must configure the ARP server for your switch. To configure the address of the ARP server, use the following AMI command:

configuration atmarp arpserver set *<NSAPaddress>* [*<interface>*]

Use the command **configuration atmarp getnsap** to display the NSAP address for this interface and cut and paste the *<NSAP address>* from the display.

Again, since you are configuring Classical IP, the *<interface>* must be one of the qaa interfaces. If you are using qaa0, you do not need to enter it since it is the default interface. If you are using a different qaa interface, you must enter a value for *<interface>*. For example, you would enter the following:

configuration atmarp arpserver set
47000580ffe1000000f12400de0020481900de00

At this point, Classical IP is running on the switch. To configure LAN Emulation, follow the examples shown in the next section.

2.4 Configuring LAN Emulation

There are different instructions for configuring an ELAN, depending on how your network is currently configured. Please read the following list to determine which set of instructions to use.

- If you had previously configured LANE without using a factory default ELAN, you want to upgrade some or all of the clients to *ForeThought* 5.0.x, and you want to upgrade all the equipment that is running services to *ForeThought* 5.0.x using DLE, use the instructions found in Section 2.5.
- If you had previously configured LANE without using a factory default ELAN, you want to leave the clients running *ForeThought* 4.1.x, and you want to upgrade all the equipment that is running services to *ForeThought* 5.0.x **without** using DLE, use the instructions found in Section 2.6.
- If you had previously configured LANE using a factory default ELAN, and you want to upgrade all the equipment to *ForeThought* 5.0.x, all you need to do is use the standard **`oper upgrade`** command on each switch. See Chapter 3 in this manual for more information about upgrading.
- If you are configuring LANE for the first time (with or without using a factory default ELAN) and all of your equipment is running *ForeThought* 5.0.x, use the instructions that follow here.

To configure an ELAN on a switch, you must log into AMI on a switch running *ForeThought* 5.0.x and use the commands found under **`configuration lane`**.

More information about each of these commands may be found in the *AMI Configuration Commands Reference Manual*.

To configure an ELAN on a switch, there are three major steps:

1. Configure an LECS configuration database file.
2. Start the LAN Emulation Services (LECS and LES/BUS peers).
3. Start the LEC(s) and join an ELAN.

If you have purchased an LE 155 switch that has the factory default LANE services already running, then you may not need to perform steps 1 and 2.

If you wish to join the default ELAN that has been set up for you, proceed to step 2 of Section 2.4.5 to add an interface for and to bring up the default LEC.

If you wish to modify the LECS configuration database file to create other ELANs or to modify the default ELAN, then you must perform steps 1 and 2 of this section.

Step 1 may be performed using a text editor on any system. However, the resulting file can be **used** only on systems running under running under Solaris 2.4 or 2.5 or on a FORE switch running *ForeThought* 4.0 or greater.

The remainder of this section gives a practical example of configuring and administering an ELAN using *ForeThought* 5.0.x.

For more information about LAN Emulation, see Chapter 3 in the *ForeRunner ATM Switch Configuration Manual*.

2.4.1 Configuring an LECS Configuration Database File

The LECS uses a text configuration file to contain the configuration information needed by LECs that wish to participate in an ELAN. The LECS configuration file may be built and edited using a text editor such as `vi` or `emacs`.

ForeThought VLAN Manager, a product available separately from FORE Systems, greatly simplifies the administration of ELANs. Its graphical user interface controls the content of the LECS configuration file transparently to the user. For more information, please refer to the *ForeView VLAN Manager User's Manual.*

2.4.1.1 Before You Begin

Before building or modifying the LECS configuration file, you should first determine the topology of the ELAN or ELANs that you want to administer. You must supply the following information when building or editing the LECS configuration file:

- Provide the name of each ELAN (`engineering`, `marketing`, etc.).
- Provide the LAN type (Ethernet or Token Ring) for each ELAN.
- Provide the MTU size for each ELAN.
- Provide the ATM address of the LES for each ELAN. If you are using DLE, this address must be the anycast address for the DLE peer servers in each ELAN. Be sure to choose a distinct anycast address for each ELAN in the network.
- Provide the address of each LEC that may participate in each ELAN.
- Provide the MPOA control parameters if you wish to run MPOA.
- If you wish LECs to use a default ELAN, the default LES information must also be included.
- Provide various other configurable parameters.

CAUTION

Do not attempt to edit an existing functional LECS configuration file without first making a backup copy of the file. Incorrect modification of the configuration file could result in loss of communication between one or more members of a defined ELAN.

NOTE

You may make changes to the LECS configuration file while the LECS process is running. The configuration file is reread periodically by the LECS process (the default period is ten minutes). Consequently, any changes that you make to the configuration file are not recognized until the file is reread.

2.4.1.2 LECS Configuration File Syntax

Each line that you enter in the configuration file takes the general form:

```
[[group].]key : value
```

The `group` field may represent:

- ELANs (by name) - ELAN names are case-sensitive, and may not exceed 32 characters in length
- clients ATM or MAC addresses
- miscellaneous LECS control information specified by using a `group` name of `LECS`

The `key` field is used to denote an individual parameter within a `group`.

The `value` field contains the value assigned to the `key`.

Omitting the `group` implies that the `key` and `value` apply to all groups in the configuration file. Leading and trailing spaces, as well as spaces on either side of the ":", are ignored.

For example, to specify a maximum frame size of 1516 bytes for the ELAN named `engineering`, enter the following:

```
engineering.Maximum_Frame_Size : 1516
```

Similarly, to specify a default maximum frame size of 1516 bytes for all ELANs defined in a given configuration file, enter the following:

```
.Maximum_Frame_Size : 1516
```

Table 2.1 defines the various key parameters that may be entered in the configuration file. The acceptable range of values and the default value for each parameter is also given.

Table 2.1 - LECS Configuration File Parameters

Parameter	Definition
`.LAN_Type: Ethernet/IEEE 802.3`	Identifies the type of ELAN, either Ethernet/IEEE 802.3 or IEEE 802.5. The default is Ethernet/IEEE 802.3.
`.Maximum_Frame_Size: 1516`	Specifies the length (in number of bytes) of the largest frame. Selections are: 1516, 4544, 9234, and 18190. The default is 1516 for Ethernet and 4544 for Token Ring.
`.Control_TimeOut: 120`	Specifies the timing out of request/response control frame interactions, in seconds. The minimum is 10 seconds and the maximum is 300 seconds. The default is 120 seconds.
`.Maximum_Unknown_Frame_Count: 1`	Limits the number of unicast frames sent to the BUS. The minimum is 1 frame per 60 seconds and the maximum is 10 frames per second. The default is 1 frame per second.
`.Maximum_Unknown_Frame_Time: 1`	Limits the number of unicast frames sent to the BUS in the specified number of seconds. The default is 1 second.
`.VCC_TimeOut_Period: 1200`	Specifies the length of time that an idle data connection remains open before being closed. The default value is 1200 seconds.
`.Maximum_Retry_Count: 1`	Limits the number of LE_ARP retransmission requests. The minimum is 0 and the maximum is 2. The default is 1.
`.Aging_Time: 300`	Specifies the period that LE_ARP cache table entries remain valid, in seconds. The minimum is 10 and the maximum is 300. The default value is 300 seconds.
`.Forward_Delay_Time: 15`	Specifies the timing out of non-local ARP cache entries in seconds. The minimum is 4 and the maximum is 30. The default value is 15 seconds.
`.Expected_LE_ARP_Response_Time: 1`	Specifies the maximum time a LEC expects an LE_ARP request/response will take, in seconds. The minimum is 1 and the maximum is 30. The default value is 1 second.
`.Flush_TimeOut: 4`	Specifies the maximum time a LEC expects an LE_FLUSH request/response will take, in seconds. The minimum is 1 and the maximum is 4. The default value is 4 seconds.

Table 2.1 - LECS Configuration File Parameters (Continued)

Parameter	Definition
`.Path_Switching_Delay: 6`	Specifies the minimum time between switching BUS and data paths, in seconds. The minimum is 1 and the maximum is 8. The default value is 6 seconds.
`.Multicast_Send_VCC_Type: Best Effort`	Specifies the multicast send mode, either Best Effort, Variable, or Constant. The default is Best Effort.
`.Connection_Complete_Timer: 4`	Specifies the time period in which data or READY_IND is expected, in seconds. The minimum is 1 and the maximum is 10. The default is 4 seconds.
`.ShortCut_Protocols: IP`	Specifies the set of protocols on which to perform flow detection. Also, specifies the set of protocols for which MPOA resolution is supported. The default is {}. For *ForeThought* 5.0, the only supported value is IP.
`.ShortCut_Threshold: 10/1`	Specifies the number of frames per second that a LANE / MPOA client (LEC / MPC) forwards to the same destination via the default forwarding path before which it should begin using a shortcut. The minimum number of frames is 1 frame and the maximum is 65,535 frames. The minimum rate of speed at which the frames are forwarded is 1 second and the maximum is 60 seconds. The default is 10 frames per second.
`.Resolution_Initial_Retry_Time: 5`	Specifies the initial retry time interval after which a LEC / MPC may send another MPOA Resolution Request if an MPOA Resolution Reply has not been received for the initial request. The minimum is 1 second. The maximum is 300 seconds. The default is 5 seconds.
`.Resolution_Maximum_Retry_Time: 40`	Specifies the maximum retry time interval after which a LEC / MPC assumes an MPOA Resolution Request has failed. The minimum is 10 seconds. The maximum is 300 seconds. The default is 40 seconds.
`.Resolution_Hold_Down_Time: 160`	Specifies the minimum amount of time to wait before re-initiating an MPOA Resolution Request after a failed resolution attempt. This value is usually greater than the Resolution_Maximum_Retry_Time. The minimum is 30 seconds. The maximum is 1,200 seconds. The default is 160 seconds.

Table 2.1 - LECS Configuration File Parameters (Continued)

Parameter	Definition
.MPOA_KeepAlive_Time: 10	Specifies how often an MPS must send MPOA Keep-Alive messages to all LEC/MPCs for which it has created and is maintaining Egress Cache Entries. The minimum is 1 second. The maximum is 300 seconds. The default is 10 seconds.
.MPOA_KeepAlive_Lifetime: 35	Specifies the length of time that a Keep-Alive message is considered valid. It is recommended that this value be at least twice the value of the MPOA_KeepAlive_Time. The minimum is 3 seconds. The maximum is 1,000 seconds. The default is 35 seconds.
.Resolution_GiveUp_Time: 40	Specifies the minimum amount of time to wait before an MPS should give up on a pending resolution request. The minimum is 5 seconds. The maximum is 300 seconds. The default is 40 seconds.
.Resolution_Default_Holding_Time: 1200	Specifies the default holding time for use in NHRP Resolution Replies. The minimum is 60 seconds. The maximum is 7,200 seconds. The default is 1,200 seconds.
.IP_Flows: <ip-flow-spec>	Specifies a set of IP flows that are defined by the parameters listed below.
<ip-flow-spec>	Specifies each IP flow. They are defined by the parameters listed below. The format is <ip-flow> {,<ip-flow>}.
<ip-flow>	Specifies the IP information that is defined by the parameters listed below. The format is <src-dst> [<proto>] <thresholds> <qos>.
<src-dst>	Specifies the source and destination addresses of an IP flow. The format is <ip-addr> <ip-addr> with the source address first and the destination address second.
<ip-addr>	Specifies the format for the IP addresses <ip-addr> used above. The format is <dotted-addr>/<prefix-leng>.
<dotted-addr>	Specifies the format for the IP addresses <dotted-addr> used above. The format is <octet>.<octet>.<octet>.<octet>.
<octet>	Specifies the format for the IP addresses <octet> used above. The range is from 0 to 255.

Table 2.1 - LECS Configuration File Parameters (Continued)

Parameter	Definition
<prefix-leng>	Specifies the prefix length to indicates how much of a given IP address is significant. The range is 0 through 32. 0 means any IP address can be matched and 32 means the entire IP address is significant.
<proto>	Specifies for which protocol this flow applies. Can be ICMP, IGMP, TCP, or UDP. The source and destination ports must also be specified when using TCP or UDP. The format is one of: ICMP, IGMP, TCP <port> <port>, or UDP <port> <port>.
<port>	Specifies the port number to be used with the <proto> parameter. 0 indicates a match for any port number. The range is 0 through 65535.
<thresholds>	Specifies a traffic threshold that must be reached before a shortcut VCC is established for a flow. Also, specifies a threshold below which a shortcut VCC is no longer considered valid, is torn down, and the default forwarding path is used. Both thresholds are expressed in frames per second. The format is <threshold> <threshold> <threshold> with the set-up threshold first, the tear-down threshold second, and the set-up threshold for the default forwarding path third.
<threshold>	Specifies the format for entering the threshold data as described for <thresholds>. The format is <frame-count>/<frame-time>. For set-up, a zero count with a non-zero time means a shortcut VCC should be established upon the first frame and a non-zero count with a zero time means a shortcut VCC is never established. For tear-down, a zero count with a non-zero time means a shortcut VCC is never torn down.
<frame-count>	Specifies the format for the number of frames for the set-up and tear-down thresholds. The range is 0 through 65535.
<frame-time>	Specifies the format for the number of seconds for the set-up and tear-down thresholds. The range is 0 through 65535.
<qos>	Specifies the parameters used in signalling a connection for the specified flow. The format is <qos-class>.

Table 2.1 - LECS Configuration File Parameters (Continued)

Parameter	Definition
<qos-class>	Specifies the Quality of Service (QoS) class for this flow. Shared specifies a UBR connection will be shared among all flows to the same destination. Discard specifies that frames on this flow should be dropped. UBR specifies a non-shared UBR connection. The format is UBR <rate>. CBR specifies a CBR connection. The format is CBR <rate>. VBR specifies a VBR connection. The format is VBR <rate> <rate> <burst> <rate> <burst>. NRT-VBR specifies a non-real time VBR connection. The format is NRT-VBR <rate> <rate> <burst> <rate> <burst>. ABR specifies an ABR connection. There is no format currently defined for ABR.
<rate>	Specifies the rate for the QoS class specified. For UBR and CBR, this is the Peak Cell Rate (PCR) in cells per second. For VBR and NRT-VBR, this is the PCR for cells that are CLP=0+1 in cells per second, the Sustainable Cell Rate (SCR) for cells that are CLP=0+1 in cells per second, and the SCR for cells that are CLP=0 in cells per second.
<burst>	Specifies the Maximum Burst Size (MBS) for the QoS class specified (VBR and NRT-VBR only). This is the MBS for cells that are CLP=0+1 in cells and the Maximum Burst Size (MBS) for cells that are CLP=0 in cells.

Lines beginning with # may be inserted if you wish to include comments or to improve the clarity of the presentation when the file is viewed or printed. These lines are ignored when the file is read. Lines may be continued by escaping the end-of-line with a backslash "\" (do not enter the quote marks).

2.4.1.3 Defining an ELAN

Each ELAN is defined by an address statement whose value denotes the ATM address of the ELAN's LES. For example:

```
engineering.Address: c5.0005.80.ffe100.0000.f21a.01b9.0020480605b2.11
```

To configure DLE for an ELAN, use the anycast address in this statement. Be sure to use a distinct anycast address for each ELAN in the network.

In addition, you may instruct a given ELAN to override any of the default values. For example, the `engineering` ELAN could override a `Maximum_Frame_Size` setting of 1516; thus:

```
engineering.Maximum_Frame_Size: 4544
```

If you want to control which clients may or may not join a given ELAN, two additional keys, `Accept` and `Reject`, whose values are comma-separated lists of matching elements, may be used.

The `Accept` values must be supplied if you are going to enable ELAN access control.

These values may be:

a MAC address,

```
engineering.Accept: 0020480605b2 , 002048080011 , 0020481020ef
```

an ATM address and equal-length bit mask,

```
engineering.Accept: 47.0005.80.FFE100.0000.0000.0000.002048000000.00\
                    FF.FFFF.FF.FFFFFF.0000.0000.0000.FFFFFF000000.00
```

or an ATM address containing "don't-care" semi-octets denoted by an "X":

```
marketing.Accept: 47.0005.80.FFE100.XXXX.XXXX.XXXX.002048XXXXXX.XX
```

The last two forms of ATM-address matching elements are functionally the same. The latter is shorter but only allows for masks whose semi-octets are all ones or all zeros, while the former allows for arbitrary masks. A prospective-client address is "captured" by an ELAN name if the client's address matches one of the `Accept` elements but not one of the `Reject` elements (if present). Finally, an ELAN may be configured to accept any client that wishes to join by including the following statement:

```
default.Accept:XX.XXXX.XX.XXXXXX.XXXX.XXXX.XXXX.XXXXXXXXXXXX.XX
```

The order in which to apply the Accept and Reject rules is given by a `Match.Ordering` group.key statement, whose value is a comma-separated list of ELAN names. For example:

```
Match.Ordering: default, engineering, marketing
```

The names of all ELANs that have `Accept` keys must be included in `Match.Ordering`.

The LE_CONFIGURE_REQUEST frame contains an ATM address and an optional MAC address or route descriptor (which is always present for ELAN access control requests). The Accept/Reject checking proceeds in two distinct phases: first, for the MAC address or route descriptor, if present, and second, for the ATM address. So, even though a client might be rejected by its MAC address, it can be accepted by its ATM address. Therefore, when configuring the Accept and Reject rules, ensure that you write them either as explicit lists of only MAC addresses or route descriptors, or only as ATM address matches.

2.4.1.4 Defining a Client

Clients need not be defined in the LECS configuration file. Typically, you would define a client for the purpose of overriding one or more of the default configuration parameters for that particular client.

A client is defined by using its ATM address, MAC address, or route descriptor in the `group` field, and perhaps giving the name of its ELAN as the value of the `LAN_Name` key. For example:

```
47.0005.80.FFE100.0000.0000.0000.002048222222.22.LAN_Name:engineering
                002048ABCDEF.LAN_Name: marketing
                  012F.LAN_Name: publications
```

Configuration parameter overrides can also be given on a per-client basis. For example, the following statements override the default `VCC_TimeOut_Period` and `Aging_Time` configuration parameters for a client whose MAC address is `002048080011` on the `engineering` ELAN:

```
002048080011.LAN_Name:engineering
002048080011.VCC_TimeOut_Period:1200
002048080011.Aging_Time: 30
```

2.4.1.5 LECS Control Parameters

Specifying values for keys in the LECS group provides control over the operation of the LECS process.

If you change the values of the LECS control parameters while the LECS process is running, the new values do not take effect until the LECS process is stopped, and then restarted.

When a client contacts the LECS, the connections established are known as Configuration Direct VCCs. To override the default value of the VCC_TimeOut_Period key (the number of seconds before an idle Configuration Direct VCC is automatically closed by the LECS), enter a statement similar to the following:

```
LECS.VCC_TimeOut_Period: 1200
```

The LECS periodically checks whether its configuration file has been modified, and, if it has, the file is reread. The length of this period, in seconds, is given by the Reload_Period key:

```
LECS.Reload_Period: 600
```

The Permanent_Circuits key holds a comma-separated list of VPI.VCI pairs denoting the local ends of 0.17 PVCs on which the LECS should listen. For example:

```
LECS.Permanent_Circuits: 0.42, 0.112
```

The LECS can provide the client with a fourteen-bit pattern to permute the MAC-address generation algorithm. This bit pattern is specified with the MAC_Address_Base key.

```
LECS.MAC_Address_Base: 38fe
```

2.4.1.6 LECS MPOA Parameters

MPOA requests use similar, and in many cases, the same database keys as LANE requests. However, there are some MPOA-specific keys that can be specified. LEC/MPC parameters can be specified for shortcuts. For example, the following group of parameters indicates that shortcuts should be established for IP flows, but only after a threshold of 10 frames per second is surpassed.

```
.ShortCut_Protocols: IP
.ShortCut_Threshold: 10/1
```

LEC/MPC parameters can also be specified for resolution requests. When a LEC/MPC sends an MPOA Resolution Request, it sets a timer to a Resolution_Initial_Retry_Time. If an MPOA Resolution Reply is not received in that amount of time, a retry may be sent. Each time a retry is sent, the timer is set to the Resolution_Initial_Retry_Time value * a retry multiplier. If the value exceeds the Resolution_Maximum_Retry_Time value, the LEC/MPC assumes the request has failed. A new request may not be sent until the Resolution_Hold_Down_Time has been surpassed.

For example, the following parameters indicate that an initial MPOA Resolution Request should be retried after 5 seconds, backing off to a maximum retry time of 40 seconds, and then the MPOA Resolution Request process is re-initialized after 160 seconds.

```
.Resolution_Initial_Retry_Time: 5
.Resolution_Maximum_Retry_Time: 40
.Resolution_Hold_Down_Time: 160
```

MPOA server (MPS) parameters can also be specified. For example, the following parameters indicate that the MPS must send Keep-Alive messages every 10 seconds. Each of these messages is valid for 35 seconds. The MPS must wait 40 seconds before giving up on a pending resolution request, and should use 1200 seconds as the default holding time in NHRP Resolution Replies.

```
.MPOA_KeepAlive_Time: 10
.MPOA_KeepAlive_Lifetime: 35
.Resolution_GiveUp_Time: 40
.Resolution_Default_Holding_Time: 1200
```

Parameters can also be specified for flow descriptors which determine whether and when to trigger creation of shortcut circuits. The LECS sends the LEC/MPC this set of parameters. These parameters consist of the following elements in the following order: a source/destination specifier, flow establishment thresholds, and a QoS descriptor.

For example, you could specify that telnet traffic to the Class C 202.19.88.0 subnet should be sent on a UBR VCC with a peak rate of 10,000 cells per second, but only after the traffic on that connection exceeds 20 frames per second. If the VCC is idle for more than 10 minutes, then the shortcut should be torn down.

```
.IP_Flows:0.0.0.0/0 202.19.88.0/24 \
          TCP 0 23 \
        20/1 1/600 0/1 \
          UBR 10000
```

2.4.2 Sample LECS Configuration File

CAUTION

Do not attempt to edit an existing functional LECS configuration file without first making a backup copy of the file. Incorrect modification of the configuration file could result in loss of communication between one or more members of a defined ELAN.

For a detailed discussion of how to configure an LECS configuration file similar to the one given in this section, please refer to Section 2.4.1.

The sample LECS configuration file shown at the end of this section in Figure 2.1 and Figure 2.2 defines three ELANs:

- default
- engineering
- marketing

The `Match.Ordering` statement specifies the ELAN names in the order that prospective clients will attempt to match. The default configuration parameters are shown with their default values. These values apply to all ELANs in this configuration file, unless overridden for a particular ELAN or client.

ELAN `default` is configured to accept any client that wishes to join. The administrator must substitute the ATM address of the `default` LES in place of the "4"s in the `default.Address` statement. If DLE is being configured for ELAN `default`, then this address must be the anycast address that allows the clients to reach any of the DLE peer servers for ELAN `default`.

Be sure to choose a distinct anycast address for each ELAN in the network.

ELAN `engineering` has overridden the default `Maximum_Frame_Size` with a new size of 4544 bytes. Consequently, this frame size applies only to traffic on the `engineering` ELAN. The `default` and `marketing` ELANs continue to use the default frame size of 1516 bytes.

Two LECs, whose MAC addresses are `002048080011` and `0020481020ef`, are identified as acceptable clients for the `engineering` and `marketing` ELANs.

```
#
# The search ordering of elan names
#
Match.Ordering: default, engineering, marketing
#
# the default configuration parameters
#
.Control_TimeOut: 120
.Maximum_Unknown_Frame_Count: 1
.Maximum_Unknown_Frame_Time: 1
.VCC_TimeOut_Period: 1200
.Maximum_Retry_Count: 1
.Aging_Time:  300
.Forward_Delay_Time: 15
.Expected_LE_ARP_Response_Time: 1
.Flush_TimeOut: 4
.Path_Switching_Delay: 6
.Multicast_Send_VCC_Type: Best Effort
.Connection_Complete_Timer: 4
.LAN_Type: Ethernet/IEEE 802.3
.Maximum_Frame_Size: 1516
.ShortCut_Protocols:IP
.ShortCut_Threshold:10/1
.Resolution_Initial_Retry_Time:5
.Resolution_Maximum_Retry_Time:40
.Resolution_Hold_Down_Time:160
.MPOA_KeepAlive_Time:10
.MPOA_KeepAlive_Lifetime:35
.Resolution_GiveUp_Time:40
.Resolution_Default_Holding_Time:1200
.IP_Flows:   0.0.0.0/0 202.19.88.0/24 \
             TCP 0 23 \
             20/1 1/600 0/1 \
             UBR 10000
#
# Parameters for the default elan
#
default.Address: 47.0005.80.ffe100.0000.f21a.21b8.0097036324b2.25
default.Accept: XX.XXXX.XX.XXXXXX.XXXX.XXXX.XXXX.XXXXXXXXXXXX.XX
```

Figure 2.1 - Sample LECS Configuration File (Part One of Two)

```
#
# Parameters for elan: engineering
#
engineering.Address: 47.0005.80.ffe100.0000.f21a.01b9.0020480605b2.11
engineering.Accept: 002048080011 , 0020481020ef
engineering.Maximum_Frame_Size: 4544
#
# Parameters for elan: marketing
#
marketing.Address: 47.0005.80.ffe100.0000.f21a.01b9.0020480605b2.21
marketing.Accept:  002048080011 , 0020481020ef
#
```

Figure 2.2 - Sample LECS Configuration File (Part Two of Two)

2.4.3 The Default LECS Configuration File

A default LECS configuration file is installed with *ForeThought* 5.0.x. It is reproduced below for reference.

```
#
# This sample LECS configuration file contains the minimum information
# needed to start a default ELAN that all clients can join. You MUST
# replace the '4's below with the ATM address of the LES.
#


#
# The search ordering of ELAN names
#
Match.Ordering: default

#
# Parameters for the default ELAN
#
default.Address: 44444444444444444444444444444444444444
default.Accept:  XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

Figure 2.3 - Default LECS Configuration File

Make a backup copy of the supplied LECS configuration file and work with the copy.

As supplied, this file allows you to set up a `default` ELAN that accepts any client that wants to join. Before you can use the supplied file, you must modify it as follows:

1. Obtain the ATM address of the machine where the LES for the default ELAN will be started. You must then modify the machine's ATM address by changing the selector byte. This modified address is the same address that is used when starting the `default` LES.

For DLE, this address is the anycast address for the DLE peer servers. Be sure to choose a distinct anycast address for each ELAN in the network.

2. Substitute the address determined in step 1 for the string of "4"s in the `default.Address` statement of the LECS configuration file. The `default.Accept` string of "X"s should not be changed as this parameter allows any client who wishes to join the default ELAN.
3. Save the modified file.

For a detailed discussion of how to configure an LECS configuration file other than the supplied default file, please refer to Section 2.4.1.

2.4.4 Starting the LAN Emulation Services

LAN Emulation services include the LECS and the LES/BUS. Once the LECS configuration database file has been configured, these services must be started so that they are available for LECs to attempt to use. Using *ForeThought* 5.0.x, the LES/BUS services must run in the same device.

2.4.4.1 Starting the LECS

Once an LECS configuration file has been configured, you need to retrieve the LECS configuration database file that you built elsewhere and put it on the switch that is going to run the LECS.

1. Use the following AMI command to retrieve the file:

configuration lane lecs get *<host>*:*<remotefile>* [*<localfile>*]

For example, you would enter something similar to the following:

```
configuration lane lecs get 198.29.22.46:lecs.cfg
```

2. After you have retrieved the LECS configuration database file, use the following AMI command to start the LECS service on the switch:

conf lane lecs new *<LECS Selector byte (HEX)>* [**-db** *<LECS database file>*]\[**-default** *<LES atm address>*] [*<LECS-wka>* | **none**]

For example, to start the LECS service using the `-db` option and using the ATM Forum's well-known address you would enter something similar to the following:

```
configuration lane lecs new 0x0c -db lecs.cfg
```

If you want to use an address other than the ATM Forum's address, you would enter that address at the end of the command. If you want to disable the well-known address so that the LECS can only be contacted by using the switch's actual address (with selector byte) type **none** at the end of the command.

3. Use the following AMI command to verify that the LECS has been started and is running.

configuration lane lecs show

```
Index  AdminStatus  OperStatus   Selector  WKA         Database
    1  up           up               0x0c  atm-forum   lecs.cfg
```

The OperStatus field shows up, meaning that the LECS is running. Now you must start the DLE peer servers as described in the next section.

NOTE If you used an address other than the ATM Forum's address, the WKA field would show other and that address would be displayed below the entry. If you disabled the well-known address the WKA field would show none.

NOTE If you used the -default option, then that LES address would be displayed below this entry in a field titled Default LES.

2.4.4.2 Starting the DLE LES/BUS Peer Servers

The LES and BUS services must be started for the ELAN. This example assumes you are using DLE; therefore, you must enter an anycast address for the LECs to use to contact the LES, and the address of each of the DLE peer servers so that this server can communicate with its peers.

Although this example illustrates how to set up DLE, to facilitate the configuration of DLE, it is recommended that you use *ForeView* instead of AMI.

1. To start the services, use the following AMI command on the switch that is going to run one of the DLE peer servers:

```
conf lane les new <LES Selector Byte (HEX)> <LES name>\
            [-bus <BUS Selector Byte (HEX)>]\
             [-type (ethernet | token-ring)] \
          [-mtu (1516 | 4544 | 9234 | 18190)] \
           [-secure wka | <LECS ATM Address>] \
           [-registertlvs (enable | disable)] \
[-anycast <LES Anycast ATM Address> [-peers <atm-addr> ...]]
```

For example, you would enter something similar to the following:

```
conf lane les new 90 engineering
-anycast c5.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.66
-peers 47.0005.80.ffe100.0000.f21a.3552.0020481a3552.10
   47.0005.80.ffe100.0000.f21a.3278.0020481a95bb.44
```

This command creates a co-located LES and BUS using a single AMI command. You cannot create a BUS separately using *ForeThought* 5.0. The **conf lane bus** commands are only useful in providing backwards compatibility with switches that are running earlier versions of *ForeThought* software.

If no ELAN type is entered, the switch assumes Ethernet and uses 1516 as the MTU size. If Token Ring is used as the type, but no MTU size is entered, 4544 is used as the size.

You must enter the address of each of the DLE peer servers when you are starting DLE; e.g., if you want four peers, then all four must be configured with the addresses of the other three peers at the time that each LES/BUS is started. You cannot add new peers to the list without deleting all of the peers and recreating all of them with the additional peers in the list.

2. Use the following AMI command to verify that the LES and the BUS have been started and are running.

configuration lane les show

```
Index AdminStatus OperStatus LesSel Type       MTU   ELAN        SECURE  TLVs
1     up          up         0x90   ethernet   1516  engineering disable enable
       LES    :0x47.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.90
       BUS    :0x47.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.90 (Co-Located)
              :c5000580ffe1000000f21c10bb0020481c10bb66 (ANYCAST)
       PEER   :0x47.0005.80.ffe100.0000.f21a.3552.0020481a3552.10
       PEER   :0x47.0005.80.ffe100.0000.f21a.3278.0020481a95bb.44
```

The `OperStatus` field shows `up`, meaning that the LES and the BUS are running.

3. You should then configure the DLE peer servers. Open an AMI session on one of the other switches that will run a DLE peer server and enter something similar to the following:

conf lane les new 10 engineering -anycast C5.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.66 -peers 47.0005.80.ffe100.0000.f21c.10bb.002048110bb.90 47.0005.80.ffe100.0000.f21a.3278.0020481a95bb.44

4. Open an AMI session on the third switch that will run a DLE peer server and enter something similar to the following:

conf lane les new 44 engineering -anycast C5.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.66 -peers 47.0005.80.ffe100.0000.f21c.10bb.002048110bb.90 47.0005.80.ffe100.0000.f21a.3552.0020481a3552.10

2.4.5 Starting the LEC(s) and Joining an ELAN

Now that the ELAN services have been started, you can have LECs join the ELAN that you have created.

The switch software only allows you to create an instance of a LEC on a switch. To create an instance of a LEC on a host, you must use the *ForeRunner* VLAN Manager or use a *ForeRunner* host adapter. Please refer to the respective User's Manual for instructions.

A LEC created on the switch cannot join a Token Ring ELAN. It can only join an Ethernet ELAN.

1. To start a LEC that will attempt to join the ELAN, use the following AMI command on the switch that is going to be a LEC:

conf lan lec new *<LEC Selector byte (HEX)> <ELAN name>*\
[(**wellknown** | **manual**)]\
manual mode options: [**-lecs** *<LECS address>*] or [**-les** *<LES address>*]

The recommended (and default) method for starting a LEC is to use the `wellknown` mode, meaning that the LEC will attempt to contact the LECS on the "well-known" address as defined by the ATM Forum's LAN Emulation standards (`47.0079.00.000000.0000.0000.0000.00A03E000001.00`).

For example, to start a LEC that attempts to join the ELAN called engineering, enter the following:

configuration lane lec new 2 engineering

If you want to use the `manual` mode, you must enter either a LECS address other than the well-known address or you must enter a LES address. If you enter a LES address, this means that the LEC bypasses the LECS and directly contacts the specified LES.

In order to use DLE, the LES address to be used must be the anycast address of the DLE peer server, not the server NSAP address.

2. Add that interface for the LEC.

```
myswitch::configuration ip> add el0 192.168.61.25
```

3. Bring up that interface for the LEC.

```
myswitch::configuration ip> admin el0 up
```

4. Verify that the interface has come up by looking at the `state` field as follows:

```
myswitch::configuration ip> show el17
interface  state        address         netmask         broadcast
el0       up           192.168.61.25   255.255.255.0   192.168.61.255
IP Forwarding State: not-forwarding
```

5. Verify that the LEC has joined the ELAN by using the following AMI command:

```
configuration lane lec show
```

```
        Admin   Oper
 Index  Status  Status  Sel   Mode        MACaddress    IfName    ELAN
     1  up      up       0x02  wellknown   00204815096b  el0       engineering
        LECS:0x47.0079.00.000000.0000.0000.0000.00a03e000001.00
        LES :c5000580ffe1000000f21c10bb0020481c10bb66
```

The `OperStatus` field shows `up`, meaning that the LEC has successfully joined the ELAN.

NOTE

If the `OperStatus` field shows `joining`, this means that the LEC is still registering with the ELAN. Wait a few seconds and check it again. When it has finished, the `OperStatus` field displays `up`.

6. After the first LEC has joined the ELAN, you can perform the same steps in this section on another switch to allow a LEC to run on that switch. You can also use the VLAN Manager or the host software to add more LECs to this ELAN. Once all the LECs have joined, the ELAN is complete.

2.5 Upgrading an ELAN to Use DLE

This section describes how to upgrade your ELAN if you had previously configured LANE, you want to upgrade some or all of the clients from *ForeThought* 4.1.x to *ForeThought* 5.0.x, and you want to upgrade all the equipment that is running services to *ForeThought* 5.0.x using DLE.

If you used the VLAN Manager to create your ELAN, you should use it to upgrade the ELAN. Refer to the *ForeView VLAN Manager User's Manual* for the appropriate steps.

Before changing to DLE, you must know which machines will run the DLE peer services. Each DLE peer server must be configured with the addresses of all the other peers at the time that each peer is started. Other new peers cannot be added to the list without deleting all of the peers and recreating all of them with the additional peers in the list.

The last failover LES (<*ELAN-name*>|n with highest number) will not be recreated. Therefore, you may wish to designate another machine to be one of the new DLE peer servers in its place.

The following basic steps are involved in upgrading your ELAN to use DLE. Each of these steps is described in detail in the following sections. It is recommended that you read the entire section before attempting to upgrade to DLE. These steps describe the commands for a switch. Refer to the corresponding User's Manual for the appropriate steps for commands for hosts, PowerHubs, ES-3810s, or the VLAN Manager.

1. Edit the LECS.CFG file.
2. Delete the old LES and BUS.
3. Upgrade the switches that are running services.
4. Create the DLE peer servers.
5. Transfer the updated LECS.CFG file.
6. Restart the LECS.
7. Recreate the LECs.
8. Delete the last failover ELAN information from the LECS.CFG file.
9. Transfer the final LECS.CFG file.
10. Restart the LECS.

2.5.1 Edit the LECS.CFG File

Before you edit the LECS.CFG file, you may wish to back it up to a host using the **`oper flash put`** command.

Transfer the LECS.CFG file that is currently being used by the LECS to a workstation (other than the one to which you backed up the file) so you can edit the file.

```
myswitch::operation> flash put lecs.cfg 169.144.85.195:/tftpboot/lecs.cfg
Transferred 2323 bytes of fs:/lecs.cfg
```

The information about the LES addresses in your old LECS.CFG file may look something like this before editing:

```
Match.Ordering:         Mktg|0, Mktg|1

Mktg|0.Address:   47000580ffe1000000f21a24f90020481a24f900
Mktg|0.Accept:    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Mktg|1.Address:   47000580ffe1000000f21a390e0020481a390e00
Mktg|1.Accept:    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

On the workstation that has the LECS.CFG file, use a text editor to make the following changes:

1. Add a new ELAN to the beginning of the Match.Ordering list that is named like the old failover ELANs, but without the |n. In this example, there are currently two failover ELANS named Mktg|0 and Mktg|1. Therefore, add an ELAN named Mktg.
2. Give the anycast address of the DLE peer servers to the new ELAN. Also, replace the LES address of the old ELANs with this anycast address, except for the last of the |n failover ELANs (in this case, Mktg|1). Leave Mktg|1 with old LES address for now so the LECs can use it until they are all changed over. (It will be deleted at the end of the process.)
3. If there were any non-colocated BUSs (none shown in this example), delete any lines that refer to them, since each BUS will co-located with a LES after you upgrade to *ForeThought* 5.0.x.

After following the steps above, the information about the LES addresses in your LECS.CFG file would look like this:

```
Match.Ordering:         Mktg, Mktg|0, Mktg|1

Mktg.Address:     c5000580ffe1000000f21c10bb0020481c10bb66
Mktg.Accept:      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Mktg|0.Address:   c5000580ffe1000000f21c10bb0020481c10bb66
Mktg|0.Accept:    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Mktg|1.Address:   47000580ffe1000000f21a390e0020481a390e00
Mktg|1.Accept:    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

2.5.2 Delete the LES and BUS

Display the LES information so that you can fins the index number of the LES.

```
myswitch::configuration lane les> show
 Index AdminStatus OperStatus Selector  Type       MTU   ELAN
     1 up          up         0x00      ethernet   1516  Mktg|0
        LES : 0x47.0005.80.ffe100.0000.f21a.24f9.0020481a24f9.00
        BUS : 0x47.0005.80.ffe100.0000.f21a.24f9.0020481a24f9.00 (Co-Located)
```

Administer the LES and BUS down for Mktg|0 using the following AMI command:

```
myswitch::configuration lane les> admin 1 down
```

Delete the co-located LES and BUS.

```
myswitch::configuration lane les> delete 1
```

Verify the LES has been deleted.

```
myswitch::configuration lane les> show
No LES information is available.
```

The LES and BUS in this example were co-located. If yours are not co-located, you need to administer the BUS down using **conf lane bus admin** <*index*> **down** and to delete the BUS using **conf lane bus delete** <*index*>. The BUS will be automatically created as a co-located BUS when you use the **conf lane les new** command.

Do the same for each old LES and BUS, except for the last LES and BUS (in this case, Mktg | 1). All clients will still be using the last LES/BUS temporarily until the DLE peer servers have been established. The last LES and BUS will be changed over at the very end of the process.

2.5.3 Upgrade the Switches Running Services

Upgrade each of the switches that is going to be running services to *ForeThought* 5.0.x using the following AMI command:

oper upgrade *<remotehost>:<full path to remotefile>*

Do not upgrade the last LES and BUS (in this case, Mktg | 1). The LECs will still be using the last LES/BUS temporarily until the DLE peer servers have been established.

2.5.4 Create the DLE Peer Servers

You must the address of each of the DLE peer servers when you are starting DLE; e.g., if you want four peers, then all four must be configured with the addresses of the other three peers at the time that each peer is started. You cannot add new peers to the list without deleting all of the DLE peer servers and recreating all of them with the additional peers in the list.

Create a DLE peer server (LES/BUS pair) with the new ELAN name (in this case, Mktg) on each switch that is to become a DLE peer server.

```
myswitch::configuration lane les> new 0x00 Mktg -anycast
c5.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.66 -peers
47.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.90
```

Use the **show** command to verify the information that you entered:

```
myswitch::configuration lane les> show
 Index AdminStatus OperStatus LesSel Type       MTU   ELAN       SECURE  TLVs
 1     up          up         0x00   ethernet   1516  Mktg       disable enable
        LES : 0x47.0005.80.ffe100.0000.f21a.24f9.0020481a24f9.00
            :   c5.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.66 (ANYCAST)
        BUS : 0x47.0005.80.ffe100.0000.f21a.24f9.0020481a24f9.00 (Co-Located)
        PEER: 0x47.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.90
```

Create each of the other peer servers using the same anycast address and giving them the peer address(es) of each peer in the ELAN. (In this example, there is only one peer.)

```
myswitch::configuration lane les> new 0x90 Mktg -anycast
c5.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.66 -peers
47.0005.80.ffe100.0000.f21a.24f9.0020481a24f9.00
```

Use the **show** command to verify the information that you entered:

```
myswitch::configuration lane les> show
 Index AdminStatus OperStatus LesSel Type       MTU   ELAN        SECURE  TLVs
 1     up          up         0x90   ethernet   1516  Mktg        disable enable
        LES    :0x47.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.90
        BUS    :0x47.0005.80.ffe100.0000.f21c.10bb.0020481c10bb.90 (Co-Located)
               :c5000580ffe1000000f21c10bb0020481c10bb66 (ANYCAST)
        PEER   :0x47.0005.80.ffe100.0000.f21a.24f9.0020481a24f9.00
```

2.5.5 Transfer the Updated LECS.CFG File

Transfer the updated LECS.CFG file back to the switch that is running the LECS.

```
myswitch::operation flash> get 169.144.85.195:/tftpboot/lecs.cfg lecs.cfg
```

2.5.6 Restart the LECS

Administer the LECS down and back up again. This forces any active clients to re-establish their connection with the LECS and forces the LECS to read and use the new LECS.CFG file.

```
myswitch::configuration lane lecs> admin 1 down

myswitch::configuration lane lecs> admin 1 up
```

Use the **show** command and look at the `OperStatus` field to verify that the LECS has come up again.

```
myswitch::configuration lane lecs> show
 Index  AdminStatus  OperStatus   Selector  WKA         Database
     1  up           up              0x00  atm-forum   lecs.cfg
```

2.5.7 Recreate the LECs

If you are going to upgrade any or all of the clients to *ForeThought* 5.0.x, you should do so now. Use the following AMI command to upgrade any of the clients that are running on switches:

oper upgrade *<remotehost>:<full path to remotefile>*

The rest of these instructions apply whether you upgraded the LEC on the switch to *ForeThought* 5.0.x or not. For commands to recreate LECs that are on platforms other than a switch, refer to the appropriate User's Manual.

Use the following command to get the interface name from the `IfName` field as follows:

```
myswitch::configuration lane lec> show
        Admin   Oper
 Index  Status  Status   Sel   Mode       MACaddress    IfName    ELAN
     1  up      up       0x11  wellknown  0a20481a2c78  el17      Mktg|0
        LECS:0x47.0079.00.000000.0000.0000.0000.00a03e000001.00
        LES :c5000580ffe1000000f21c10bb0020481c10bb66
     2  up      up       0x12  wellknown  000000000000  FAILOVER  Mktg|1
        LECS:0x47.0079.00.000000.0000.0000.0000.00a03e000001.00
        LES :0x47.0005.80.ffe100.0000.f21a.390e.0020481a390e.00
```

Configure that LEC down.

```
myswitch::configuration> ip admin el17 down
```

Delete all instances of the LEC (including anything that had been <*ELAN name*>|n).

```
myswitch::configuration lane lec> delete 1

myswitch::configuration lane lec> delete 2
```

Recreate the LEC. (You now only need one instance per LEC and you will not specify |n in the name anymore.)

```
myswitch::configuration lane lec> new 0x11 Mktg
```

Use the following command to get the interface name from the IfName field as follows:

```
myswitch::configuration lane lec> show
        Admin   Oper
 Index  Status  Status   Sel   Mode       MACaddress    IfName    ELAN
     1  up      down     0x11  wellknown  1620481a2c78  el17      Mktg
        LECS:0x47.0079.00.000000.0000.0000.0000.00a03e000001.00
        LES :00000000000000000000000000000000000000000000
```

Add that interface for the LEC.

```
myswitch::configuration ip> add el17 192.168.61.25
```

Bring up that interface for the LEC.

```
myswitch::configuration ip> admin el17 up
```

Verify that the interface has come up by looking at the state field as follows:

```
myswitch::configuration ip> show el17
interface  state        address         netmask         broadcast
el17       up           192.168.61.25   255.255.255.0   192.168.61.255
IP Forwarding State: not-forwarding
```

Use the following command to verify that the LEC has joined the ELAN by looking at the `OperStatus` field as follows:

```
myswitch::configuration> lane lec show
        Admin   Oper
 Index  Status  Status   Sel   Mode       MACaddress    IfName    ELAN
     1  up      up       0x11  wellknown  1620481a2c78  el17      Mktg
        LECS:0x47.0079.00.000000.0000.0000.0000.00a03e000001.00
        LES :c5000580ffe1000000f21c10bb0020481c10bb66
```

Repeat all of the steps in this section for each LEC. Refer to the corresponding User's Manual for the appropriate steps for re-creating LECs that are running on hosts, PowerHubs, or ES-3810s. At this time, you may also add any new clients to the ELAN.

2.5.8 Deleting the Last Failover ELAN

After all of the LECs have been changed over and any new LECs have been added, go back and delete the remaining failover LES.

```
myswitch::configuration lane les> delete <LES index>
```

After you delete it, go back and delete the remaining failover ELAN information from the LECS.CFG file. Transfer the file to a workstation for editing.

```
myswitch::operation> flash put lecs.cfg 169.144.85.195:/tftpboot/lecs.cfg
Transferred 2323 bytes of fs:/lecs.cfg
```

On that workstation, use a text editor to delete all lines referring to any of the `|n` failover ELANs (in this case, Mktg|0 and Mktg|1). If the LES address portion of your LECS.CFG file looked like this before editing:

```
Match.Ordering:         Mktg, Mktg|0, Mktg|1

Mktg.Address:     c5000580ffe1000000f21c10bb0020481c10bb66
Mktg.Accept:      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Mktg|0.Address:   c5000580ffe1000000f21c10bb0020481c10bb66
Mktg|0.Accept:    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Mktg|1.Address:   47000580ffe1000000f21a390e0020481a390e00
Mktg|1.Accept:    XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

It will look like this after editing:

```
Match.Ordering:         Mktg

Mktg.Address:     c5000580ffe1000000f21c10bb0020481c10bb66
Mktg.Accept:      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

2.5.9 Transfer the Final LECS.CFG File

Transfer the final LECS.CFG file back to the switch that is running the LECS.

```
myswitch::operation flash> get 169.144.85.195:/tftpboot/lecs.cfg lecs.cfg
```

2.5.10 Restart the LECS

Administer the LECS down and back up again. This forces the active LECs to re-establish their connection with the LECS and forces the LECS to read and use the new LECS.CFG file.

```
myswitch::configuration lane lecs> admin 1 down

myswitch::configuration lane lecs> admin 1 up
```

Use the **show** command and look at the `OperStatus` field to verify that the LECS has come up again:

```
myswitch::configuration lane lecs> show
 Index  AdminStatus  OperStatus   Selector  WKA         Database
     1  up           up              0x00  atm-forum   lecs.cfg
```

The transfer of your ELAN to DLE services is now complete.

2.6 Upgrading an ELAN without Using DLE

This section describes how to upgrade your ELAN if you had previously configured LANE, you want to leave the clients running *ForeThought* 4.1.x, and you want to upgrade all the equipment that is running services to *ForeThought* 5.0.x **without** using DLE.

The following basic steps are involved in upgrading your ELAN *ForeThought* 5.0.x **without** using DLE. Each of these steps is described in detail in the following sections. It is recommended that you read the entire section before attempting the upgrade.

1. If the LES and BUS are not co-located, they must be deleted and re-created as co-located because *ForeThought* 5.0.x on the switch only supports co-located services. If the LES and BUS are already co-located, skip to step 2.
2. Upgrade the switches that are running services.
3. Re-create the LES and BUS if they were not co-located. If the LES and BUS were already co-located, skip to step 4.
4. Administer up the switches that are running services.

If you used the VLAN Manager to create your ELAN, you should use it to upgrade the ELAN. Refer to the *ForeView VLAN Manager User's Manual* for the appropriate steps.

These steps describe commands for services running on a switch. Refer to the corresponding User's Manual for the appropriate steps for commands for any services that are running on hosts, PowerHubs, or ES-3810s.

2.6.1 Deleting the Non Co-located Services

There are several steps involved in changing the non co-located services.

2.6.1.1 Administer Down the Services

Administer down the LECS.

```
myswitch::configuration lane> lecs admin <LECS index> down
```

Administer down the LES and BUS.

```
myswitch::configuration lane> les admin <LES index> down

myswitch::configuration lane> bus admin <BUS index> down
```

2.6.1.2 Delete the Non Co-located LES and BUS

Delete the LES and BUS.

```
myswitch::configuration lane> les delete <LES index>

myswitch::configuration lane> bus delete <BUS index>
```

2.6.1.2.1 Edit the LECS.CFG File

Before you edit the LECS.CFG file, you may wish to back it up using the **`oper flash backup`** command.

Transfer the LECS.CFG file that is currently being used by the LECS to a workstation (other than the one to which you backed up the file) so you can edit the file.

```
myswitch::operation> flash put lecs.cfg 169.144.85.195:/tftpboot/lecs.cfg
Transferred 2323 bytes of fs:/lecs.cfg
```

On the workstation that has the LECS.CFG file, use a text editor to delete any lines that refer to any non-colocated BUSs.

After you have made the changes, transfer the LECS.CFG file back to the LECS.

```
myswitch::operation flash> get 169.144.85.195:/tftpboot/lecs.cfg lecs.cfg
```

2.6.2 Upgrade the Switches Running Services

Upgrade the switch(es) running each of the services to *ForeThought* 5.0.x using the following AMI command:

oper upgrade *<remotehost>*:*<full path to remotefile>*

2.6.3 Recreate the LES and BUS Together

If your LES and BUS are already co-located, skip to step 4. If your LES and BUS were not co-located, re-create each LES and BUS using the following single AMI command:

```
myswitch::configuration lane> les new <LES Selector Byte (HEX)> <LES name>\
       [-bus <BUS Selector Byte (HEX)>]\
       [-type (ethernet | token-ring)]\
       [-mtu (1516 | 4544 | 9234 | 18190)]\
       [-secure wka | <LECS ATM Address>]\
       [-registertlvs (enable | disable)]\
       [-anycast <LES Anycast ATM Address> [-peers <atm-addr> ...]]
```

You need to specify the LES selector byte (the BUS uses the same selector byte by default) and you need to give the same LES name that you used before. You may optionally specify any of the parameters, except for the anycast address and the peer addresses since you are not using DLE.

2.6.4 Administer the Services Up

Administer up the LES/BUS pair and the LECS on the switch(es) running each of the services.

```
myswitch::configuration lane> les admin <LES index> up

myswitch::configuration lane> lecs admin <LECS index> up
```

The transfer of your ELAN to *ForeThought* 5.0.x is now complete.

CHAPTER 3 Software Upgrade Instructions

This chapter details the steps necessary to upgrade the *ForeThought* software on your *ForeRunnerLE* 155 ATM switch. Some instructions in this chapter apply only in certain situations, and you may or may not have to go through every section. Read over the following list to better understand how the instructions are ordered before moving on:

- **Section 3.1 -** Obtaining the Software Upgrade File
- **Section 3.2 -** Performing the Software Upgrade
- **Section 3.3 -** Setting Up a TFTP Server
- **Section 3.4 -** Booting via the Serial Port

CAUTION

As a precaution, it is recommended that you back up your configuration database (CDB) before beginning the upgrade process. For more information, see the section entitled, "Backing Up the CDB," in the *ATM Management Interface (AMI) Manual*.

The **`operation upgrade`** command can be issued one of two ways, depending on how TFTP is configured on the UNIX workstation that holds the upgrade file. For more information about using this command, see Section 3.2 and Section 3.3.

3.1 Obtaining the Software Upgrade File

Before beginning the upgrade process, you will need the upgrade file from FORE Systems. This file can be obtained via FTP or diskette. To obtain the file via FTP, you must have FTP access.To obtain the file from diskette, you will need the distribution diskettes from FORE Systems.

If your tftp server is on a UNIX workstation, the workstation must have at least 5 Mbytes of free disk space. If you are upgrading from the distribution diskettes, the UNIX workstation must also be equipped with a floppy drive. The UNIX workstation must be connected (via ATM) to the switch being upgraded.

3.1.1 Obtaining the Software Upgrade File via FTP

The software upgrade can be retrieved from FORE Systems via anonymous FTP using the following procedure.

Please contact FORE Technical Support to obtain the proper directory name and the latest list of file names.

First, **`ftp`** to **`ftp.fore.com`** and log in as **`anonymous`**. Enter your full e-mail address (e.g., **`jdoe@somewhere.com`**) when you are prompted for a password.

For security reasons, your password is not echoed.

Once you connect to FORE's FTP site (you will see the `ftp>` prompt), you must change to the directory name which you obtained from FORE Technical Support (e.g., **`cd /some/software/directory`**). This directory contains the *ForeThought* software upgrade files and the .readme files which contain important information about the software release.

The .readme files can be retrieved as ASCII text. However, before you retrieve the software files, you must switch the transfer mode to `binary`.

The following script is an example of how you might retrieve the software and .readme files. For the actual file names, please contact FORE Technical Support. User input is shown in **bold courier** font.

```
server-jdoe:52=> ftp ftp.fore.com
Connected to ftp.fore.com.
220-FORE Systems Inc. FTP Server
220-
220-This FTP site is only for authorized customers and employees of FORE
220-Systems, Inc.  Unauthorized access or use is subject to discipline,
220-criminal, and/or civil sanctions.  This system will be monitored for
220-unauthorized users.  All users consent to monitoring.
220-
220 ftp.fore.com FTP server (Version wu-2.4(4) Tue Apr 11 13:53:34 EDT 1995) ready.
Name (ftp.fore.com:jdoe): anonymous
331 Guest login ok, send your complete e-mail address as password.
Password:  TYPE YOUR FULL E-MAIL ADDRESS HERE <ENTER>
230 Guest login ok, access restrictions apply.
ftp> cd /some/software/directory <ENTER>
250 CWD command successful.
ftp> get LE_switch_5.0.0_1.13304.readme <ENTER>
200 PORT command successful.
150 Opening ASCII mode data connection for LE_switch_5.0.0_1.13304.readme (51578 bytes).
226 Transfer complete.
local: LE_switch_5.0.0_1.13304.readme remote: LE_switch_5.0.0_1.13304.readme
51578 bytes received in 1 seconds (50 Kbytes/s)
ftp> binary <ENTER>
200 Type set to I.
ftp> get LE_switch_5.0.0_1.13304.Z <ENTER>
200 PORT command successful.
150 Opening BINARY mode data connection for LE_switch_5.0.0_1.13304.Z (8147013 bytes).
226 Transfer complete.
local: LE_switch_5.0.0_1.13304.Z remote: LE_switch_5.0.0_1.13304.Z
8147013 bytes received in 2.3e+02 seconds (35 Kbytes/s)
ftp> quit <ENTER>
221 Goodbye.
```

If you have retrieved a software file with a .Z extension, then you need to uncompress the file using the following command:

uncompress *<filename>*

where *<filename>* represents the full name of the upgrade file you have retrieved. For example, using the software file from the previous example:

uncompress LE_switch_5.0.0_1.13304.Z

If you have retrieved a software file with a .tar extension, do NOT untar it. The **operation upgrade** command in the ATM Management Interface (AMI) will expect the upgrade file to be in tarfile format.

If you have difficulty retrieving the files or if you have any other questions regarding the FTP site, please contact FORE Systems' Technical Support.

Once you have successfully retrieved the software upgrade file via FTP, follow the instructions in Section 3.2.

3.1.2 Obtaining the Software Upgrade File via Diskette

Using the FORE Systems distribution diskettes, the upgrade software must be installed on a workstation attached (via ATM) to the switch being upgraded. The first disk contains a part of the distribution software, as well as a script that extracts the remaining software from the rest of the disks and builds the upgrade distribution on the workstation. The first disk can be extracted using the **tar** command:

tar -xvf *<device>*

where *<device>* is the block device name of the floppy drive. This disk should then be ejected from the floppy drive. On a SunOS system, the following command will eject a floppy disk:

eject *<device>*

where *<device>* is the block device name of the floppy drive. On other operating systems, there may be a different command for ejecting a floppy disk or there may be a manual eject button. If there is a manual eject button, eject the disk and proceed. If there is a UNIX command for ejecting the floppy, use that command to eject the floppy and proceed.

At this point, two files should have been created: `fore_extract` and `LE_switch_`<*version*> (where <*version*> is the new software version). The `fore_extract` file is the script that will extract the files from the other floppies. If there is a command to eject a floppy on your system, set the following environment variable so the `fore_extract` script can properly eject the floppies:

setenv FORE_EJECT <eject_command> (for csh)

or

FORE_EJECT<=eject_command>;export FORE_EJECT (for sh)

On a Sun running SunOS 4.1.x, set the following environment variable so the `fore_extract` script can properly eject the floppies:

setenv FORE_EJECT eject

Execute the `fore_extract` script with the following command:

./fore_extract *<device>*

Once again, *<device>* is the block device name of the floppy drive. You will be asked to insert the remaining disks in sequence. If these steps are performed correctly, something similar to the following should appear on the screen:

```
filename:  LE_switch_<version>
directory: <directory from which it was extracted>
```

The `fore_extract` script will create a file called `LE_switch_<`*version*`>` in the current directory. This is the file that the SCP will use to upgrade its software. You will need to provide this filename and path later during the upgrade process.

3.2 Performing the Software Upgrade

The software upgrade is performed using the **`operation upgrade`** command in AMI. The default underlying file transfer mechanism used in the upgrade is TFTP. The first time you upgrade to *ForeThought* 5.0.x, you must use TFTP. However, you can change this transfer protocol to FTP by using the **`conf system protocol`** command. (See the *AMI Configuration Commands Reference Manual* for more information.) If you are using TFTP, then follow the upgrade instructions in Section 3.2.1. If you are using FTP, then follow the upgrade instructions in Section 3.2.2.

3.2.1 Upgrading the Software Using TFTP

TFTP can run in "secure" or "unsecure" mode, and it is assumed that your TFTP server is running in secure mode. Therefore, if TFTP is to run properly between, the file(s) being transferred must reside in the `/tftpboot` directory on the source machine (see Section 3.3 for more information). When using UNIX to perform these commands, each version of UNIX may be slightly different.

To perform an upgrade, the switch initiates a TFTP session with the specified host, which searches for the file requested. The host, which is running TFTP, looks for the file in `/tftpboot`. The TFTP process on the server automatically adds `/tftpboot` in front of the path or filename specified by the client.

For example, issuing **`oper upgrade 169.144.3.54:LE_switch_5.0.0_1.13304`** causes the TFTP server to locate and transfer the file `/tftpboot/LE_switch_5.0.0_1.13304`. For this reason, it is imperative that you place the upgrade file in the `/tftpboot` directory on the workstation to which you downloaded or extracted the file. If this directory does not already exist, it is likely that TFTP is not running on the workstation. See Section 3.3 for instructions on setting up a TFTP server and placing the upgrade file in the `/tftpboot` directory.

Once you have verified your TFTP server and placed the software upgrade file, you need to invoke the upgrade process on the SCP. Log in to AMI and enter the following parameters at the prompt:

`operation upgrade ?`

This will display the specific parameters that you need to enter as follows:

`upgrade` *<remotehost>*`:`*<full path to remotefile>*

In the `remotehost` field, enter the remote machine name or IP address of the workstation which holds the upgrade file. In the `full path to remotefile` field, enter ONLY the filename of the upgrade file.

If you obtained the upgrade file via FTP, *<full path to remotefile>* is the name of the uncompressed file. If you obtained the file from diskette, *<full path to remotefile>* is the name printed during extraction.

For example, if you used FTP, you would enter something similar to the following:

```
operation upgrade 169.144.3.54:LE_switch_5.0.0_1.13304
```

If you extracted the file from diskette, you would enter something similar to the following:

```
operation upgrade 169.144.3.54:LE_switch_5.0.0_1.13304
```

In either case, you should receive messages similar to the following:

```
Transfer successful
Reboot the switch[y]?
```

Type **y** and press **<ENTER>** or simply press **<ENTER>** to reboot.

```
Reboot the switch[y]? y
```

Once the SCP reboots, all active AMI sessions will be terminated on the SCP. You need to log in to AMI again if you want to begin another session.

If something went wrong during the upgrade process, a new file named UPGRADE appears in the FLASH file system and you are not prompted with the "Reboot the switch [y]?" message.

If the upgrade is unsuccessful or if you have any other problems with the upgrade, please contact FORE Systems' Technical Support.

3.2.2 Upgrading the Software Using FTP

FTP cannot be used the first time you upgrade to *ForeThought* 5.0.x.

To upgrade the software using FTP, log in to AMI and enter the following parameters at the prompt:

```
operation upgrade ?
```

This will display the specific parameters that you need to enter as follows:

upgrade *<remotehost>*:*<full path to remotefile>*

In the *<remotehost>* field, enter the remote machine name or IP address of the workstation which holds the upgrade file. In the *<full path to remotefile>* field, enter the full file-name of the upgrade file.

If you obtained the upgrade file via FTP, *<full path to remotefile>* is the name of the uncompressed file. If you obtained the file from diskette, *<full path to remotefile>* is the name printed during extraction.

For example, if you used FTP, you would enter something similar to the following:

```
operation upgrade 169.144.3.54:LE_switch_5.0.0_1.13304
```

If you extracted the file from diskette, you would enter something similar to the following:

```
operation upgrade 169.144.3.54:LE_switch_5.0.0_1.13304
```

In either case, since you are using FTP, you are prompted for the remote userid and password of the remote host from which you are retrieving the upgrade file. For example:

operation upgrade 169.144.3.54:LE_switch_5.0.0_1.13304

```
Will upgrade directly to flash
remote userid: <remote userid>
remote password: <remote password>
```

Once the proper userid and password are entered, you should receive messages similar to the following:

```
Transfer successful

Reboot the switch[y]?
```

Type **y** and press **<ENTER>** or simply press **<ENTER>** to reboot.

```
Reboot the switch[y]? y
```

Once the SCP reboots, all active AMI sessions will be terminated on the SCP. You will need to log in to AMI again if you want to begin another session.

If something went wrong during the upgrade process, a new file named `UPGRADE` appears in the FLASH file system and you are not prompted with the "`Reboot the switch [y]?`" message.

If the upgrade is unsuccessful or if you have any other problems with the upgrade, please contact FORE Systems' Technical Support.

3.3 Setting Up a TFTP Server

To set up a TFTP server, on a SunOS 4.1.x system, perform the following steps:

This procedure only has to be performed once. The next time that the software is upgraded, put the upgrade file in `/tftpboot`.

1. In `/etc/inetd.conf`, uncomment the last line shown below so that the file appears as follows:

```
#
# Tftp service is provided primarily for booting.  Most sites
# run this only on machines acting as "boot servers."
# Since these can be security holes, they are commented out by default.
#
tftp   dgram   udp    wait    root    /usr/etc/in.tftpd     in.tftpd -s /tftpboot
```

`-s /tftpboot` in the line above indicates the server is running secure TFTP. If `-s /tftpboot` does not appear, many of the command examples in this chapter are invalid.

2. Add the following line to `/etc/services`:

```
tftp          69/udp
```

3. Set up the `tftpboot` directory with the following command lines:

```
host: mkdir  /tftpboot
host: cp <upgrade-file>  /tftpboot
```

4. At the root level, determine the process number of `inetd` by entering the following:

```
host: ps -aux | grep inetd
```

Something similar to the following is displayed:

```
root       216  0.0  0.0   48    0 ?  IW   Jan 27  0:14 inetd
```

where `216` represents the process number of `inetd`.

5. Enter the following command to make `inetd` re-read its configuration file:

```
host: kill -HUP 216
```

3.4 Booting via the Serial Port

If the software image in FLASH memory of your *ForeRunnerLE* switch becomes corrupt, it may be necessary to boot your switch via the serial port. This section details the steps necessary to boot your switch if it will not boot from FLASH.

3.4.1 Requirements

To boot your *ForeRunnerLE* 155 switch over the serial port, you will need the following:

- Switch software file
- Personal computer with a serial communications (COM) port (DB9 Male)
- Terminal emulation or serial communications software
- DB9 Female to DB9 Female, null modem serial cable (supplied with switch)

The switch software file must be a **.tar file**, and the serial communications software package you use must support the **X-Modem** transfer protocol.

3.4.2 Performing the Serial Boot

Perform the following steps to boot your switch over the serial port:

1. Connect the COM port of the host PC to the serial port of the switch using the supplied serial cable.
2. Run the serial communications program on the host and set the baud rate to 9600.
3. Plug in your switch. If the switch is already plugged in, then unplug it and plug it in again.

   The following messages are displayed on the screen of the host PC:

```
Serial OK
Testing DRAM...
10 MB DRAM on board
DRAM Test Passed

Switch Control Processor CF-16 Dec 3 1996
Copyright 1995, FORE Systems, Inc.
Copyright 1992, Intel Corporation

Testing Peripherals...
```

4. As soon as the `Testing Peripherals...` message appears, send a <BREAK> signal from the host PC (refer to the documentation or on-line help of your serial communications program to find out how to send a <BREAK>.)

   If there are no hardware failures on the switch, the following messages will be displayed on the screen of the host PC:

```
Timer OK
Clock OK
SRAM OK
SDB OK
```

   These messages are followed by a question:

```
Exit to monitor [n]?
```

5. Type **y** and press <ENTER>.

   The following is displayed:

```
SCP Debug Monitor
                i
```

6. At this point, set the speed of your serial communications program to its maximum (but no higher than 128K baud).
7. Hit <ENTER> a few times until the following is displayed:

```
Switch Control Processor CF-16 Dec 3 1996
Copyright 1995, FORE Systems, Inc.
Copyright 1992, Intel Corporation

=>
```

8. At the => prompt, type **boot-ser** and press <ENTER>.

   The following message is displayed:

```
Downloading
§§§
```

9. Send the switch software file (.tar format) to the switch from the host PC using the serial communications program.

NOTE The download can take anywhere from two to 20 minutes, depending on the speed selected in Step 6 above.

Once the downloaded file is decompressed and executed, an AMI session will be opened over the serial port. Log in to this session from the host PC and upgrade the software image on the FLASH of the switch (as described in this chapter).

CHAPTER 4 Troubleshooting

The troubleshooting tests detailed in this appendix will clearly indicate and identify the most common problems in establishing ATM networks. Therefore, before calling FORE Systems' Technical Support, perform these tests to correct or to pinpoint the problem.

If you need to call Technical Support, please have the results of these tests ready, in addition to the information requested in Section 4.3, when reporting your problem.

4.1 Adapter Hardware Troubleshooting

The flowchart in Figure 4.1 illustrates the tests used to check the basic hardware functionality of a FORE Systems adapter, with the adapter card isolated from the network. The tools used to perform the tests are provided by FORE Systems and the computer hardware vendor. Each of the tests, indicated by the diamond-shaped blocks in Figure 4.1, is described individually in the following subsections.

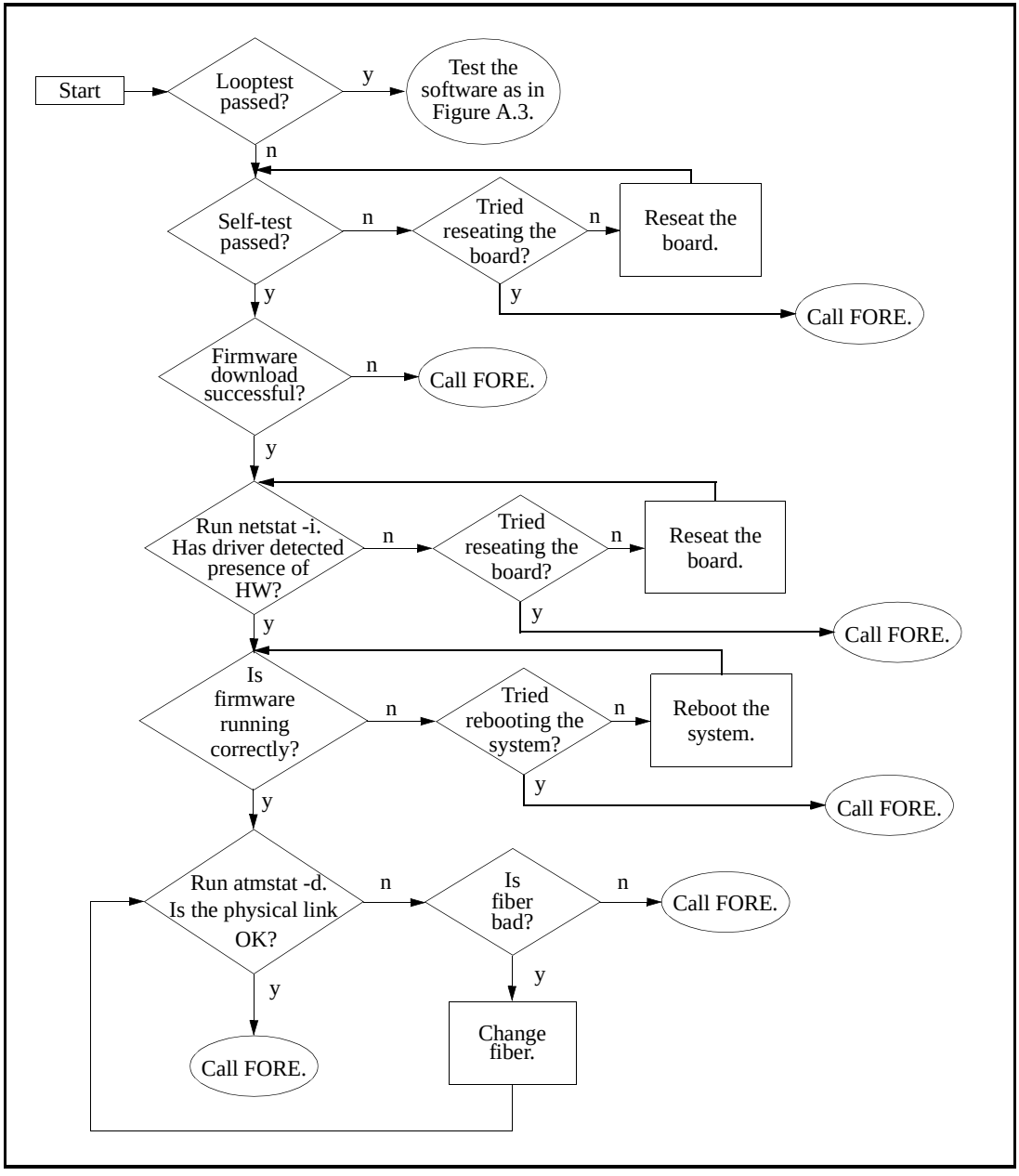


Figure 4.1 - Adapter Hardware Troubleshooting Flowchart

4.1.1 Run Looptest

To determine if an interface is functioning properly, run the `looptest` utility on a host that has been disconnected and isolated from the network.

Before running `looptest`, the Receive and Transmit connectors on the backplate of the card must be connected to each other using a short loop of fiber-optic cable. This fiber should remain on throughout this test.

The `looptest` utility uses FORE Systems' ATM user-level Application Programming Interface. For proper operation, `looptest` requires read/write access to the ATM device. To run `looptest`, enter the following command at the system prompt in the working directory:

```
looptest fa0
```

where `fa0` is the default device name for a single ATM adapter.

The `looptest` utility verifies that the board of an adapter is operating correctly. Correct operation means that all of the following conditions are true:

1. The self-test has been passed successfully.
2. The firmware has been downloaded successfully.
3. The driver has detected the existence of the hardware.
4. The firmware is running.
5. The physical link is up.

If `looptest` passes, then the board hardware of the adapter is OK. The next step is to test the software as shown in Figure 4.3.

If `looptest` fails, the point of failure will be indicated by messages generated for each of the five items above. Refer to the following subsections for instructions about testing the individual items.

4.1.2 Check Self-Test (Automatically Performed)

During a system boot, the ATM adapter automatically performs a self-test of the hardware, running a low-level diagnostic which checks memory read / write capability. Upon completion of the self-test, a message is printed to the console of the workstation indicating whether or not the hardware failed.

If the self-test is successful, proceed to the instructions regarding the firmware download as described in the next subsection.

If the self-test fails, reseat the board by performing the following steps to ensure that failure was not due to improper insertion of the board:

1. Halt the system, being sure to follow the procedures outlined in the User's Manual for your particular adapter.
2. Open the computer as shown in the User's Manual for your particular adapter, and reseat the board.
3. Reboot the system.

If the board still fails after a reseat, then it should be returned for repair. Call FORE Systems' Technical Support for further assistance.

4.1.3 Firmware Download (Automatically Performed)

Before operating as an ATM interface, the firmware is automatically downloaded from the system RAM to the onboard i960 processor during host system boot. A message similar to: `XXX-200 initializing...` is displayed on the console, indicating that the board is being initialized. When the initialization is complete, success is indicated with the message "done" and failure is indicated with the message "failed".

If the download is successful, check to see if the hardware has been detected by the driver as described in the next subsection.

If the firmware failed to download, then there is most likely a hardware problem. Call FORE Systems' Technical Support for further assistance.

4.1.4 Hardware Detected by Driver

To determine if the driver software on the host has detected the presence of an ATM adapter board, issue the following command once the host system has come up completely:

```
netstat -i
```

If the driver has located the ATM board, the screen output shows `fa0` in response to the **`netstat`** command. If there is more than one adapter card, the next board will be named `fa1`, and so on. If you have configured a Classical IP interface, this will also be shown. The option `-i` shows the state of interfaces that were auto-configured, as happens when the FORE software is loaded and run upon system boot. Interfaces statically configured in a system, but not located at boot time, are not shown.

If the driver does not see the ATM board, no response will be given. Reseat the board by performing the following steps to ensure that failure was not due to improper insertion of the board:

1. Halt the system, being sure to follow the procedures outlined in the User's Manual for your particular adapter.
2. Open the computer as shown in the User's Manual for your particular adapter, and reseat the board.
3. Reboot the system.

If the board still fails after a reseat, then it should be returned for repair. Call FORE Systems' Technical Support for further assistance.

4.1.5 Check Firmware

To check whether or not the firmware is running correctly, issue the following command:

```
atmstat fa0 1
```

In this command, the last parameter “1”, causes the command to be repeated at one-second intervals.

If the firmware is running correctly, the response will show Input, Output, and Error Statistics for the adapter in the following format:

```
PHY/ATM/AAL statistics:
     Output               Input                        Errors
   ATM     AAL*        ATM     AAL*    4B5B    4B5B     ATM    AAL*    AAL*
 Cells  CS-PDUs      Cells  CS-PDUs Framing Hdr-CRC VPI/VCI Pay-CRC   Proto
161747   153692     142289   134685       0       0      20       0       0
```

If the firmware is not running correctly, `atmstat` hangs and nothing is returned, indicating either a problem with the firmware, a problem with the board, or a severe software failure. Call FORE Systems’ Technical Support for further assistance.

If the output shows zeros for all possible values, the firmware may not have been initialized. Try rebooting the system. If there is still a problem, call FORE Systems’ Technical Support for further assistance.

4.1.6 Check Physical Link

To see the carrier state of the board, issue the following command:

```
atmstat -d fa0
```

The `-d` option displays device statistics in the following format:

```
Device statistics:
      Buffer Allocation Failures
        Type 1           Type 2
    Small    Large    Small    Large    Receive Queue Full    Carrier
       0        0        0        0                     0         ON
```

If ON is displayed in the Carrier field, then the physical link is fine.

If the board does not see a carrier (OFF is displayed in the Carrier field), then there is either a problem with the loopback fiber or there is a hardware problem with the optical drivers on the board. Check the fiber. If the fiber is bad, replace the fiber and run `looptest` again. If the fiber is not bad, then call FORE Systems' Technical Support for further assistance.

Alternatively, if you have access to the back of the host and can see the LED displays on the adapter backplate, a red LED on the R (Receive port) also indicates carrier failure.

4.2 Testing Network Connectivity Using PVCs

The network connectivity tests require that two ATM adapters be connected to an ATM switch fabric with PVCs (as shown in Figure 4.2). The carrier lights should be extinguished on the adapters and on the switch fabric, indicating that the fibers are OK.

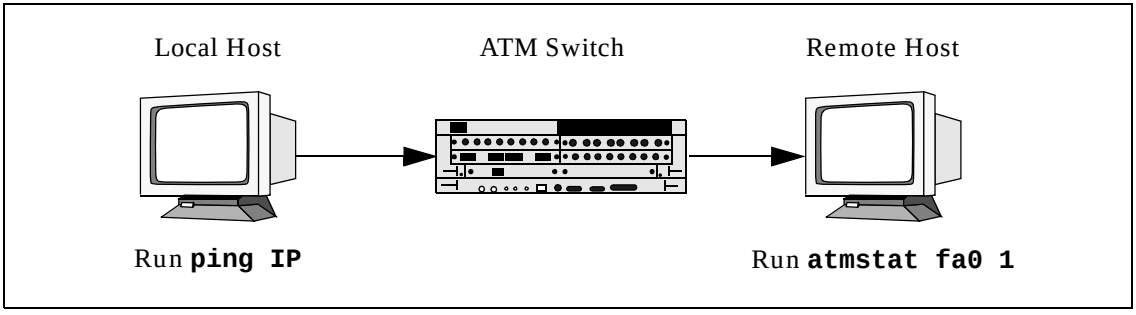


Figure 4.2 - Hardware Configuration for Checking PVCs

The network connectivity test suite, shown in Figure 4.3, examines higher level functionality after basic adapter board performance has been verified by passing all the tests and checks shown in Figure 4.1.

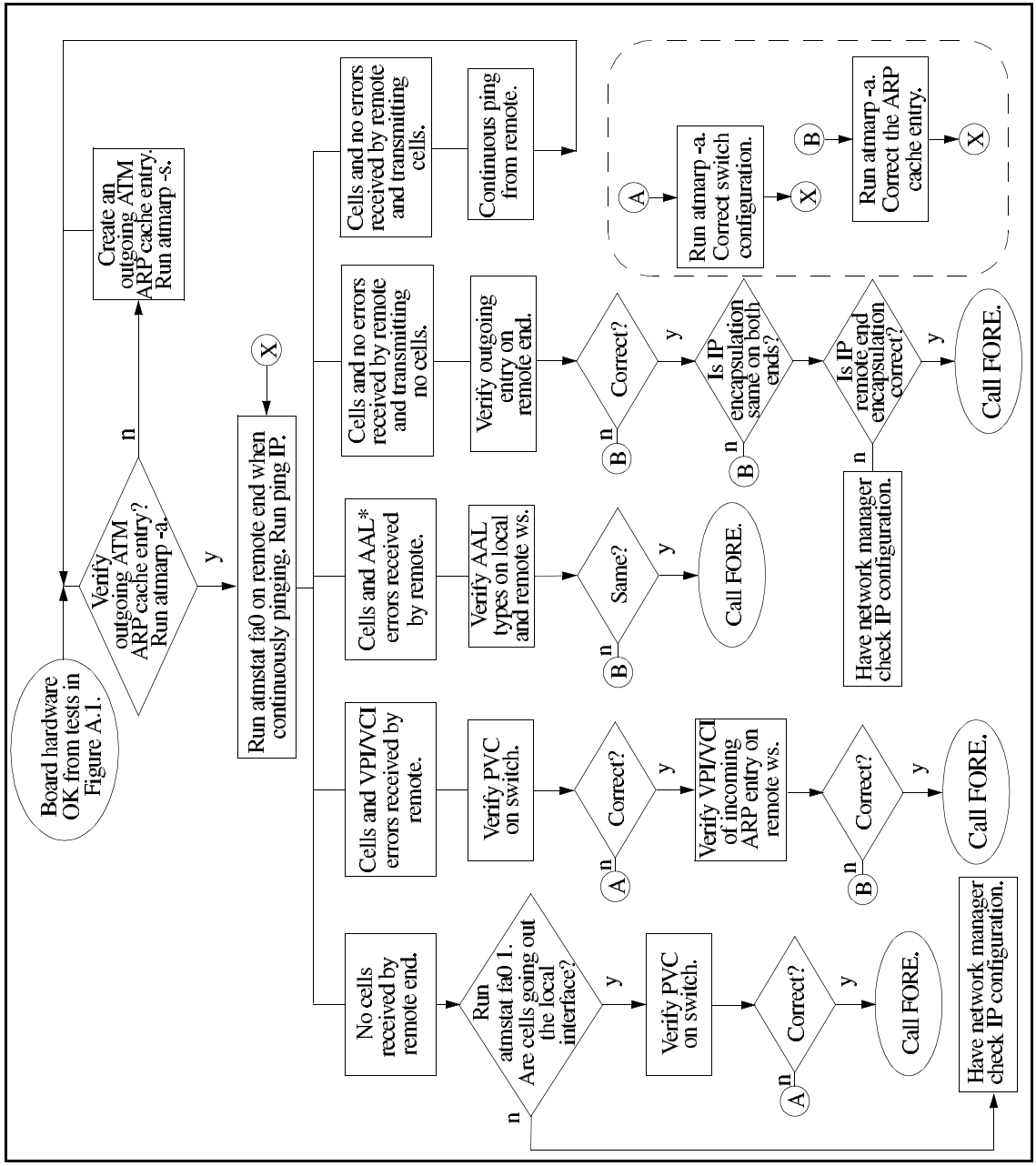


Figure 4.3 - Networking Connectivity Using PVCs

This test sequence requires that the switch fabric be configured with a valid PVC and the endstations to have the proper IP configuration and ATM ARP cache entries. The tests in Figure 4.3 assume that there is no IP connectivity between the two endstations. The lack of an IP connection is checked by trying a `ping` and getting no response (`ping` failed).

The tests in Figure 4.3 also require that if a switch fabric is used, it is a FORE Systems switch fabric on which SPANS has been disabled on both the ports of the switch fabric and on the ATM endstations. SPANS must be disabled because it automatically creates ATM connections, which may alter the test results.

All of the failure conditions are the result of running a continuous ping with the following command:

`ping <IP_address_of_remote_workstation>`

4.2.1 Verifying the Outgoing ATM ARP Entry

To verify the outgoing ATM ARP cache entry for the endstation originating the ping, enter the following command on the host:

```
atmarp -a
```

The following is an example of a typical ATM ARP cache display:

```
Outgoing connections:
fa0: ws2-atm (198.29.21.74): vpi.vci=0.100 aal=5
        switch.port=-.-
        flags=(PVC) encapsulation=NULL peak rate=(unlimited)
fa0: ws3-atm (198.29.21.94): vpi.vci=0.200 aal=5
        switch.port=-.-
        flags=(PVC) encapsulation=NULL peak rate=(unlimited)
Incoming connections:
fa0: switch.port=-.- vpi.vci=0.100 aal=5 flags=(PVC) decapsulation=NULL
fa0: switch.port=-.- vpi.vci=0.200 aal=5 flags=(PVC) decapsulation=NULL
```

Make sure the ARP cache entry does indeed match the IP address of the remote endstation and is using the PVC configured on the switch fabric.

If the prompt is returned with no information displayed, this indicates that the ATM ARP cache is empty.

Use the following two commands to create a PVC on the host:

```
./atmarp -s <hostname> <device> <vpi> <vci> <aal>

./atmarp -l <device> <vpi> <vci> <aal>
```

If the ATM ARP cache entry is valid, then perform the instructions in the next subsection for `atmstat`.

4.2.2 atmstat

To determine a particular failure state, enter the following command on the remote workstation while continuously pinging:

```
atmstat fa0 1
```

```
PHY/ATM/AAL statistics:
      Output               Input                        Errors
    ATM     AAL*        ATM     AAL*    4B5B    4B5B     ATM    AAL*    AAL*
  Cells  CS-PDUs      Cells  CS-PDUs Framing Hdr-CRC VPI/VCI Pay-CRC   Proto
 161747   153692     142289   134685       0       0      20       0       0
```

The failure states are determined by examining the output from the **`atmstat fa0 1`** command string. The failures are classified by whether or not cells are sent (or received) and whether or not errors are received. The output shown below is typical of the first response from the **`atmstat fa0 1`** command string. Succeeding lines of data continue in the same column format. Refer to the following subsections for a description of each type of failure.

4.2.2.1 No Cells Received by Remote End

If no cells are received by the remote end (the Input ATM Cells field displays zero), then run the following command on the local machine to verify that cells are going out to the ATM interface:

```
atmstat fa0 1
```

If there are no cells going out (the ATM Output Cells field shows zero), then there is most likely an IP routing problem rather than an ATM problem. Please have your network administrator check the IP configuration.

If cells are going out (the ATM Output Cells field shows a value other than zero), then the PVC on the switch fabric may be configured incorrectly. Check the PVC configuration. If it is not set up properly, then correct the PVC and rerun the test. If the PVC is configured correctly and the error persists, call FORE Systems' Technical Support for further assistance.

4.2.2.2 Cells and VPI/VCI Errors Received by Remote

If the remote workstation is receiving cells and is receiving VPI/VCI errors, then this indicates that cells are coming into the workstation, but are on a VPI/VCI that may not be configured correctly.

Check the PVC configuration. If it is not set up properly, then correct the PVC and rerun the test. If the PVC is configured correctly and the error persists, then the incoming ARP entry on the remote workstation is most likely the problem. List the ATM ARP cache using **`atmarp -a`** and check the incoming ARP entry for that connection.

If the incoming ARP entry is not configured properly, then correct the configuration and rerun the test. If the incoming ARP entry is configured properly and the error persists, then call FORE Systems' Technical Support for further assistance.

4.2.2.3 Cells and AAL* Errors Received by Remote

If the remote workstation is receiving cells and AAL* errors, it is likely that the AAL types of the outgoing entry on the local workstation and the incoming entry on the remote workstation do not match. Check both ATM AAL types using **`atmstat`** to see if they match. If they are different, set the AAL parameter to the same type and rerun the test. If they match and the error persists, then call FORE Systems' Technical Support for further assistance.

4.2.2.4 Cells and No Errors Received by Remote and Transmitting No Cells

If the remote workstation is receiving cells with no errors, but is not transmitting any cells, then either the outgoing IP address on the remote end is incorrect or the IP encapsulation does not match on both ends. (A Classical IP PVC uses LLC/SNAP encapsulation while a regular PVC uses AAL5-based, Multiplexing-based (NULL) encapsulation).

First, check the outgoing IP address on the remote end using **`atmarp -a`**. If it is not configured properly, then correct the configuration and rerun the test. If the outgoing ARP entry is configured properly, then check to see if the IP encapsulation matches on both ends using **`atmarp -a`**.

If the IP encapsulation does not match on both ends, then correct the configuration and rerun the test. If the IP encapsulation matches on both ends and the error persists, then there may be an IP routing problem on the remote host.

The network administrator should verify the IP routing. If there is still a problem, then call FORE Systems' Technical Support for further assistance.

4.2.2.5 Cells and No Errors Received by Remote and Transmitting Cells

If the remote end is receiving cells with no errors and is transmitting cells in response, then the remote end is OK. Looking at Figure 4.2, reverse the direction. From the remote host, start a continuous ping and then run these same tests starting again with Section 4.2.1. Watch the results of these tests on the local host.

4.3 Collecting Additional Information

Once basic adapter installation and network connectivity have been tested, this section explains how to obtain all of the additional information that you need to have ready before calling FORE Systems Technical Support. This information should exist either on-line (by redirecting the output to a file) or in hard copy form.

4.3.1 Basic Information

The following basic network information is very useful in helping FORE Systems' Technical Support staff troubleshoot your problem:

1. Host platform configuration
   - Vendor name
   - Platform type
   - RAM (MB)
   - Disk drive size (approximate)
2. Patches installed (very important for SunOS and Solaris)
3. Network topology (physical configuration)
   - Sketch and FAX in, if possible

Please have your support contract ID number and serial number ready, also.

4.3.2 Adapter Information

On the host, at a command line, type the following six commands and note the responses:

- **`uname -a`** (Shows operating system, and platform names and versions)
- **`ifconfig fa0`** (Shows adapter interface configuration)
- **`netstat -nr`** (Shows routing table with destinations, gateways, and flags)
- **`netstat -in`** (Shows device names and addresses, and usage information)
- **`adinfo fa0`** (Shows adapter device name and version information)
- **`atmstat -d fa0`** (Shows carrier state and a variety of error counters)

Typical responses are shown under each command. The responses from these commands enable support to gather sufficient information to resolve the majority of problems.

The assumed adapter name in the examples is `fa0`. On your particular system, the adapter may have a different designation. To check the name of your adapter, use the command: **`netstat -in.`**

`uname -a`

```
IRIX beluga 5.3 11091812 IP22 mips
```

`ifconfig fa0`

```
fa0: flags=863<UP,BROADCAST,NOTRAILERS,RUNNING,MULTICAST>
        inet 198.29.38.206 netmask 0xffffff00 broadcast 198.29.38.255
```

`netstat -nr`

```
Routing tables
Destination          Gateway              Flags    Refcnt Use        Interface
127.0.0.1            127.0.0.1            UH       3      2264661    lo0
198.29.24.0          198.29.16.74         UG       1      9751       fa0
default              192.88.243.19        UG       3      123714     ie0
198.29.16.0          198.29.16.54         U        29     10892307   fa0
204.95.89.0          198.29.16.28         UG       0      2080       fa0
198.29.25.0          192.88.243.19        UG       0      0          ie0
198.29.26.0          192.88.243.19        UG       0      2696       ie0
198.29.27.0          192.88.243.19        UG       0      7853       ie0
198.29.19.0          198.29.16.85         UG       0      0          fa0
192.88.243.0         192.88.243.54        U        350    9188789    ie0
204.120.44.0         192.88.243.19        UG       1      1677       ie0
198.29.28.0          198.29.16.8          UG       0      87706      fa0
198.29.29.0          198.29.16.2          UG       0      0          fa0
198.29.31.0          198.29.16.75         UG       5      16417      fa0
198.29.23.0          192.88.243.53        UG       6      122731     ie0
```

netstat -in

```
Name Mtu   Network     Address            Ipkts Ierrs    Opkts Oerrs  Coll
ec0  1500  192.88.243  192.88.243.171   1173050 39926   509363     0 107115
fa0  9188  198.29.38   198.29.38.206          0     0        0     0     0
qaa0 9180  198.29.22   198.29.22.206          0     0        0     0     0
qaa1*9180  none        none                   0     0        0     0     0
qaa2*9180  none        none                   0     0        0     0     0
qaa3*9180  none        none                   0     0        0     0     0
lo0  8304  127         127.0.0.1          32048     0    32048     0     0
```

adinfo fa0

```
FORE Systems Release: ForeThought_3.0.1b (1.20)
fa0: esa-200 media=4b5b-100 hw=1.0.0 fw=2.3.0 serial=2 slot=0
```

atmstat -d fa0

```
Device statistics:
      Buffer Allocation Failures
        Type 1           Type 2
    Small    Large    Small    Large    Receive Queue Full    Carrier
       0        0        0        0                     0         ON
```

4.3.3 Switch Information

On the host, at a command line, type the following commands and note the responses:

- **atmstat fa0** command
- **netstat -ai** command
- **asxmon** command
- **cport** command

Log in to the ATM Management Interface (AMI) and open a session on the switch fabric to check the following:

- **configuration spans show**
- **configuration port show**
- **configuration uni30 show**

Typical responses are shown under each command. The responses from these commands enables support to gather sufficient information to resolve the majority of problems.

atmstat fa0

```
PHY/ATM/AAL statistics:
     Output               Input                        Errors
   ATM     AAL*        ATM     AAL*    4B5B    4B5B     ATM    AAL*    AAL*
 Cells  CS-PDUs      Cells  CS-PDUs Framing Hdr-CRC VPI/VCI Pay-CRC   Proto
476058   469354     276580   273789       0       0       0       0       0
```

netstat -ai

```
Name Mtu   Network     Address            Ipkts Ierrs    Opkts Oerrs  Coll
ec0  1500  fore        gar-eth          1174803 39928   509563     0 107117
                        ALL-SYSTEMS.MCAST.N
                        08:00:69:07:e3:93
fa0  9188  198.29.38   198.29.38.206          0     0        0     0     0
                        ALL-SYSTEMS.MCAST.N
qaa0 9180  fore-sw     198.29.22.206          0     0        0     0     0
qaa1*9180  none        none                   0     0        0     0     0
lo0  8304  loopback    localhost          32072     0    32072     0     0
                        ALL-SYSTEMS.MCAST.N
```

asxmon <switch_name>

```
ASX-200 switch up 3:35, 17 ports (9 active), software 2.3.5, hardware 1.1
port name            uptime VPs/max VCs/max    Kb/s    free     max   total Mb
 B1  198.29.22.34      2:57   1/1     5/5         0       0  140000        847
 B2  198.29.22.18      3:35   1/1     3/3         0       0  140000        141
 C1  198.29.22.27      3:35   1/1     4/4         0       0  140000      83035
 C2  198.29.22.3       3:35   1/1     4/4         0       0  140000         11
 D1  198.29.22.2       3:35   1/1     2/2         0       0  100000         11
 D2  198.29.22.11      3:35   1/1     3/3         0       0  100000         11
 CTL 198.29.22.37      3:35   1/1    36/36        0       0   80000        203
```

NOTE

In the output above, the **Kb/s** and **free** columns do not contain valid data.

cport <switch_name>

```
Input                    Output
Port Type Mb/s State Time       VPs  VCs   BW     Cells  VPs  VCs   BW     Cells
 B1  user  100 down  19:08:15     1    2  100         0    1    2  100    137783
 B2  user  100 down  19:08:15     1    2  100         0    1    2  100    137784
 B3  user  100 up    19:08:15     1    3  100    141332    1    4  100    149078
 B4  user  100 down  19:08:15     1    2  100         0    1    2  100    137784
 C1  user  140 up    19:08:15     1    4  140    140569    1    3  140    148928
 C2  net   140 up    02:44:38     1    7  140    1046 M    1    6  140    193732
 C3  net   140 up    19:08:15     1    5  140    1297 M    1    6  140    455400
 C4  user  140 up    19:06:57     1    5  140    138800    1    5  140    1046 M
 CTL user   80 up    19:08:13     1   22   80       1 M    1   22   80       1 M
```

The following commands are run by logging in to AMI and opening a session on the switch fabric. Enter the following parameters at the prompt:

configuration spans show

```
Port  VPI  State Type   CDVT  Action RemoteAddress
1C1     0  down  uni     250  tag
1C2     0  down  uni     250  tag
1C3     0  down  uni     250  tag
1C4     0  up    uni     250  tag    169.144.60.108
1D1     0  down  uni     250  tag
1D2     0  down  uni     250  tag
1D3     0  down  uni     250  tag
1D4     0  down  uni     250  tag
1CTL    0  up    uni       0  tag    10.10.10.48
```

configuration port show

```
Port Carrier   Mbps   CDVT  Policing VBROB BuffOB  AIS/RDI   Model
2A1  no       155.0    250  enabled    100    100  disabled  OC3
2A2  no       155.0    250  enabled    100    100  disabled  OC3
2A3  no       155.0    250  enabled    100    100  disabled  OC3
2A4  no       155.0    250  enabled    100    100  disabled  OC3
2C1  no       155.0    250  enabled    100    100  disabled  OC3
2C2  no       155.0    250  enabled    100    100  disabled  OC3
2C3  no       155.0    250  enabled    100    100  disabled  OC3
2C4  no       155.0    250  enabled    100    100  disabled  OC3
2E1  no      2560.0    100  disabled   100    100  disabled  ASX-BP
2E3  no      2560.0    100  disabled   100    100  disabled  ASX-BP
2E4  no      2560.0    100  disabled   100    100  disabled  ASX-BP
2CTL yes       80.0   5000  enabled    100    100  disabled  ASX-CTL
```

configuration uni show

```
 Port  VPI Version  State ILMI  Side     Type   OperType RemoteAddress
 1D1     0 uni30(a) up    up    network  auto   FT-PNNI  169.144.64.42
 1D2     0 auto (a) down  down  network  auto   privUNI
 1D3     0 uni30(a) up    up    user     auto   FT-PNNI  169.144.64.85
 1D4     0 auto (a) down  down  network  auto   privUNI
 1D5     0 uni30(a) up    up    user     auto   FT-PNNI  169.144.64.232
 1D6     0 auto (a) down  down  network  auto   privUNI
 1CTL    0 uni30(a) up    down  network  auto   privUNI
```

APPENDIX A AMI Overview

The switch software provides switch and connection management, IP connectivity, and SNMP network management. The Switch Control Software (SCS) is the “brains” of the switch. The SCS controls the switch board(s) and handles connection set-up and tear-down duties. The SCS can also communicate with other FORE Systems switches to learn network topology and establish connections across multiple switches. In addition, there is an SNMP agent built into the SCS to allow SNMP management and control.

The user interface to the SCS is called the ATM Management Interface (AMI). AMI can be run on any *ForeRunner* switch running *ForeThought* switch software version 3.0.1 or later. This chapter contains a description of how to log in to AMI, how to open or close an AMI session, and how to perform other AMI root level commands. AMI allows you to configure and to make statistical queries of various hardware and software aspects of *ForeRunner* switches and network modules by providing a hierarchical menu system similar to a UNIX file system. A single root menu provides a number of commands. Some of those commands, in turn, call submenus which provide a number of subcommands. At any given time, you work within a particular submenu which is indicated by the prompt. You can traverse a submenu one level at a time, or can traverse a number of levels simultaneously if the entire command string is known. For example, to show the current configuration of the network modules, enter the following at the prompt:

```
myswitch::> configuration module show
```

rather than entering one command line at a time as follows:

```
myswitch::> configuration

myswitch::configuration> module

myswitch::configuration module> show
```

Additionally, you only need to enter the minimum number of letters in a command which would make the command unique to that level. For example, you could enter **co m s** instead of **configuration module show**. However, the minimum number of letters entered must also distinguish the command from global commands, such as **up**. For example, you would have to enter **upc** to distinguish **upc** from the global command **up**.

AMI is described throughout this chapter using the following conventions:

- All AMI output, including user prompts, is shown in `courier` font.
- All user input; e.g., sub-commands, is shown in **`bold courier`** font.
- Each submenu is described in a separate section.
- Commands that are submenus are immediately followed by a ">" symbol. The ">" should not be entered as part of the command.
- Required parameter values are indicated inside angle brackets "< >". The "< >" should not be entered as part of the command.
- Optional parameter values are indicated inside square brackets "[ ]". The "[ ]" should not be entered as part of the command.
- Parameter values that require a choice are separated by vertical bars and are enclosed in parentheses "(|)" Neither the vertical bar nor the parentheses should be entered as part of the command.
- Optional parameter names are indicated with dashes "-".
- All port numbers are in BNP (board, network module, port) notation.
- AMI commands are not case-sensitive.

A.1 Initial Login from Serial Port

Initially, you must log in to the switch through the serial port. After you have performed the configurations listed in Chapter 2, you can reach the switch remotely via a telnet session.

A.1.1 Login from Serial Port

When connecting to the switch via the serial port, output similar to the following is displayed on your console:

```
S_ForeThought_5.0.0 Beta (1.10464) (le155) (fishtank)
```

Above, S_ForeThought_5.0.0 (1.10464) indicates the version of software, (le155) indicates what type of switch this is, and (fishtank) indicates the name that has been assigned to this SCP. If (ATM SWITCH) is displayed for the switch name, this means that no host name has been assigned yet.

Only one user may open an AMI session on an SCP at a time. If another AMI session is already in use, and you attempt to log in through the serial port, you receive a message similar to the following:

```
Userid <<userid>> is already logged into AMI.
Disable it? (y/n)
```

Entering **y** disables the other user's session and allows you to log in. Entering **n** aborts your login attempt.

At the login prompt, you must enter your userid. Initially, the only userid is **ami**. (**asx**, which is a default alias for **ami**, is also valid.) The userid **ami** is defaulted to use the local authentication method, to have admin privileges (meaning you are allowed to use all AMI commands), and all access (meaning you are allowed to login to AMI using all the possible methods).

Type **ami <ENTER>** for the login. For example:

```
login: ami <ENTER>
```

Initially, the userid **ami** has no assigned password. In this case, you are not prompted for a password and the following message is displayed:

```
Warning : Userid ami does not have a local password set.
          Please use "configuration security login password"
          to set the local password.
```

It is highly recommended that you assign a password to the **ami** userid since this userid has admin privileges. See Chapter 2 of the *ATM Management Interface (AMI) Manual* for more information.

On subsequent logins, you will be prompted for a password as follows:

```
Password:
```

Enter the password that has been assign for your userid. For security reasons, the switch does not echo your keystrokes when you enter a password.

After three unsuccessful login attempts, there is a five-second delay before you may attempt to login again.

If SecurID authentication has been configured, you are also prompted for the two-part SecurID passcode:

```
Enter PASSCODE: <PIN><Code on SecurID Token> <ENTER>
```

Once you enter the correct local password and, if applicable, the SecurID passcode, the following is displayed and a session is opened on the SCP:

```
ATM Management Interface v5.0
Copyright (c) 1994-1997 FORE Systems, Inc.
VxWorks Copyright (c) 1984-1996 Wind River Systems, Inc.
All Rights Reserved

General commands:
  '?' to get list of commands at the current level
  'up' to go up one menu level
  'top' to go to the root menu
  'exit' to leave AMI
Opening a session for "127.0.0.1", please wait...
Connected to "127.0.0.1" (le155).
myswitch::>
```

A.1.2 Login from Telnet

To telnet to the SCP, enter the following parameters at the > prompt on the host:

```
> telnet <address>
```

address Enter the IP address of the SCP.

For example, to telnet to an SCP with the IP address 204.95.89.231, enter the following:

```
> telnet 204.95.89.231
```

Only one user may open an AMI session on an SCP at a time. If another AMI session is already in use, and you attempt to log in through a telnet session, you receive a message similar to the following and are prevented from logging into the switch:

```
Userid <<userid>> is already logged into AMI.
Exiting...
```

If no other AMI session is running, something similar to the following is displayed:

```
Trying 204.95.89.231 ...
Connected to fishtank.
Escape character is '^]'.

S_ForeThought_5.0.0 Beta (1.10464) (le155) (fishtank)
```

Above, `S_ForeThought_5.0.0 Beta (1.10464)` indicates the version of software, `(le155)` indicates what type of switch this is, and `(fishtank)` indicates the name that has been assigned to this SCP. If `(ATM SWITCH)` is displayed for the SCP name, this means that no host name has been assigned yet.

At the login prompt, you must enter your userid. Type your assigned userid for the login and then enter the assigned password. For example:

```
login: myuserid <ENTER>
Password:       <ENTER>
```

For security reasons, the switch does not echo your keystrokes when you enter a password.

After three unsuccessful login attempts, there is a five-second delay before you may attempt to login again.

If you do not log in and enter the password within 60 seconds, the telnet session times out with the following message:

```
login: Login timed out after 60 seconds
```

If SecurID authentication has been configured, you are also prompted for the two-part SecurID passcode:

```
Enter PASSCODE: <PIN><Code on SecurID Token> <ENTER>
```

Once you enter the correct local password and, if applicable, the SecurID passcode, the following is displayed and a session is opened on the SCP:

```
ATM Management Interface v5.0
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All Rights Reserved

General commands:
  '?' to get list of commands at the current level
  'up' to go up one menu level
  'top' to go to the root menu
  'exit' to leave AMI
Opening a session for “127.0.0.1”, please wait...

Connected to “127.0.0.1” (le155).

myswitch::>
```

A.1.3 Logging in Remotely

You can also log in to another switch remotely using the **open** command. See Section A.2.9 for more information. This does not require the use of a password. For example, if you are logged in locally to a switch called fishtank (there is no asterisk (*) in front of the prompt), you can open a session to another switch. That switch's name is displayed with an asterisk (*) in front of it as your prompt.

```
myswitch::> open shark
shark::>
```

A.1.3.1 AMI Commands Not Available When Running Remotely

When you log in to a switch remotely, some of the AMI commands are not available. In the above example, since you are logged in locally to a switch called fishtank and you open a remote session to a switch called shark, some AMI commands will not work on shark.

The following sections list the commands that are not available when running a remote AMI session on the various switch platforms.

1.1.3.1.1 ASX-1000

The following commands are not available remotely on an ASX-1000:

- configuration system prompt
- configuration system syslog
- configuration system timeout
- operation cdb init
- operation flash copy
- operation flash delete
- operation flash dir
- operation flash delete
- operation flash free
- operation flash init
- operation flash rename
- operation panic
- operation reboot
- operation version

1.1.3.1.2 ASX-200BX and ASX-200WG with a 16 Mb SCP

The following commands are not available remotely on an ASX-200BX nor are they available remotely on an ASX-200WG that has a 16 MB SCP:

- configuration system prompt
- configuration system syslog
- configuration system timeout
- operation cdb init
- operation flash copy
- operation flash delete
- operation flash dir
- operation flash delete
- operation flash free
- operation flash init
- operation flash rename
- operation panic
- operation reboot
- operation version

1.1.3.1.3 *ForeRunnerLE* 155

The following commands are not available remotely on a *ForeRunnerLE* 155:

- configuration system prompt
- configuration system syslog
- configuration system timeout
- operation cdb init
- operation flash copy
- operation flash delete
- operation flash dir
- operation flash delete
- operation flash free
- operation flash init
- operation flash rename
- operation panic
- operation reboot
- operation version

A.2 AMI Root Menu for an Open Session

This menu is the root submenu for an AMI session. By typing a "**?**" at any prompt, a list of available commands at the current level is displayed. By typing a "**?**" at this root level prompt, the following list of available commands is shown:

```
myswitch::> ?
  about              close              configuration>     debug>
  display>           exit               help               history
  open               operation>         ping               redo
  rows               statistics>        top                up
```

Each of these root level commands is described in the following subsections.

A.2.1 About Command

By entering the **about** command at the root level prompt, you can display information regarding AMI and how to begin an AMI session on a host or on a switch.

```
myswitch::> about
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  materials which are a trade secret of FORE Systems, Inc. or its
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  Software is supplied to the Department of Defense (“DoD”), it is
  classified as “Commercial Computer Software” under paragraph
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  Regulations (“DFARS”) (or any successor regulations) and the
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  other than DoD, it is classified as “Restricted Computer Software”
  and the Government's rights in the Software are defined in
  paragraph 52.227-19 of the Federal Acquisition Regulations (“FAR”)
  (or any successor regulations) or, in the cases of NASA, in paragraph
  18.52.227-86 of the NASA Supplement to the FAR (or any successor
  regulations).

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  AMI uses SNMP to manage FORE Systems' ATM switches.
  AMI is platform independent and runs on hosts and FORE ATM switches.
  When AMI is executed on a host, you must first use the OPEN command
  to specify the switch to manage.  If AMI is started on a switch, it
  immediately opens a connection to itself.
```

A.2.2 Close Command

Any number of sessions may be opened to remote SCPs from your local SCP. An asterisk (*) is displayed in front of the remote switch's prompt to distinguish the local switch session from the remote one. However, only one AMI session may be open at a time on an LE 155. By typing **close** at the prompt, you can end the current AMI session.

If an individual session is closed, you are sent back to the last session that is still open. For example, if you opened a session on switch1 and on switch2 from your local SCP (myswitch), and you wanted to close the session on switch2, you would be sent back to the last open session which is on switch1 as follows:

```
*switch2::> close
*switch1::>
```

If you decided to close the session on switch1, you would be sent back to the last open session which is on your local SCP as follows:

```
*switch1::> close
myswitch::>
```

If all sessions are closed, you are sent back to the root prompt as follows:

```
myswitch::> close
>
```

At this point, you can open another session or exit the switch.

A.2.3 Configuration Commands

By entering **configuration** at the root level, you can access several subcommands that allow you to configure specific parts of the hardware or specific properties of the software. These commands are described fully in the *AMI Configuration Commands Reference Manual.*

A.2.4 Debug Commands

By entering **debug** at the root level, you can access several subcommands that give you more information which may help you to troubleshoot specific parts of the software. These commands are described fully in the *ATM Switch Diagnostics and Troubleshooting Manual.*

A.2.5 Display Commands

This command lets you display ATM routing information. You can display the available subcommand by typing **?** at the **display** level. By entering **display** at the root level, you can access several subcommands that allow you to display more ATM routing information. These commands are described fully in Chapter 3 of the *ATM Management Interface (AMI) Manual*.

A.2.6 Exit Command

The **exit** command lets you log out of the main AMI system. When entered, this command ends all open sessions on the SCP. Enter the following:

```
myswitch::> exit
Connection closed by foreign host.
```

A.2.7 Help Command

By typing **help** at any submenu level, a list of available commands at the current level, and a short description of each command, is shown. By typing **help** at the root level, the following commands and descriptions are shown:

```
myswitch::> help
General commands:
  '?' to get list of commands at the current level
  'up' to go up one menu level
  'top' to go to the root menu
  'exit' to leave AMI
  about                  - Display program information
  close                  - Close this connection
  configuration>         - System configuration submenu
  debug>                 - Switch debug submenu
  display>               - Switch display submenu
  exit                   - Exit AMI
  help                   - Display help for each command
  history                - Display command history
  open                   - Open a connection
  operation>             - Switch operation submenu
  ping                   - Ping a host or switch
  redo                   - Repeat a history command
  rows                   - Get/set number of rows
  statistics>            - Switch statistics submenu
  top                    - Go to the root menu
  up                     - Go up 1 menu level
```

A.2.8 History Command

By typing **history** at any prompt, you can list up to the last 20 previously typed commands for that particular session as follows:

```
myswitch::> history
    35  peer
    36  ptse
    37  stmap
    38  help
    39  ..
    40  ?
    41  span
    42  ?
    43  map
    44  ..
    45  help
    46  sp
    47  help
    48  con
    49  ?
    50  ..
    51  ?
    52  help
    53  ?
    54  his
```

A.2.9 Open Command

The **open** command lets you begin a session on a remote switch. At the prompt, enter the following parameters:

```
myswitch::> open <switch> [<community>]
```

These parameters are defined as follows:

Parameter	Description
switch	The IP address of the remote switch on which you want to open a session.
community[1]	The SNMP community string that indicates the level of access that you have on the switch. The default is `public`, which allows read-only access.

1. Although the default SNMP community string is `public`, you must use the `private` SNMP community string if you wish to make any changes on the remote SCP (e.g., if you want to create a SPANS SPVC to that SCP).

For example, to log in to a remote switch called fishtank that has an IP address of 192.25.6.113 using the `private` community string, enter the following parameters:

```
myswitch::> open 192.25.6.113 private
Opening a session for “192.25.6.113”, please wait...
Connected to “192.25.6.113” (le155).
*fishtank::>
```

An asterisk (*) is displayed in front of the remote switch’s prompt to distinguish the local switch from the remote one.

If another user already has an AMI session open on that SCP, then you are not permitted to log in to that SCP. You receive the following message:

```
Another ami is running on this switch. . Exiting...
Connection closed by foreign host.
```

If the remote switch to which you are connecting is running a different software version than the local switch, you receive the following caution:

```
myswitch::> open 192.25.6.128
Opening a session for “192.25.6.128”, please wait...
Connected to “192.25.6.128” (asx1000).
Host 192.25.6.128 running a different version. There may be some
incompatibilities.
```

A.2.10 Operation Commands

By entering **operation** at the root level prompt, you can access several subcommands that allow you to manage various parts of the switch. These commands are described fully in Chapter 4 of the *ATM Management Interface (AMI) Manual.*

A.2.11 Ping Command

The **ping** command lets you send a ping to another switch or a host to see if it is "alive," or reachable, by sending it an ICMP echo request and waiting for a response. You can access this command by entering **ping** at the root level. Enter the following parameters:

```
myswitch::> ping <IP-address>
```

This parameter is defined as follows:

Parameter	Description
IP-address[1]	The IP address of the host or switch to which the ping is sent.

1. The ping is always sent from the first switch or host on which AMI was originally started. For example, you are logged into switch A. From there, you open a session to switch B. If you enter the **ping** command while in your session on switch B, the ping is sent from switch A, NOT from switch B.

A.2.12 Redo Command

The **redo** command can be used in conjunction with the **history** command. It lets you repeat a command that was given in the same open session. You can access this command by entering **redo** at any level. To repeat the last command that was performed, enter **redo** with no additional parameters as follows:

```
myswitch::> redo
```

To repeat a command given within the last 20 commands in the same open session, enter the following parameters:

```
myswitch::> redo <command-number>
```

This parameter is defined as follows:

Parameter	Description
command-number	The command and the number associated with the command that was previously performed by the switch during this same session. Enter the **history** command to list the previous commands and their associated numbers as shown in the following example.

Type **history** at the prompt to list the last 20 previously typed commands for that particular session as follows:

```
myswitch::> history

1  oper env cpu
2  stat
3  ?
4  module
5  show
6  port
7  spans
8  tcp
9  udp
10  vcc
11  help
12  history
```

Then, to repeat a previously given command, type **redo** and the command number at the prompt. For example, to repeat command number 8, which is listing statistics for tcp, enter the following:

```
myswitch::> redo 8

tcp Counter                    Value
------------------------------ --------------------
tcpActiveOpens                                    1
tcpPassiveOpens                                  49
tcpAttemptFails                                   0
tcpEstabResets                                    1
tcpCurrEstab                                      1
tcpInSegs                                     14060
tcpOutSegs                                     9967
tcpRetransSegs                                    0
```

A.2.13 Rows Command

The **rows** command allows users to set the number of rows that their terminal displays. Users can access this command by entering **rows** at the root level as follows:

```
myswitch::> rows [<rows>]
Terminal Rows = 24
```

This parameter is defined as follows:

Parameter	Description
rows	The number of terminal rows to be used.

A.2.14 Statistics Commands

By entering **statistics** at the root level, you can access several commands that display operational performance and error information for the various hardware and software features of the switch and the network modules. These commands are described fully in Chapter 5 of the *ATM Management Interface (AMI) Manual*.

A.2.15 Top Command

By entering **top** at any level, you are sent to the root level of AMI. For example, if you are at the operation cdb level and you want to go directly to the root level, simply enter **top** at the prompt as follows:

```
myswitch::operation cdb> top
myswitch::>
```

A.2.16 Up Command

Entering **up** allows you to go up one menu level. For example, if you are at the **configuration port traffic** level and you want to go one level above that to **configuration port**, simply enter **up** at the prompt as shown here.

```
myswitch::configuration port traffic> up
myswitch::configuration port>
```

Entering the characters **..** has the same effect as entering the command **up**. For example,

```
myswitch::configuration port traffic> ..
myswitch::configuration port>
```

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