ATM Management Interface (AMI) Manual

MANU0021-06
Revision A
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Software Version 6.0.x

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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 *TNX*-210, *TNX*-1100, *ASX*-200WG, *ASX*-200BX, *ASX*-1000, *ASX*-1200, *ASX*-4000, *ForeRunnerLE* 25, and *ForeRunnerLE* 155 have 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.

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."

VCCI CLASS A NOTICE

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This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this equipment is used in a domestic environment, radio disturbance may arise. When such trouble occurs, the user may be required to take corrective actions.

AUSTRALIA EMC COMPLIANCE

This product has been tested and found to comply with the Class A electromagnetic compatibility limits specified in AS/NZ 3548.

FCC REQUIREMENTS (Notice to Users of DS1 Service)

The following instructions are provided to ensure compliance with the FCC Rules, Part 68.

(1) This device must only be connected to the DS1 network connected behind an FCC Part 68 registered channel service unit. Direct connection is not allowed.

(2) Before connecting your unit, you must inform the telephone company of the following information:

Port ID	REN/SOC	FIC	USOC
NM-6/DS1C NM-2/DS1C NM-8/DS1D NM-4/DS1D	6.0N	04DU9-BN, 04DU9-DN, 04DU9-1ZN 04DU9-1SN, and 04DU9-1KN	RJ48C

(3) If the unit appears to be malfunctioning, it should be disconnected from the telephone lines until you learn if your equipment or the telephone line is the source of the trouble. If your equipment needs repair, it should not be reconnected until it is repaired.

(4) If the telephone company finds that this equipment is exceeding tolerable parameters, the telephone company can temporarily disconnect service, although they will attempt to give you advance notice if possible.

(5) Under the FCC Rules, no customer is authorized to repair this equipment. This restriction applies regardless of whether the equipment is in or out of warranty.

(6) If the telephone company alters their equipment in a manner that will affect use of this device, they must give you advance warning so as to give you the opportunity for uninterrupted service. You will be advised of your right to file a complaint with the FCC.

CANADIAN IC CS-03 COMPLIANCE STATEMENT

NOTICE: The Industry Canada label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational and safety requirements. The Industry Canada label does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

E1 AND E3 NOTICE

The E1 (NM-6/E1C and NM-2/E1C) and E3 (NM-4/E3C and NM-2/E3C) network modules that are described in this manual are approved for use in FORE Systems' host systems providing that the instructions below are strictly observed. Failure to follow these instructions invalidates the approval.

Pan European Approval - CE Marking

Pan European approval of the E1 network module was issued by BABT following assessment against CTR12. This means that it can be connected to ONP and unstructured PTO-provided private circuits with 120 Ω interfaces in all European countries, according to Telecommunications Terminal Equipment (TTE) Directive 91/263/EEC. Thus, the following CE mark applies:

CE168X

The E1 and E3 network modules conform to safety standard EN60950 1992 following the provisions of Low Voltage Product Safety Directive 73/23/EEC and CE Marking Directive 93/68/EEC, and can be marked accordingly with the CE symbol.

The E1 and E3 network modules conform to EN55022 1994 and EN50082-1 1992 following the provisions of the EMC Directive 89/336/EEC, and can be marked accordingly with the CE symbol.

National Approvals

UK

Network Module	Connects to	Approval Number
E1	Structured and unstructured PTO-provided private circuits with 75 Ω interfaces	AA60953
E3	PTO-provided private circuits with 75 Ω interfaces	NS/4387/1/T/605954

Germany

Network Module	Connects to	Approval Number
E3	Structured PTO-provided private circuits with 75 Ω interfaces	A127535H for the ASX-1000 A127534H for the ASX-200BX or ASX-200WG

Switzerland

Network Module	Connects to	Approval Number
E1	Structured PTO-provided private circuits with 120 Ω interfaces	96.0872.J.N
E3	Structured PTO-provided private circuits with 75 Ω interfaces	96.0873.J.N

Required User Guide Statements - UK Installation

The use of auxiliary products not authorized by FORE Systems® in FORE Systems ATM Switches may cause the power specification to be exceeded and is a potential safety hazard.

The equipment must be installed such that with the exception of the connections to the host, clearance and creepage distances shown in the table below are maintained between the network module and any other assemblies which use or generate a voltage shown in the table below. The larger distance shown in brackets applies where the local environment within the host is subject to conductive pollution or dry non-conductive pollution which could become conductive due to condensation. Failure to maintain these minimum distances invalidates the approval.

Clearance (mm)	Creepage (mm)	Voltage Used or Generated by Host or by Network Modules
2.0	2.4 (3.8)	Up to 50 V_{rms} or V_{dc}
2.6	3.0 (4.8)	Up to 125 V_{rms} or V_{dc}
4.0	5.0 (8.0)	Up to 250 V_{rms} or V_{dc}
4.6	6.4 (10.0)	Up to 300 V_{rms} or V_{dc}

For a host or other expansion card fitted in the host, using or generating voltages greater than 300V (rms or dc), advice from a competent telecommunications engineer must be obtained before installation of the relevant equipment.	Above 300 V_{rms} or V_{dc}

NOTE: Installing the network modules in the appropriate FORE Systems hosts, according to the installation instructions provided, satisfies the requirements listed above.

The following tables show the available ports and their safety status:

NM-6/E1C and NM-2/E1C

Ports	Safety Status
E1 Ports	TNV operating at SELV
Bus Connector	SELV

NM-4/E3C and NM-2/E3C

Ports	Safety Status
E3 Ports	TNV operating at SELV
Bus Connector	SELV

SAFETY CERTIFICATIONS

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

Table of Contents

CHAPTER 3 AMI Operation Commands

CHAPTER 4 AMI Statistics Commands

Preface

This manual provides the technical information needed to configure the ATM Management Interface (AMI) for the *ForeRunner*® family of ATM Switches, *ForeRunnerLE*® Switches, *TNX*™ ATM Switches, and ESX™-3000 Switch. This document was created for users with various levels of experience. If you have any questions or problems, please contact the FORE Systems' Technical Assistance Center (TAC).

Chapter Summaries

Chapter 1 - AMI Overview - Provides an overview of AMI and contains a text and graphical description of the root level AMI commands.

Chapter 2 - AMI Display Commands - Contains a text and graphical description of the display level AMI commands.

Chapter 3 - AMI Operation Commands - Contains a text and graphical description of the operation level AMI commands.

Chapter 4 - AMI Statistics Commands - Contains a text and graphical description of the statistics level AMI commands.

Acronyms - Contains a list of common networking acronyms.

Glossary - Contains definitions for networking terms, both general and ATM-specific.

Related Manuals

References are made in this manual to the following manuals:

AMI Configuration Command Reference Manual, Part 1 - Describes the configuration level AMI commands and menus from **`configuration alarms>`** to **`configuration nsap>`**.

AMI Configuration Command Reference Manual, Part 2 - Describes the configuration level AMI commands and menus from **`configuration port>`** to **`configuration vpt>`**.

ATM Switch Diagnostics and Troubleshooting Manual - Describes the debug level AMI commands and menus. Also, describes error messages, loopbacks, SCP diagnostics, and ATM Forum PNNI debugging information.

ATM Switch Network Configuration Manual - Discusses topics such as LAN Emulation, Classical IP, ATM Forum PNNI, and *ForeThought*® PNNI.

These manuals can be found on the CD and can be read and printed using Acrobat Reader which is also included on the CD. If Acrobat Reader is installed locally, run Acrobat and open the manual from the `/DOCS` directory of the CD. If Acrobat Reader is not installed locally, run the Acrobat installer to load Acrobat Reader on your machine. Then run the `ACROREAD.EXE` file in the `/DOCS` directory of the CD.

Technical Support

In the U.S.A., customers can reach FORE Systems' Technical Assistance Center (TAC) using any one of the following methods:

1. Select the "Support" link from FORE's World Wide Web page:

   http://www.fore.com/

2. Send questions, via e-mail, to:

   support@fore.com

3. Telephone questions to "support" at:

   800-671-FORE (3673) or **724-742-6999**

4. FAX questions to "support" at:

   724-742-7900

Technical support for customers outside the United States should be handled through the local distributor or via telephone at the following number:

+1 724-742-6999

No matter which method is used to reach FORE Support, customers should be ready to provide the following:

- A support contract ID number
- The serial number of each product in question
- All relevant information describing the problem or 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 ensure correct and complete installation, as well as to avoid damage to the FORE Systems product or to 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 FORE Systems product, the system, or currently loaded software, and is indicated as follows:

WARNING!

Hazardous voltages are present. To reduce the risk of electrical shock and danger to personal health, follow the instructions carefully.

CAUTION statements contain information that is important for proper installation/operation. Compliance with **CAUTION** statements can prevent possible equipment damage and/or loss of data and are 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 is set off from the text as follows:

If you change the value 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.

Laser Warning

Every FORE Systems network module having a single mode fiber optic interface contains a Class 1 laser.

Class 1 Laser Product:
This product conforms to applicable requirements of 21 CFR 1040 at the date of manufacture.

Class 1 lasers are defined as products which do not permit human access to laser radiation in excess of the accessible limits of Class 1 for applicable wavelengths and durations. These lasers are safe under reasonably foreseeable conditions of operation.

WARNING!

Do not stare into the beam or view the beam with optical instruments.

Safety Precautions

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

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.

CHAPTER 1 AMI Overview

ForeThought switch software provides switch and connection management, IP connectivity, and SNMP network management. The Switch Control Software (SCS) resides on the Switch Control Processor (SCP) and 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 and any *TNX* switch running *ForeThought* switch software version 5.1 or later. This chapter contains a description of how to log in and navigate in AMI.

1.1 Entering Commands in AMI

AMI allows you to configure and to make statistical queries of various hardware and software aspects of *ForeRunner* and *TNX* 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, the AMI prompt indicates your current location within the AMI menu. You can traverse a menu 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. For example, 1A4 indicates the first switch board, network module A, port 4. For more information about port numbering, see the *Installation and Maintenance Manual* for your switch.
- AMI commands are not case-sensitive.

1.2 Logging into a Switch

You can log in to a switch in several different ways:

- via the serial port
- via telnet
- via a remote AMI session from another switch
- via *ForeView*
- via *Element Manager*

The first three methods are described here. For information about logging in via *ForeView*, please see the *ForeView Network Management User's Manual*. For information about logging in via *Element Manager*, please see the *ForeThought Element Manager Quick Start Guide*. Initially, you must log in to the switch through the serial port.

1.2.1 Login from the Serial Port

When connecting to the switch via the serial port, only one user may open an AMI session on an SCP at a time. If an 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.

On a new switch, there are two separate default userids: `ami` and `asx`. Both are configured with the `local` authentication method (user is prompted for a login ID (userid) and a password unless user tries to open an AMI session via a remote switch or via *ForeView*), with `admin` privileges (meaning you are allowed to use all AMI commands), and `all` access (meaning you are allowed to login to the switch using all the possible methods). Both userids are assigned a null password.

At the login prompt, you must enter your userid. For example:

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

If your userid has no assigned password, 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 and to the `asx` userid, since these userids have `admin` privileges by default. For more information, see the *ATM Switch Network Configuration Manual* and see Part 2 of the *AMI Configuration Commands Reference Manual*.

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 you login with a userid that has been configured for SecurID authentication, you are instead prompted for the two-part SecurID passcode. When a user is configured for SecurID authentication and he or she attempts to log in, the user is prompted for a login ID (userid) and a SecurID passcode. The two-part passcode consists of: a secret, memorized personal identification number (PIN) and the current code generated by the user's assigned SecurID token. (The passcode is not required if the user tries to open an AMI session via a remote switch or via *ForeView*.) After a validation check is made, an AMI session is started (provided that a local AMI session is not already running).

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

If you enter an incorrect passcode three times in a row, you are prompted to enter the two-part SecurID passcode and the next Tokencode. At the next Tokencode prompt, wait until the display changes on your SecurID token and enter either your PIN number and that next code number, or just that next code number.

```
login: test1
Enter PASSCODE:
Login incorrect

login: test1
Enter PASSCODE:
Login incorrect

login: test1
Enter PASSCODE:
Login incorrect

login: test1
Enter PASSCODE:
next Tokencode:
```

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

```
ATM Management Interface v6.0.0
Copyright (c) 1994-1998 FORE Systems, Inc.
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” (asx200bx).
myswitch::>
```

There are several different possible login scenarios. See the *ATM Switch Network Configuration Manual* for your switch for a list of scenarios and the action the switch takes for each.

1.2.2 Login from Telnet

Three different types of telnet sessions can be requested, depending on the authentication type you are assigned:

- local authentication
- Kerberos authentication
- SecurID authentication.

1.2.2.1 Using Local Authentication

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 an 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_6.0.0 (1.22914) (asx200bx) (fishtank)
```

1.2.2.2 Using Kerberos Authentication

If a DES encrypted telnet session has been requested and authentication has been successful, the following displays:

```
Trying 169.20.4.21...
Connected to fishtank.
Escape character is '^]'.
[ Kerberos V5 accepts you as ``jsmith@FORE.COM'' ]

S_ForeThought_6.0.0 (1.29680+30d) (asx200bx) (fishtank)
```

If Kerberos authentication has failed, the following displays:

```
Trying 172.19.4.20...
Connected to magic-swslab.eng.fore.com.
Escape character is '^]'.
Authentication negotiation has failed, which is required for encryption.
Good bye.
```


`S_ForeThought_6.0.0 (1.22914)` indicates the version of software, `(asx200bx)` 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.

On a new switch, there are two separate default userids: `ami` and `asx`. Both are configured with the `local` authentication method (user is prompted for userid and password), with `admin` privileges (meaning you are allowed to use all AMI commands), and `all` access (meaning you are allowed to login to the switch using all the possible methods). Both userids are assigned a null password.

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.

NOTE 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
```

1.2.2.3 Using SecurID Authentication

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

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

If you enter an incorrect passcode three times in a row, you are prompted to enter the two-part SecurID passcode and the next Tokencode. At the next Tokencode prompt, wait until the display changes on your SecurID token and enter either your PIN number and that next code number, or just that next code number.

```
login: test1
Enter PASSCODE:
Login incorrect

login: test1
Enter PASSCODE:
Login incorrect

login: test1
Enter PASSCODE:
next Tokencode:
```

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

```
ATM Management Interface v6.0.0
Copyright (c) 1994-1998 FORE Systems, Inc.
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” (asx200bx).
myswitch::>
```

NOTE

There are several different possible login scenarios. See the *ATM Switch Network Configuration Manual* for your switch for a list of scenarios and the action the switch takes for each.

1.2.3 Logging in Remotely

You can also log in to another switch remotely using the **open** command. See Section 1.3.9 for more information. This does not require the use of a password. For example, if you are locally logged in 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.

```
fishtank::> open 208.121.29.2 private
Opening a session for "208.121.29.2", please wait...
Connected to "208.121.29.2" (asx200bx).
*shark::>
```

To return to the local session, you must type **localhost** (instead of the prompt name).

```
*shark::> localhost
fishtank::>
```

1.2.3.1 AMI Commands Not Available 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 commands are not available remotely when running a remote AMI session on an *ASX*™-200WG (with a 16 MB SCP), *ASX*-200BX, *ASX*-1000, *ASX*-1200, *ASX*-4000, *ESX*-3000, *ForeRunnerLE*™ 25, *ForeRunnerLE* 155, *TNX*-210, or a *TNX*-1100:

- configuration http>
- configuration system prompt
- configuration system syslog
- configuration system timeout
- operation cdb init
- operation flash>
- operation panic>
- operation reboot
- operation version

1.3 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               startup            statistics>        top
  up
```

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

1.3.1 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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  (or any successor regulations) or, in the cases of NASA, in paragraph
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  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.
```

1.3.2 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 per switch may be open at any time. 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.

1.3.3 Configuration Commands

By entering **configuration** at the root level, you can access a directory of subcommands that allow you to configure specific parts of the hardware or specific properties of the software. The commands and menus from **configuration alarms>** to **configuration nsap>** are described in detail in Part 1 of the *AMI Configuration Commands Reference Manual.* The commands and menus from **configuration port>** to **configuration vpt>** are described in detail in Part 2 of the *AMI Configuration Commands Reference Manual.*

1.3.4 Debug Commands

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

1.3.5 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 a directory of subcommands that allow you to display more ATM routing information. These commands are described in detail in Chapter 2 of this manual.

1.3.6 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.
```

1.3.7 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
```

1.3.8 History Command

By typing **history** at any prompt, you can list up to the last 50 previously typed commands for that particular session:

```
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
```

1.3.9 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 208.29.16.113 private
Opening a session for “208.29.16.113”, please wait...
Connected to “208.29.16.113” (asx200bx).
*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:

```
Userid “eng“ is already logged into AMI.
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 209.21.14.108
Opening a session for “209.21.14.108”, please wait...
Connected to “209.21.14.108” (asx200bx).
Host 209.21.14.108 running a different version. There may be some
incompatibilities.
```

1.3.10 Operation Commands

By entering **operation** at the root level prompt, you can access a directory of subcommands that allow you to manage various parts of the switch. These commands are described in detail in Chapter 3 of this manual.

1.3.11 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.

1.3.12 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 50 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 50 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  stat scp 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
```

1.3.13 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.

1.3.14 Startup Command

This command guides you through a series of questions to help you quickly configure a new switch or to change the configuration on an existing switch.

1.3.14.1 Typical Configuration Session

The following screens address questions that must be answered for proper configuration, and contain samples of the text that may appear on your screen during the configuration process. User inputs to prompts are indicated in bold e.g., **myswitch <ENTER>**.

Default values are provided (if available) inside of square brackets [ ] after each question. To accept the default value, simply use the **<ENTER>** key. If you press the **<ENTER>** key and no default value exists, then that question is skipped. When running this command on an existing switch, the current setting is displayed as the default value for each question.

To display help at any question, type a **?**.

To abort this command, type **quit** or **exit** at any question. Any changes made up to that point are put into effect and you receive the following error message:

```
What name do you want to give the switch? [myswitch]: exit
?ERROR: aborting startup. Any changes made have been saved.
```

You must have **admin** level security privileges to run this command.

The prompts that you see while using this command vary based on the level of software license that you enable, and based on answers to previous questions. The prompts presented in your actual session reflect the license level you have entered and the configuration that you wish to implement.

An example session is shown here. Each of the prompts and answers are discussed in the subsections that follow the example session. In those subsections, the question will be shown first, and the explanations of effects of the possible replies are shown after the questions.

To begin the configuration session, enter the following command:

startup

The following is an example of a typical configuration:

```
myswitch::> startup
Welcome to the ForeThought startup configuration wizard.
Just answer a few questions, and the switch will be set up to meet your needs.

If at any time you wish to have a question clarified, type “?”.
You can abort the startup configuration at any time by typing “exit”.
Any changes made before typing “exit” have been saved.
To skip a question (or accept the listed default), press <Enter>.

What name do you want to give the switch?: fishtank
The switch has been configured with the name fishtank.

What is this switch’s software license key: [Base] A12345678901
You are entitled to this license’s features: A12345687901 (Enterprise).

IP interface to configure (ethernet/lane/none)? [ethernet]:
The following two questions apply to the ethernet interface.

What IP address do you want to give the switch?: 174.88.2.11

And what network mask? [255.255.255.0]: 255.255.253.0
The switch now has IP address 174.88.2.11 with mask 255.255.253.0 on ie0.

What is the address for the gateway router?: 174.88.2.1
The switch has been configured to use 174.88.2.1 as the default gateway.

Would you like to select a new password (y/n)? [n]: y
Old local password:
New local password:
Retype new local password:

Password successfully changed.
The switch has been configured with the new password.
```

```
What is the address of your ForeView management console?: 174.88.2.65
The ForeView management console has been configured.

Only permit access from the ForeView management console (y/n)? [n]: y
Only the ForeView management console may access the switch.

Would you like to run LAN Emulation services on this switch (y/n)? [n]: y

This switch has been configured to offer LAN Emulation services.

It has a LAN Emulation Configuration Server (LECS) available at the standard
well-known address. Every workstation, server and ATM uplink that connects
to this LECS will be directed to an ELAN named 'default', which is configured
to support Ethernet emulation and packets up to 1514 bytes long.  The LAN
Emulation Server (LES) and Broadcast/Unknown Server (BUS) for this ELAN are
operating on this switch. These services will support LANE 1.0, LANE 2.0 and
MPOA clients.

Which routing protocol should this switch run (pnni/ftpnni)? [pnni]: <ENTER>

Your switch has now been configured.

One or more of the changes you have made requires the switch to be rebooted
before the change will take effect.
Would you like to reboot the switch now (y/n)? [y]: y
```

1.3.14.1.1 Configuring the Switch Name

The first prompt asks you to name the switch. Enter the name you want to give the switch. When the switch name is configured using this command, the new switch name is stored in the CDB and persists across reboots. Also, the prompt name changes immediately to match new switch name. If this is a new switch, then no default name is shown.

```
What name do you want to give the switch?: fishtank
The switch has been configured with the name fishtank.
```

For more information about configuring a switch name, see Chapter 13 in Part 2 of the *AMI Configuration Commands Reference Manual.*

1.3.14.1.2 Configuring the Software License Key

Next, you are prompted to enter a software license key. If you have purchased a software license for your switch, enter the 12-character key. Otherwise, hit **<Enter>** to use the default license.

```
What is this switch's software license key: [Base] A12345678901
```

For more information about software license keys, see Chapter 13 in Part 2 of the *AMI Configuration Commands Reference Manual*.

Depending on what type of license you have configured, you may or may not see the remaining prompts.

1.3.14.1.3 Configuring an IP Interface

The next prompt asks you to configure an IP interface. On a new switch, the `ie0`, `asx0`, `qaa0`, `qaa1`, `qaa2`, and `qaa3` interfaces are not configured. An IP address for at least one of the interfaces must be configured to allow IP access to the switch, which in turn, enables SNMP access. By setting the IP address of the FORE IP (`asx0`) or one of the Classical IP (`qaa`) interfaces, in-band (over ATM) access to the switch control processor (SCP) is enabled. By setting the IP address of the Ethernet IP (`ie0`) interface, out-of-band access to the SCP is enabled.

For more information about Ethernet IP addresses, please see Chapter 2 in the *Installation and Maintenance Manual* for your switch, or Chapter 12 in Part 1 of the *AMI Configuration Commands Reference Manual*. For more about information LANE IP addresses, please see Chapter 2 in the *Installation and Maintenance Manual* for your switch, or Chapter 13 in Part 1 of the *AMI Configuration Commands Reference Manual*.

On an *ASX*-1000, *ASX*-1200, or a *TNX*-1100, the IP address must be configured individually on each SCP.

```
IP interface to configure (ethernet/lane/none)? [ethernet]:
```

The `ethernet` option is not offered on and does not apply to switches that do not have an Ethernet port.

If you choose ethernet, you are prompted with the questions in Section 1.1.1.1.4 and Section 1.1.1.1.5. If you choose lane, a default LEC with selector byte 00 is created and you are prompted with the questions in Section 1.1.1.1.4 and Section 1.1.1.1.5. If you choose none, the questions in Section 1.1.1.1.4 and Section 1.1.1.1.5 are skipped.

1.3.14.1.4 Configuring an IP Address

The following prompt appears only if you answered ethernet or lane to the previous question. You are asked to configure an IP address. An IP address is a unique 32-bit integer used to identify a device in an IP network. The IP address must be entered in dotted decimal notation. If the Ethernet or LANE interface has an IP address, then that is shown as a default address.

```
The following two questions apply to the ethernet interface.

What IP address do you want to give the switch?: 174.88.2.11
```

For more information about IP addresses, please see Chapter 2 in the *Installation and Maintenance Manual* for your switch, or Chapter 12 in Part 1 of the *AMI Configuration Commands Reference Manual*.

1.3.14.1.5 Configuring a Network Mask

The following prompt appears only if you answered ethernet or lane to the question in Section 1.1.1.1.3. You are asked to configure a network mask. 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. The IP subnet mask must be entered in dotted decimal notation.

```
And what network mask? [255.255.255.0]: 255.255.253.0
The switch now has IP address 174.88.2.11 with mask 255.255.253.0 on ie0.
```

For more information about network masks, please see Chapter 2 in the *Installation and Maintenance Manual* for your switch, or Chapter 12 in Part 1 of the *AMI Configuration Commands Reference Manual*.

1.3.14.1.6 Configuring a Gateway Router

Next, you are prompted to configure a gateway router. This is a static IP route that you can add to the local IP routing table. The gateway address must be entered in dotted decimal notation.

```
What is the address for the gateway router?: 174.88.2.1
The switch has been configured to use 174.8.2.1 as the default gateway.
```

For more information about gateway routers, please see Chapter 2 in the *Installation and Maintenance Manual* for your switch, or Chapter 12 in Part 1 of the *AMI Configuration Commands Reference Manual*.

1.3.14.1.7 Configuring a Password

The administrative password on your switch may be changed to provide password-protected access to AMI. It is highly recommended that you do this to prevent unauthorized users from accessing your switch.

The password can be up to 512 characters long. When the password is changed, the old password must be entered correctly before a new password can be entered. The switch does not echo your keystrokes when you enter a password.

```
Would you like to select a new password (y/n)? [n]: y
Old local password:
New local password:
Retype new local password:

Password successfully changed.
The switch has been configured with the new password.
```

For complete information about how to assign or change the password and how to configure userids, please see Chapter 8 in Part 2 of the *AMI Configuration Commands Reference Manual.*

1.3.14.1.8 Configuring the *ForeView* Management Console Address

If one or more trap destinations have already been defined, then the first destination is shown as the default. This address must be entered in dotted decimal notation.

```
What is the address of your ForeView management console?: 174.88.2.65
The ForeView management console has been configured.
```

1.3.14.1.9 Configuring Access to the *ForeView* Management Console

If the address entered for the previous question is listed in the IP filtering table, then this question is skipped. Answering **y** to this prompt adds the address from the previous question to the IP filtering table.

CAUTION

If no other entries exist in the IP filtering table, access to this switch is blocked from all sources except the address listed.

```
Only permit access from the ForeView management console (y/n)? [n]: y
Only the ForeView management console may access the switch.
```

1.3.14.1.10 Configuring LANE Services

If a default ELAN exists, this question is skipped. If you answer **y**, a default ELAN is created.

```
Would you like to run LAN Emulation services on this switch (y/n)? [n]: y

This switch has been configured to offer LAN Emulation services.

It has a LAN Emulation Configuration Server (LECS) available at the standard
well-known address. Every workstation, server and ATM uplink that connects
to this LECS will be directed to an ELAN named 'default', which is configured
to support Ethernet emulation and packets up to 1514 bytes long.  The LAN
Emulation Server (LES) and Broadcast/Unknown Server (BUS) for this ELAN are
operating on this switch. These services will support LANE 1.0, LANE 2.0 and
MPOA clients.
```

For more information about LAN Emulation, please see Chapter 3 in the *ATM Switch Network Configuration Manual*. For more information about a default ELAN, please see Chapter 13 in Part 1 of the *AMI Configuration Commands Reference Manual.*

1.3.14.1.11 Configuring the Routing Protocol

You are prompted to choose a default routing protocol. The switch can support either ATM Forum PNNI Version 1.0 (PNNI) or *ForeThought* PNNI, which is FORE's pre-standard version of PNNI (FT-PNNI). The default is PNNI. If you answered `base` to the software license key question in Section 1.1.1.1.2, this question does not appear.

```
Which routing protocol should this switch run (pnni/ftpnni)? [pnni]:
```

For more information about ATM Forum PNNI, please see Chapter 6 in the *ATM Switch Network Configuration Manual*, or Chapter 4 in Part 1 of the *AMI Configuration Commands Reference Manual*. For more information about FT-PNNI, please see Chapter 5 in the *ATM Switch Network Configuration Manual*, or Chapter 4 in Part 1 of the *AMI Configuration Commands Reference Manual*.

1.3.14.1.12 Rebooting the Switch

The answers to some of the previous questions may require that you reboot the switch for the changes to take effect.

```
Your switch has now been configured.

One or more of the changes you have made requires the switch to be rebooted
before the change will take effect.
Would you like to reboot the switch now (y/n)? [y]: y
```


1.3.15 Statistics Commands

By entering **`statistics`** at the root level, you can access a directory of subcommands 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 in detail in Chapter 4 of this manual.

1.3.16 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::>
```

1.3.17 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>
```

1.4 AMI Command Line Editing

This feature allows easier configuration of the switch. You scroll through the commands stored in AMI's history. Then you can edit the lines by deleting, inserting, and replacing characters. This is particularly useful if you need to enter several long command strings that are similar.

When editing a line, the current cursor position is always in "insert" mode. Cursor movements are controlled using standard ANSI terminal escape sequences. Non-ANSI terminals are not supported.

The following key sequences are supported by this feature:

Key Sequence	Description
up and down arrow keys	The up and down arrows keys on a standard keyboard let you toggle through the history of AMI commands. The up arrow displays the previous command in AMI's history. The down arrow displays the following command in AMI's history.
left and right arrow keys	The left and right arrows let you move the cursor over a displayed AMI command. The displayed line is not modified. Only the cursor position is changed.
Control-P	This key sequence has the same effect as using the up arrow key.
Control-N	This key sequence has the same effect as using the down arrow key.
Control-B	This key sequence has the same effect as using the left arrow key.
Control-F	This key sequence has the same effect as using the right arrow key.
Control-A	This key sequence moves the cursor to the beginning of the line being edited.
Control-E	This key sequence moves the cursor to the end of the line being edited.
Control-H	This key sequence deletes the character before the current cursor position.
Control-D	This key sequence deletes the character under the current cursor position.
Control-K	This key sequence deletes everything on the line being edited from the current cursor position to the end of the line. The deleted characters are saved in a temporary buffer.
Control-U	This key sequence deletes all characters on the current line. The deleted characters are saved in a temporary buffer.
Control-Y	This key sequence restores the characters that were deleted by the last Control-K or Control-U sequence. This key sequence has no effect if nothing has been deleted.
Control-J	This key sequence returns the current line to AMI to be executed.
Control-L	This key sequence clears the terminal screen. The current AMI prompt and the current AMI command are re-displayed at the top of the screen.

CHAPTER 2 AMI Display Commands

This chapter contains a detailed description of the AMI **display** commands. The main **display** menu can be found at the root level. There is one main menu under **display** that contains other submenus. Commands that are submenus are immediately followed by a ">" symbol. Typing **?** at the **display** level lists these commands as follows:

```
myswitch::display> ?
  atmroute>          hdcomp
```

2.1 Displaying ATM Routing Information

These commands let you display ATM routing information. You can display the list of available subcommands by typing **?** at the **atmroute** level.

```
myswitch::display atmroute> ?
  ftpnni>          ptab             pnni>            spans>
```

2.1.1 Displaying FT-PNNI Routing Information

This command lets you display *ForeThought* PNNI route information. You can display the list of available subcommands by typing **?** at the **ftpnni** level.

```
myswitch::display atmroute ftpnni> ?
  map
```

2.1.1.1 Displaying FT-PNNI Network Map Information

This command lets you display the *ForeThought* PNNI topology database. This database consists of logical links (loglinks). Enter the following parameters:

```
myswitch::display atmroute ftpnni> map
 Board Src                                                SrcMask SrcPort SrcVpi
 0     0x47.0005.80.ffe100.0000.f243.000c.000000000000.00 104     128     0
       Dest                                               DstMask DstPort DstVpi
       0x47.0005.80.ffe100.0000.f243.000c.000000000000.00 104     128     0
       Cost Freshness EstUbrBw CbrCapacity VbrCapacity
       100  1         0        2396159     2396159
       Orig             CapabilitySet
       spans-pnni       0x0

 Board Src                                                SrcMask SrcPort SrcVpi
 0     0x47.0005.80.ffe100.0000.f243.000c.000000000000.00 104     192     0
       Dest                                               DstMask DstPort DstVpi
       0x47.0005.80.ffe100.0000.f243.000c.000000000000.00 104     192     0
       Cost Freshness EstUbrBw CbrCapacity VbrCapacity
       100  1         0        2396159     2396159
       Orig             CapabilitySet
       spans-pnni       0x0

Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
Board	The index number of this switch board.
Src	The ATM address of the source of this loglink.
SrcMask	The number of bits that are significant in the Src address.
SrcPort	The port through which the loglink is attached at the source.
Dest	The ATM address of the destination of this loglink.
DestMask	The number of bits that are significant in the Dest address.
DestPort	The port through which the loglink is attached at the destination.
Cost	The administrative routing cost of this loglink.
Freshness	The freshness of this loglink. The smaller the number, the more fresh the information is.
EstUbrBw	The default bandwidth to be used for UBR SPVCs, in Kcps.

Field	Description
CbrCapacity	The available capacity for CBR connections, in Kbps.
VbrCapacity	The available capacity for VBR connections, in Kbps.
Orig	The source of this routing information.
CapabilitySet	A bitmap indicating the capabilities of this link. The possible values are as follows: • 0x80000000 - This is a SPANS NNI border link. • 0x40000000 - This is a FT-PNNI border link. • 0x20000000 - VCs are depleted on this link. • 0x10000000 - This is the FT-PNNI backbone link. • 0x08000000 - This is a FT-PNNI PGSN reachability link. • 0x02000000 - This is a static reachability link. • 0x01000000 - This is a FT-PNNI exterior reachability link. • 0x00800000 - This is a bidirectional link. • 0x00400000 - This is a non-transit link. • 0x00004000 - This link supports Available Bit Rate (ABR). • 0x00001000 - This link supports Early Packet Discard (EPD).

2.1.2 Displaying Routing Prefix Table Information

This command lets you display the contents of the prefix tables. A routing prefix table consists of prefix nodes. There are prefix table entries (PTEs) associated with each prefix node. See the *ATM Switch Diagnostics and Troubleshooting Manual* for more information about reading this table. Enter the following parameters:

```
myswitch::display atmroute> ptab
 Domain Prefix                                    Len  Flags      TimeStamp
 1      47.000580ffe1000000f21a3445.002048067f56  152  0x0        334102be
        OwnerLevel OwnerProtocol  OwnerPathFlags
        255        ilmi           0x0

        PTEs:
        ProtoId ProtoHndl Protocol PathFlags Level Area  Scope SrcArea  Type
        0       0xb6fef0  pnni     0x0       255   0     0     0        1

 Domain Prefix                                    Len  Flags      TimeStamp
 1      47.000580ffe1000000f21a3445.0020480682e5  152  0x2        33410311
        OwnerLevel OwnerProtocol  OwnerPathFlags
        0          ilmi           0x0

 Domain Prefix                                    Len  Flags      TimeStamp
 1      47.000580ffe1000000f21a3445.0020481a3445  152  0x0        334102ad
        OwnerLevel OwnerProtocol  OwnerPathFlags
        255        ilmi           0x0

        PTEs:
        ProtoId ProtoHndl Protocol PathFlags Level Area  Scope SrcArea  Type
        0       0xc12890  pnni     0x0       255   0     0     0        1
```

The fields in this display are defined as follows:

Field	Description
Domain	The index of the domain to which the prefix table belongs.
Prefix	The ATM address prefix of this prefix node.
Len	The number of bits in the prefix that are significant.
Flags	The flag bitmask of this prefix node. The possible values are as follows: 0x0 - There is no flag set. 0x1 - The prefix node is currently in the change list. 0x2 - The prefix node has no valid registered PTE. 0x3 - Both the 0x1 and 0x2 flags are set.

Field	Description
Timestamp	The time at which this prefix node was last updated.
OwnerLevel	The level of the most preferable PTE.
OwnerProtocol	The protocol type of the most preferable PTE.
OwnerPathFlags	The path flags of the most preferable PTE.
PTE ProtoId	The protocol ID of the entity that registers this PTE with the prefix table. 0 is used for local prefixes, and n (1,2,...) indicates the index of the node that registered the PTE.
PTE ProtoHndl	The handle that the registerer uses to identify this PTE.
PTE Protocol	The protocol type of this PTE's registerer.
PTE PathFlags	The flag bit mask of this PTE. The possible values are as follows: • 0x0 - There is no flag set. • 0x1 - The PTE corresponds to a locally generated PTSE.
PTE Level	The FORE level of this PTE's registerer.
PTE Area	The FORE area of this PTE's registerer.
PTE Scope	The advertisement scope of this PTE.
PTE SrcArea	The source area of this PTE.
PTE Type	The type of this PTE. 0 means this is an exterior PTE and 1 means it is internal.

You can also display information for a specific domain by entering the following:

```
myswitch::display atmroute> ptab [<domainid> [<prefix> [<plen>]]]
myswitch::display atmroute> ptab 1
```

or you can display information for a specific domain, prefix, and length as follows:

```
myswitch::display atmroute> ptab [<domainid> [<prefix> [<plen>]]]
myswitch::display atmroute> ptab 1 47.000580ffe1000000f21c1f4e.0020481c1f4e 152
 Domain Prefix                                    Len  Flags      TimeStamp
 1      47.000580ffe1000000f21c1f4e.0020481c1f4e  152  0x0        3535c02d
        OwnerLevel OwnerProtocol  OwnerPathFlags
        255        ilmi           0x0

        PTEs:
        ProtoId ProtoHndl Protocol PathFlags Level Area  Scope SrcArea  Type
        0       0xe9108   static   0x0       255   0     0     0        1
```

The fields in this display are defined in the same manner as those in the previous example.

2.1.3 Displaying ATM Forum PNNI Routing Information

These commands allow you to display information about ATM Forum PNNI routing in your network. You can display the list of available subcommands by typing **?** at the **pnni** level.

```
link            map             mapaddr         mapnode
pcmap           peer            peerport        ptse
stmap           svccrcc
```

2.1.3.1 Displaying PNNI Link Information

This command lets you display the PNNI link table, which shows all of the links attached to a node and other information about each link. Enter the following parameters:

```
myswitch::display atmroute pnni> link
Node PortId     HelloState    LinkType                  Version        Port VPI
 1    0x10000021 twoWayInside  lowestLevelHorizontalLink version1point0 1E2  0
      RmtNodeId                                          RmtPortId   DerAggrTk
      80:160:47.000580ffe100000103000044.ff1c12c20002.00  0x10000020  0x0
 Node PortId     HelloState    LinkType                 Version        Port VPI
 1    0x10000012 commonOutside outsideLinkAndUplink     version1point0 1C3  0
      RmtNodeId                                         RmtPortId   DerAggrTk
      72:160:47.000580ffe100000104000174.ff1a35040001.00  0x1000001a  0x0
      UpNodeId                                           UpLinkPortId
      72:160:47.000580ffe100000104000174.ff1a35040001.00  0x20000012
      UpnodeAtmAddress                              CommonPGID
     47.000580ffe100000104000174.ff1a35040001.00 72:47.000580ffe100000100000000
 Node PortId     HelloState    LinkType                Version        SvccRccIx
 2    0x30000000 twoWayInside  horizontalLinkToFromLgn  version1point0 0
      RmtNodeId                                         RmtPortId   DerAggrTk
      72:160:47.000580ffe100000104000174.ff1a35040001.00  0x30000006  0x0
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node to which the displayed link is attached. This field is displayed for all link types.
PortId	The port identifier for this link. This field is displayed for all link types.

Field	Description
HelloState	The state of the hello protocol running between the peer nodes. • `down` means that the link is not usable, so no routing packets are sent or received over it. • `attempt` means that either no hellos or hellos with mismatch information have been received from the neighbor, and attempts are being made to reach the neighbor by sending hellos at the specified hello interval. • `oneWayInside` means that hellos have been received from the neighbor and the neighbor has established that they are peers, but the neighbor's remote node ID and remote port ID are 0. • `twoWayInside` means that hellos have been received from the neighbor, the neighbor has established that they are peers, and the neighbor has sent the correct remote node ID and remote port ID. Bi-directional communication can occur over this link. • `oneWayOutside` means that hellos have been received from the neighbor and the neighbor has established that they are from different peer groups, but the neighbor's remote node ID and remote port ID are 0. • `twoWayOutside` means that hellos have been received from the neighbor, the neighbor has established that they are from different peer groups, and the neighbor has sent the correct remote node ID and remote port ID, but the nodal hierarchy list does not include a common peer group. • `commonOutside` means that a common level of the routing hierarchy has been found and bi-directional communication can occur over this link. This field is displayed for all link types.
LinkType	The type of link between the two peers. Can be `unknown`, `lowestLevelHorizontalLink`, `horizontalLinkToFromLgn`, `lowestLevelOutsideLink`, `uplink`, or `outsideLinkAndUplink`. This field is displayed for all link types.
Version	The version of ATM Forum PNNI that the peer nodes are using for this hello protocol. This field is displayed for all link types.
Port	The port through which the link is attached to the node. This field is only displayed for lowestLevelHorizontalLink and outsideLinkAndUplink.
VPI	The virtual path number on the port on which the PNNI protocol is running. This field is only displayed for lowestLevelHorizontalLink and outsideLinkAndUplink.
SvccRccIx	For horizontal links to and from LGNs, this is the SVCC-based RCC used to exchange information with the neighboring peer LGN. If the LinkType is not `horizontalLinkToFromLgn`, this index is 0. This field is only displayed for horizontalLinkToFromLgn.
RmtNodeId	The node ID of the peer node. This field is displayed for all link types.
RmtPortId	The port ID that identifies the link in the peer node. This field is displayed for all link types.
DerAggrTk	The derived aggregation token value used on this link. For horizontal links between lowest-level nodes and when the link type is not known, this value is 0. This field is displayed for all link types.

Field	Description
UpNodeId	For outside links and uplinks, this is the Node Identifier of the upnode (the neighbor node at the level of the common peer group). If the upnode has not been identified, this ID is 0. For horizontal links or when the link type is not yet known, this ID is 0. This field is only displayed for outsideLinkAndUplink and uplink.
UpLinkPortId	The port ID of the uplink. This field is only displayed for outsideLinkAndUplink and uplink.
UpNodeAtmAddress	For outside links and uplinks, this is the ATM End System Address that is used to establish connections to the upnode. If the upnode has not been identified, this value is 0. For horizontal links or when the link type is not yet known, this value is 0. This field is only displayed for outsideLinkAndUplink and uplink.
CommonPGID	For outside links and uplinks, this is the peer group identifier of the lowest level common peer group in the ancestry of both the neighboring node and the local node. This value is determined by the Hello exchange of hierarchical information that occurs between the two lowest-level border nodes. If the common peer group has not been identified, this value is 0. For horizontal links or when the link type is not yet known, this value is all zeros. This field is only displayed for outsideLinkAndUplink and uplink.

You can also display information for a specific node by entering **`disp atmr pnni link`** *`<nodeix>`*. You can also display information for a specific node or portid as follows:

```
myswitch::display atmroute pnni> link [<nodeix>] [<portid>]
myswitch::display atmroute pnni> link 1
Node PortId     HelloState    LinkType                  Version        Port VPI
 1    0x10000021 twoWayInside  lowestLevelHorizontalLink version1point0 1E2  0
      RmtNodeId                                          RmtPortId   DerAggrTk
      80:160:47.000580ffe100000103000044.ff1c12c20002.00  0x10000020  0x0
 Node PortId     HelloState    LinkType                  Version        Port VPI
 1    0x10000012 commonOutside outsideLinkAndUplink      version1point0 1C3  0
      RmtNodeId                                          RmtPortId   DerAggrTk
      72:160:47.000580ffe100000104000174.ff1a35040001.00  0x1000001a  0x0
      UpNodeId                                           UpLinkPortId
      72:160:47.000580ffe100000104000174.ff1a35040001.00  0x20000012
      UpnodeAtmAddress                             CommonPGID
     47.000580ffe100000104000174.ff1a35040001.00 72:47.000580ffe100000100000000
```

The fields in this display are defined in the same manner as those in the previous example.

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> link
No link information is available
```

2.1.3.2 Displaying PNNI Map Information

This command lets you display information about horizontal links, uplinks, and nodal state elements of the network. See the *ATM Switch Diagnostics and Troubleshooting Manual* for more information about reading this table. Enter the following parameters:

```
myswitch::display atmroute pnni> map
 Node OriginatingNodeId                                    OrigPortId Index
 1    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00  0x10000008 1
      Type           PeerGroupId                    AggrToken RmtPortId
      horizontalLink 80:47.000580ffe1000000f2000000 0         0x10000003
      RemoteNodeId                                    VpCap PTSEId     MTag
      80:160:47.000580ffe1000000f21c1042.ff1c10420001.00  false 0x10000008 0
      Category Dir      AdmWt MCR    ACR    CTD    CDV    CLR0 CLR0+1 CRM  VF
      cbr      outgoing 5040  353207 353199 745    725    8    8      0    0
      rtvbr    outgoing 5040  353207 353199 745    725    8    8      0    0
      nrtvbr   outgoing 5040  353207 353199 745    725    8    8      0    0
      ubr      outgoing 5040  353207 353199 745    725    8    8      0    0
 Node OriginatingNodeId                                    OrigPortId Index
 1    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00  0x10000020 1
      Type           PeerGroupId                    AggrToken RmtPortId
      horizontalLink 80:47.000580ffe1000000f2000000 0         0x10000023
      RemoteNodeId                                    VpCap PTSEId     MTag
      80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00001.00  false 0x10000020 0
      Category Dir      AdmWt MCR    ACR    CTD    CDV    CLR0 CLR0+1 CRM  VF
      cbr      outgoing 5040  5660377 5660377 0      0      8    8      0    0
      rtvbr    outgoing 5040  5660377 5660377 0      0      8    8      0    0
      nrtvbr   outgoing 5040  5660377 5660377 0      0      8    8      0    0
      ubr      outgoing 5040  5660377 5660377 0      0      8    8      0    0
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node.
OriginatingNodeId	The node identifier of the node that generated the PTSE.
OrigPortId	The port identifier with which the originating node identifies this topology link.
Index	The index number of the link with the same originating node ID and port ID.
Type	The type of link. Can be `horizontal link`, `uplink`, or `node` for nodal state parameters.
PeerGroupId	The peer group identifier of the node that generated the PTSE.
AggrToken	For uplinks and for horizontal links and uplinks between Logical Group Nodes (LGNs), shows the derived aggregate token value.

Field	Description
RmtPortId	For horizontal links and uplinks, shows the port identifier of the port at the remote end of the link as assigned by the remote node. For nodal state elements, shows the port identifier of the port at the other end of the spoke or bypass from the originating port.
RemoteNodeId	For horizontal links and uplinks, shows the node identifier of the node at the other end of the link.
VpCap	**true** means VP capability is set for this PNNI route address. If the signalling interface on which this PNNI route address was created supports VP capability, then the address is advertised by PNNI with VP capability. **false** means VP capability is not set for this PNNI route address. PNNI does not advertise VP capability for this address even if the signalling interface on which this PNNI route address was created supports VP capability.
PTSEId	The PTSE identifier.
MTag	The metrics tag which identifies a set of traffic parameters.
Category	The class of service that applies to this link.
Dir	The direction of the link to which the traffic parameters apply.
AdmWt	The administrative weight assigned to this link.
MCR	The maximum cell rate assigned to this link.
ACR	The available cell rate of this link.
CTD	The cell transfer delay on this link.
CDV	The cell delay variation assigned to this link.
CLR0	The maximum cell loss ratio for CLP=0 traffic on this link.
CLR0+1	The maximum cell loss ratio for CLP=0+1 traffic on this link.
CRM	The cell rate margin on this link.
VF	The variance factor on this link.

You can also display address information about a specific node, or a specific originating node ID, or a specific originating port ID, or a specific index. Enter the following to display address information about a specific node:

```
myswitch::display atmroute pnni> map [<nodeix> [<orignodeid> [<origportid>
 [<index>]]]]
myswitch::display atmroute pnni> map 1
 Node OriginatingNodeId                                    OrigPortId Index
 1    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00  0x10000008 1
      Type           PeerGroupId                    AggrToken RmtPortId
      horizontalLink 80:47.000580ffe1000000f2000000 0         0x10000003
      RemoteNodeId                                    VpCap PTSEId     MTag
      80:160:47.000580ffe1000000f21c1042.ff1c10420001.00  0     0x10000008 0
      Category Dir      AdmWt MCR    ACR    CTD    CDV    CLR0 CLR0+1 CRM  VF
      cbr      outgoing 5040  353207 353199 745    725    8    8      0    0
      rtvbr    outgoing 5040  353207 353199 745    725    8    8      0    0
      nrtvbr   outgoing 5040  353207 353199 745    725    8    8      0    0
      ubr      outgoing 5040  353207 353199 745    725    8    8      0    0
 Node OriginatingNodeId                                    OrigPortId Index
 1    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00  0x10000020 1
      Type           PeerGroupId                    AggrToken RmtPortId
      horizontalLink 80:47.000580ffe1000000f2000000 0         0x10000023
      RemoteNodeId                                    VpCap PTSEId     MTag
      80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00001.00  0     0x10000020 0
      Category Dir      AdmWt MCR    ACR    CTD    CDV    CLR0 CLR0+1 CRM  VF
      cbr      outgoing 5040  5660377 5660377 0      0      8    8      0    0
      rtvbr    outgoing 5040  5660377 5660377 0      0      8    8      0    0
      nrtvbr   outgoing 5040  5660377 5660377 0      0      8    8      0    0
      ubr      outgoing 5040  5660377 5660377 0      0      8    8      0    0
```

The fields in this display are defined in the same manner as those in the previous example.

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> map
No map information is available
```

2.1.3.3 Displaying PNNI Map Address Information

This command lets you display all of the reachable addresses, including the Resource Availability Information Group (RAIG) information, if available. Enter the following parameters:

```
myswitch::display atmroute pnni> mapaddr
 Node AdvertisingNodeId                                  AdvPortId  Index
 1    80:160:47.000580ffe1000000f21c0201.ff1c02010001.00  0          1
      Prefix                                  PrefixLength
      47.000580ffe1000000f21c0201.000000000000 104
 Node AdvertisingNodeId                                  AdvPortId  Index
 2    80:160:47.000580ffe1000000f21a00d5.ff1a00d50001.00  0          1
      Prefix                                  PrefixLength
      47.000580ffe1000000f21a00d5.000000000000 104
 Node AdvertisingNodeId                                  AdvPortId  Index
 2    80:160:47.000580ffe1000000f21a00d5.ff1a00d50001.00  0          2
      Prefix                                  PrefixLength
      47.007900000000000000000000.00a03e000001 152
 Node AdvertisingNodeId                                  AdvPortId  Index
 2    80:160:47.000580ffe1000000f21a23c0.ff1a23c00002.00  0          1
      Prefix                                  PrefixLength
      47.000580ffe1000000f21a23c0.000000000000 104
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node to which this topology database belongs.
AdvertisingNodeId	The identifier of a node that is advertising reachability to the address prefix.
AdvPortId	The port identifier used by the advertising node to reach the given address prefix.
Index	A unique index number that summarizes all of the addresses advertised by a node.
Prefix	The value of the ATM end system address prefix.
PrefixLength	The prefix length to be applied to the ATM end system address prefix.

You can also display address information about a specific node, or a specific originating node ID, or a specific originating port ID, or a specific index. Enter the following to display address information about a specific node:

```
myswitch::display atmroute pnni> mapaddr [<nodeix> [<orignodeid> [<origportid>
 [<index>]]]]
myswitch::display atmroute pnni> mapaddr 1
 Node AdvertisingNodeId                                    AdvPortId  Index
 1    80:160:47.000580ffe1000000f21c0201.ff1c02010001.00   0          1
      Prefix                                  PrefixLength
      47.000580ffe1000000f21c0201.000000000000 104
```

The fields in this display are defined in the same manner as those in the previous example.

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> mapaddr
No mapaddr information is available
```

2.1.3.4 Displaying PNNI Map Node Information

This command lets you display PNNI map node information. Enter the following parameters:

```
myswitch::display atmroute pnni> mapnode
 Node MapNodeId
 1    64:72:47.000580ffe100000000000000.00605c715901.00
      PeerGroupId                    AtmAddress
     64:47.000580ffe100000000000000 47.000580ffe1000000f3000000.00605c715901.03
      RstrTransit ComplexRep RstrBranch DBOverld Leader LdrPriority
      false       false      false      false    false  0
      PreferredPeerGroupLeader
      0:0:00.000000000000000000000000.000000000000.00

 Node MapNodeId
 1    72:80:47.000580ffe1000000f2000000.ff1a2d0f0002.00
      PeerGroupId                    AtmAddress
     72:47.000580ffe100000000000000 47.000580ffe1000000f21b0050.ff1a2d0f0002.00
      RstrTransit ComplexRep RstrBranch DBOverld Leader LdrPriority
      false       false      false      false    false  0
      PreferredPeerGroupLeader
      72:80:47.000580ffe1000000f3000000.00605c715901.00
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node to which this topology database belongs.
MapNodeId	The node identifier of the node whose information is being displayed.
PeerGroupId	The Peer Group Identifier of the originating node.
AtmAddress	The ATM address of the originating node.
RstrTransit	Shows whether the originating node is restricted to not allow support of SVCs going through this node. **true** means SVCs are restricted from going through this node. **false** means SVCs are not restricted.
ComplexRep	Shows whether the originating node uses the complex node representation. **true** means that the complex node representation is used. **false** means that the simple node representation is used.
RstrBranch	Shows whether or not the originating node is able to support additional point-to-multipoint branches. **true** means that additional branches can be supported. **false** means that additional branches cannot be supported.

Field	Description
DBOverId	Shows whether or not the originating node is currently operating in topology database overload state. **true** means that it is operating in database overload state. **false** means that it is not.
Leader	Shows whether or not the originating node claims to be the Peer Group Leader (PGL) of its peer group. true means that it claims to be the PGL. false means that it does not.
LdrPriority	Shows the leadership value advertised by the originating node.
PreferredPeerGroupLeader	Shows the node ID of the node which the originating node believes should be or is the PGL. If a preferred PGL has not been chosen, this value is set to all zeros.
ParentNodeId	Shows the node identifier of the parent Logical Group Node (LGN).
ParentAtmAddress	Shows the ATM address of the parent LGN.
ParentPeerGroupId	Shows the peergroup identifier of the parent peer group.

The higher layer (parent) information is displayed only if the originating node is a PGL and if any higher layer information is available.

You can also display map information about a specific node, a specific map node ID, or both. Enter the following to display map information about a specific node and map node ID:

```
myswitch::display atmroute pnni> mapnode [<nodeix> [<mapnodeid>]]
myswitch::display atmroute pnni> mapnode 1
647247000580ffe100000000000000000605c71590100
 Node MapNodeId
 1    64:72:47.000580ffe100000000000000.00605c715901.00
      PeerGroupId                    AtmAddress
     64:47.000580ffe100000000000000 47.000580ffe1000000f3000000.00605c715901.03
      RstrTransit ComplexRep RstrBranch DBOverld Leader LdrPriority
      false       false      false      false    false  0
      PreferredPeerGroupLeader
      0:0:00.000000000000000000000000.000000000000.00
```

The fields in this display are defined in the same manner as those in the previous example.

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> mapnode
No mapnode information is available
```

2.1.3.5 Displaying PNNI Precomputed Path Map Information

This command lets you display precomputed paths. The precomputed paths are shown as trees, such that each node has the next hop node towards the source of the tree, which is the node to which the Topology Database (TDB) belongs.

For each CBR and VBR profile, three trees are computed: one optimized for Cell Delay Variation (CDV), one optimized for Cell Transfer Delay (CTD), and one optimized for administrative weight.

For each ABR and UBR profile, only one tree is computed, which is optimized for administrative weight. When load balancing is enabled for ABR and UBR profiles, then, at most, three trees are computed with the other two trees containing the secondary and tertiary options for load balancing.

See the *ATM Switch Diagnostics and Troubleshooting Manual* for more information about reading this table. Enter the following to display the precomputed path information:

```
myswitch::display atmroute pnni> pcmap
Node Profile Tree MapNodeId
1    10      0    72:80:47.000580ffe1000000f2000000.ff1a2d0f0002.00
     ParentNodeId                                          LocalPort
     80:160:47.000580ffe1000000f41b0551.ff1a3ba80001.00  20000013
     AdmWt MCR    ACR    CTD(usec) CDV(usec) CLR0   CLR0+1 CRM  VF
     5040  353207 352367 100021    725       8      8      0    0

Node Profile Tree MapNodeId
1    10      0    72:80:47.000580ffe1000000f3000000.00605c715901.00
     ParentNodeId                                          LocalPort
     72:80:47.000580ffe1000000f2000000.ff1a2d0f0002.00   299d000
     AdmWt MCR    ACR    CTD(usec) CDV(usec) CLR0   CLR0+1 CRM  VF
     10080 353207 352367 200042    725       8      8      0    0
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the source node of the tree being displayed.
Profile	The index number of the profile of the tree being displayed.
Tree	The tree number. For CBR and VBR profiles, 0 is for CDV, 1 is for CTD, and 2 is for administrative weight. For ABR and UBR, 0 is for administrative weight, and if load balancing is enabled, 1 is for the secondary load balancing option, and 2 is for the tertiary load balancing option.
MapNodeId	The node identifier of a given node in the tree.

Field	Description
ParentNodeId	The local node identifier of the next hop towards the source node. The value 0 indicates that there is no parent node.
LocalPort	The port through which the node is connected to the next hop node.
AdmWt	The total administrative weight from the source node to the node identified by MapNodeId.
MCR	The largest maximum cell rate from the source node to the node identified by MapNodeId.
ACR	The largest available cell rate from the source node to the node identified by MapNodeId.
CTD	The total cell transfer delay from the source node to the node identified by MapNodeId.
CDV	The total cell delay variation from the source node to the node identified by MapNodeId.
CLR0	The largest maximum cell loss ratio objective for CLP=0 traffic from the source node to the node identified by MapNodeId.
CLR0+1	The largest maximum cell loss ratio objective for CLP=0+1 traffic from the source node to the node identified by MapNodeId.
CRM	The cell rate margin on this link. FORE switches do not advertise this value. However, if another vendor's switch advertises this value, it is displayed.
VF	The variance factor on this link. FORE switches do not advertise this value. However, if another vendor's switch advertises this value, it is displayed.

You can also display precomputed path information about a specific node, or a specific profile, or a specific tree, or a specific map node ID. Enter the following to display information about a specific node and profile:

```
myswitch::display atmroute pnni> pcmap [<nodeix> [<profile> [<tree>
       [<mapnodeid>]]]]
myswitch::display atmroute pnni> pcmap 1 10
Node Profile Tree MapNodeId
1    10      0    72:80:47.000580ffe1000000f2000000.ff1a2d0f0002.00
     ParentNodeId                                          LocalPort
     80:160:47.000580ffe1000000f41b0551.ff1a3ba80001.00  20000013
     AdmWt MCR    ACR    CTD(usec) CDV(usec) CLR0   CLR0+1 CRM  VF
     5040  353207 352367 100021    725       8      8      0    0
Press return for more, q to quit: q
```

The fields in this display are defined in the same manner as those in the previous example.

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> pcmap
No precomputed path information is available
```

2.1.3.6 Displaying PNNI Peer Information

This command lets you display information about all of the peers that this node knows about. Enter the following parameters:

```
myswitch::display atmroute pnni> peer
 Node PeerRemoteNodeId                                        State       PortCount
 2    72:80:47.000580ffe1000000f2000000.ff1a2d0f0002.00       full        1
 3    80:160:47.000580ffe1000000f41b0519.ff1a2e760001.00      full        1
```

The fields in this display are defined as follows:

Field	Description
nodeix	The index number of this node.
PeerRemoteNodeId	The node identifier of each of the neighboring peer nodes.
State	The state of the database exchange protocol running between this node and the listed neighboring peer. • `npdown` means there are no active links to the neighboring peer. • `negotiating` means the two peers are deciding which one will start the initial topology database exchange. • `exchanging` means this node is sending its topology database to the neighboring node. • `loading` means this node is receiving the neighboring node's topology database. • `full` means this node has received all PTSEs known to be available from the neighboring peer. Links to the neighboring peer can now be advertised in PTSEs.
PortCount	The number of hello protocols running between the two peers.

You can also display peer information for a specific node or remote node ID. Enter the following parameters to display information for a specific node:

```
myswitch::display atmroute pnni> peer [<nodeix> [<rmtnodeid>]]
myswitch::display atmroute pnni> peer 2
 Node PeerRemoteNodeId                                        State       PortCount
 2    72:80:47.000580ffe1000000f2000000.ff1a2d0f0002.00       full        1
```

The fields in this display are defined in the same manner as those in the previous example.

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> peer
No peer information is available
```

2.1.3.7 Displaying Peer Port Information

This command lets you display information about all ports that connect this node to a neighboring peer that is in a twoWayInside Hello state. Enter the following parameters:

```
myswitch::display atmroute pnni> peerport
Node  PeerRemoteNodeId                                        PortId      FldStatus
 1    88:160:47.000580ffe100000201020530.ff150cf20001.00     0x10000013  true
 2    72:80:47.0005000000ae1e1e2e000000.ff1a57280003.00      0xffffffff  true
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node to which the peer is attached.
PeerRemoteNodeId	The node identifier of the remote peer.
PortId	The port number of the local port that connects to the neighboring peer that is in the twoWayInside Hello state.
FldStatus	Indicates whether or not this port is being used for transmission of flooding and PNNI database synchronization information to the neighboring peer.

You can also display peer port information for a specific node, remote node ID, or port ID. Enter the following parameters to display information for a specific node:

```
myswitch::display atmroute pnni> peerport [<nodeix> [<rmtnodeid>] [<portid>]]
myswitch::display atmroute pnni> peerport 1
Node  PeerRemoteNodeId                                        PortId      FldStatus
 1    88:160:47.000580ffe100000201020530.ff150cf20001.00     0x10000013  true
```

The fields in this display are defined in the same manner as those in the previous example.

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> peerport
No peer port information is available
```

2.1.3.8 Displaying PTSE Information

PNNI topology information can be grouped into small units called PNNI Topology State Elements (PTSEs) and then flooded through the network on a hop-by-hop basis. This command lets you display PTSE information. Enter the following parameters:

```
myswitch::display atmroute pnni> ptse
 Node OriginatingNodeId                                    PtseId
 1    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00  1
      Type                      SequenceNum Checksum LifeTime
      nodalInformation          5           ca71     3599
 Node OriginatingNodeId                                    PtseId
 1    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00  10000008
      Type                      SequenceNum Checksum LifeTime
      horizontalLinks           8           f217     3599
 Node OriginatingNodeId                                    PtseId
 1    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00  10000020
      Type                      SequenceNum Checksum LifeTime
      horizontalLinks           1           f107     3599
 Node OriginatingNodeId                                    PtseId
 1    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00  50000000
      Type                      SequenceNum Checksum LifeTime
      internalReachableAddresses 6          c250     3599
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node.
OriginatingNodeId	The node ID of the node that originated the PTSE.
PtseId	The PTSE identifier that was assigned by the originating node.
Type	Shows what kind of PTSE this is. Can be `nodalInformation`, `internalReachableAddresses`, `externalReachableAddresses`, `nodalStateParameters`, `horizontalLinks`, or `uplinks`.
SequenceNum	The sequence number of the PTSE that was assigned by the originating node.
Checksum	The checksum of the PTSE.
LifeTime	The remaining life time of the PTSE before it is flushed out.

This command also lets you display advanced information about PTSEs. Enter the following parameters:

```
myswitch::display atmroute pnni> ptse [advanced] [<nodeix> [<orignodeid> [<ptseid>]]]
myswitch::display atmroute pnni> ptse advanced
 Node OriginatingNodeId                                    PtseId
 1    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00  1
      Type                       SequenceNum Checksum LifeTime
      nodalInformation           5           ca71     3599
      0   : 00 40 00 44 00 61 00 00 00 00 01 00 00 00 05
      16  : ca 71 0e 0f 00 61 00 30 47 00 05 80 ff e1 00 00
      32  : 00 f2 1c 1f 4e ff 1c 1f 4e 00 02 00 00 00 00 00
      48  : 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
      64  : 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
 Node OriginatingNodeId                                    PtseId
 1    80:160:47.000580ffe1000000f2121f4e.ff1c1f4e0002.00  10000008
      Type                       SequenceNum Checksum LifeTime
      horizontalLinks            8           f217     3599
      0   : 00 40 00 bc 01 20 00 00 10 00 00 08 00 00 00 08
      16  : f2 17 0e 0f 01 20 00 a8 00 00 50 a0 47 00 05 80
      32  : ff e1 00 00 00 f2 1c 10 42 ff 1c 10 42 00 01 00
      48  : 10 00 00 03 10 00 00 08 00 00 00 00 00 80 00 20
      64  : 80 00 00 00 00 00 13 b0 00 05 63 b7 00 05 63 b5
      80  : 00 00 02 e9 00 00 02 d5 00 08 00 08 00 80 00 20
      96  : 40 00 00 00 00 00 13 b0 00 05 63 b7 00 05 63 b5
      112 : 00 00 02 e9 00 00 02 d5 00 08 00 08 00 80 00 20
      128 : 20 00 00 00 00 00 13 b0 00 05 63 b7 00 05 63 b5
Press return for more, q to quit: q
```

The fields in this display are defined in the same manner as in the previous example.

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> ptse
No ptse information is available
```

2.1.3.9 Displaying PNNI Spanning Tree Information

This command lets you display information about the computed spanning tree, which is used for Peer Group Leader (PGL) election. This tree shows reachability information for all of the nodes within a peer group. Enter the following parameters:

```
myswitch::> display amtroute pnni> stmap
 Node MapNodeId                                              Status
 1    80:160:47.000580ffe1000000f21c1f4e.ff1c1f4e0001.00     linkdeleted
      ParentNodeId                                           Port       LinkType
      80:160:47.000580ffe1000000f21c1042.ff1c10420001.00     0x10000003 hlink
 Node MapNodeId                                              Status
 1    80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00001.00     uptodate
      ParentNodeId                                           Port       LinkType
      80:160:47.000580ffe1000000f21c1f4e.ff1c1f4e0001.00     0x10000020 hlink
 Node MapNodeId                                              Status
 1    80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00002.00     uptodate
      ParentNodeId                                           Port       LinkType
      80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00001.00     0x10000008 hlink
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node to which the TDB (or root of the tree) belongs.
MapNodeId	The node identifier of a given node in the spanning tree.
Status	The status of the spanning tree. If links are added or removed, it may take a short while for the spanning tree to update. The status may be: `uptodate`, `linkadded`, `linkdeleted`, or `treeclean`.
ParentNodeId	The node identifier of the next hop node.
Port	The port identifier of the local port that connects to the next hop node.
LinkType	The type of link that connects this node to the remote node. Can be uplink or hlink (horizontal link).

You can also display information about a specific node, or a specific node and map node ID. Enter the following parameters to display information about a specific node and map node ID:

```
myswitch::display atmroute pnni> stmap [<nodeix> [<mapnodeid>]]
myswitch::> display amtroute pnni> stmap 1
       80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00002.00
 Node MapNodeId
 1    80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00002.00
      ParentNodeId                                          Port       LinkType
      80:160:47.000580ffe1000000f21c1fe0.ff1c1fe00001.00  0x10000008 hlink
```

These fields in this display are defined in the same manner as in the previous example.

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> stmap
No spanning tree map information is available
```

2.1.3.10 Displaying PNNI SVCC RCC Information

This command lets you display information about the SVCC RCCs that LGNs use to communicate with each other. Enter the following parameters:

```
myswitch::display atmroute pnni> svccrcc
 Node SvccRccIx Version        HelloState    RcvHellos XmtHellos
 2    1         version1point0 twoWayInside  219       225
          RemoteNodeId                                          IfIndex
          72:80:47.000580ffe1000000f2000000.ff1a2d0f0002.00   1310720
          RemoteAtmAddress                               Vpi  Vci
          47.000580ffe1000000f21b0050.ff1a2d0f0002.00 0    201
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node to which the SVCC RCC belongs.
SvccRccIx	The SVCC RCC index number.
Version	The PNNI routing protocol version used to exchange information with the neighbor node. Can be either `version1point0` or `unsupported`.
HelloState	The state of the Hello protocol exchange over the SVCC RCC. • `down` means that the SVCC establishment is in progress. • `attempt` means that either no hellos or hellos with mismatch information have been received from the neighbor, and attempts are being made to reach the neighbor by sending hellos at the specified hello interval. • `oneWayInside` means that hellos have been received from the neighbor and the neighbor has established that they are peers, but the neighbor's remote node ID and remote port ID are 0. • `twoWayInside` means that hellos have been received from the neighbor, the neighbor has established that they are peers, and the neighbor has sent the correct remote node ID and remote port ID. Bi-directional communication can occur over this link.
RcvHellos	The number of Hello Packets received over this SVCC RCC.
XmtHellos	The number of Hello Packets transmitted over this SVCC RCC.
RemoteNodeId	The remote node at which the SVCC RCC terminates.
IfIndex	The interface on which the SVCC RCC exits the switch. If the SVCC RCC has not been established, then this value is 0.
RemoteAtmAddress	The ATM End System Address to which this LGN is attempting to establish an SVCC RCC.
Vpi	The VPI on the interface from which the SVCC-based RCC exits the switch. If the SVCC RCC has not been established, then this value is 0.
Vci	The VCI on the interface from which the SVCC-based RCC exits the switch. If the SVCC RCC has not been established, then this value is 0.

You can also display information about a specific node, or a specific node and RCC ID. Enter the following parameters to display information about both a specific node and RCC ID:

```
myswitch::display atmroute pnni> svccrcc [<nodeix> [<rccix>]]
myswitch::display atmroute pnni> svccrcc 2 1
 Node SvccRccIx Version        HelloState    RcvHellos XmtHellos
 2    1         version1point0 twoWayInside  219       225
          RemoteNodeId                                          IfIndex
          72:80:47.000580ffe1000000f2000000.ff1a2d0f0002.00   1310720
          RemoteAtmAddress                              Vpi  Vci
          47.000580ffe1000000f21b0050.ff1a2d0f0002.00 0    201
```

These fields in this display are defined in the same manner as in the previous example.

If ATM Forum PNNI has not been configured on this switch, then the following is displayed:

```
myswitch::display atmroute pnni> svccrcc
No svccrcc information is available
```

2.1.4 Displaying the SPANS Topology

This menu lets you display the SPANS topology of the ATM network of which this switch is a part. Enter the following parameters to display the available command:

```
myswitch::display atmroute spans> ?
  map
```

2.1.4.1 Displaying the SPANS Topology Map

This command displays the SPANS topology of the ATM network of which this switch is a part. All SPANS-NNI links appear in the topology. Enter the following parameters:

```
myswitch::display atmroute spans> map
B Source           IPaddress       Destination      IPaddress       Capacity Age
1 f21a344a.e0000001   ---          f21a344a.e0000001   ---               0    3
1 f21a3596.e0000001   ---          f21a3596.e0000001   ---               0    5
1 f21a355f.02.0       ---          f21a3596.02.0       ---          149759    5
1 f21a3596.02.0       ---          f21a355f.02.0       ---          149759    3
1 f21a344a.08.0       ---          f21a3445.08.0       ---          149759    0
```

The fields in this display are defined as follows:

Field	Description
B	The number of the board (switch fabric).
Source	The source SPANS address of the link.
IPaddress	The IP address mapping to the source SPANS address, if known. Displays - - - if it is unknown.
Destination	The destination SPANS address of the link.
IPaddress	The IP address mapping to the destination SPANS address, if known. Displays - - - if it is unknown.
Capacity	The link capacity in Kbps. A negative value in this field indicates that the link has gone down, but it has not timed out yet.
Age	The age (freshness value) of the link. A value of -1 indicates that the link is invalidated, but has not timed out yet. The maximum freshness value is 200. All links age out at this point.

If this switch is not connected to any other FORE switches that are using SPANS, then the following is displayed:

```
myswitch::display atmroute spans> map
No topology information is available
```

2.2 Displaying HDCOMP Information

You can display version information about the HDCOMP ASIC on an individual switch fabric as follows:

```
myswitch::display> hdcomp
HDCOMP  Version
1       0
```

Something similar to the following is displayed on an *ESX*-3000:

```
myswitch::display> hdcomp
HDCOMP  Version
1       1
5       1
```

The following is displayed on an *ASX*-4000:

```
myswitch::display> hdcomp
HDCOMP  Version
1A      1
1B      1
1C      1
1D      1
2C      1
2D      1
3A      1
3B      1
3C      1
3D      1
```

The fields in this display are defined as follows:

Field	Description
HDCOMP	The number of the slot in which the board (switch fabric) is installed.
Version[1]	The version number of the HDCOMP ASIC on this switch board.

1. The HDCOMP ASIC must be version 1 or greater to support the AAL5 partial packet policing command under **`conf port pppolicing`** and to support changing the clockscale under **`conf switch clockscale`**.

You can also display HDCOMP ASIC information about a particular switch board in an *ASX*-4000 as follows:

```
myswitch::display> hdcomp [<hdcomp>]
myswitch::display> hdcomp 3a
HDCOMP  Version
3A      1
```

You can display HDCOMP ASIC information about a particular switch board in an *ESX*-3000 as follows:

```
myswitch::display> hdcomp [<hdcomp>]
myswitch::display> hdcomp 5
HDCOMP  Version
5       1
```

The fields in these displays are defined in the same manner as those in the previous example.

CHAPTER 3 AMI Operation Commands

This chapter contains a detailed description of the AMI **operation** commands. The main **operation** menu can be found at the root level. There are several commands available under **operation**. Commands that are submenus are immediately followed by a ">" symbol. Typing **?** at the **operation** level displays these commands as follows:

```
myswitch::operation> ?
  cdb>              date              environment>      flash>
  module>           panic>            reboot            upgrade
  version
```

The **module>** menu is not available on an LE 155, LE 25, *ESX*-3000, or *ASX*-4000 switch.

3.1 Configuration Database (CDB) Commands

These commands allow you to manage the configuration database (CDB). Typing **cdb ?** at the prompt at the operation level displays the cdb commands as follows:

```
myswitch::operation> cdb ?
backup          init            reset           restore
```

3.1.1 Backing Up the CDB

This command lets you make a backup copy of the CDB either to a remote host or to the switch's FLASH memory. If you enter the **-ami** option, it lets you externalize your CDB as an AMI script file. Enter the following:

```
myswitch::operation cdb> backup [-ami] [[<host>:] <full path to backup file>]
```

These parameters are defined as follows:

Parameter	Description
ami	If specified, the CDB file is converted into an AMI command script file which can be used later to generate that configuration on the switch. This file is downloaded to the specified host. If a host or filename is not specified, the AMI command file is output to the console. Depending on size of your CDB, it takes about 2 to 5 minutes to output this file to the console. You cannot stop this output. See Section 3.1.1.1 in this manual for more information.
host	The IP address of the host to which the CDB or AMI command file will be backed up.
full path to backup file	The full path name of the file to which the CDB or AMI command file will be backed up.

If you configured the transfer protocol to be FTP using **conf system protocol**, you only need to enter the command shown above to perform the CDB backup. After you enter the command shown above, you are prompted for the remote userid and password of the remote host to which you are backing up the file.

If you configured the transfer protocol to be TFTP (this is the default) using **conf system protocol**, the remote host to which the file will be backed up must be running the TFTP server code. If you are unsure of how to do this, see the *ATM Switch Installation and Maintenance Manual*.

If you are using TFTP to perform the CDB backup, you must first create an empty file in the `/tftpboot` directory on the remote host to receive the CDB. Use the **touch** command to do this. Then, use the **chmod** command to change the permissions of that file so that it will let the switch write the backup CDB to that file.

Perform the following steps to back up your CDB:

1. Telnet to your remote host and log in.
2. Enter the following commands in sequence:

```
cd  /tftpboot
touch <backup file name>
chmod 777 <backup file name>
```

3. Exit from the telnet session.
4. Telnet to the switch and log into AMI.

5. Enter the following command:

   oper cdb backup *<host>*:**/tftpboot/***<backup file name>*

You should receive the following message:

```
CDB backup was successful
```

Your backup file now resides in the file and on the host you specified.

3.1.1.1 Externalizing the CDB Configuration

The **-ami** option allows you to convert the CDB file into an AMI command script file which generates the current switch configuration. You can look at your configuration and edit it. When you edit the externalized CDB file, it is an ASCII text script file which lists AMI commands that should run in a logical order.

Any commands that require the user's interaction for a response to a **y**/**n** prompt are executed with the default response of **y**. However, any CDB configuration requests that require the switch to be rebooted or which prompt for a password are ignored, and are indicated with an error message. For example:

```
Line 37::configuration module traffic LC setmodel 1A 1
?ERROR: This command is not supported in non-interactive mode
```

In addition, the following commands and menus are not supported:

- conf atmroute domain modify
- conf atmroute ftpnni border
- conf atmroute ftpnni forearea
- conf atmroute ftpnni forelevel
- conf atmroute ftpnni pgmask
- conf atmroute ftpnni prefix
- conf atmroute ftpnni swmask
- conf atmroute ftpnni spans> (all commands in this menu)
- conf ces> (all commands in this menu)
- conf fratm new
- conf funi new
- conf lane lec default mode

- conf port j2 emptycells
- conf port traffic lc clp1 <port> UBR <number of cells>
- conf port traffic lc qsize
- conf port traffic le clp1 <port> UBR <number of cells>
- conf port traffic le qsize
- conf security login> (all commands in this menu)
- conf spans spvx spvcc new
- conf spvx spvcc pnni parameters reroute threshold
- conf switch callrecord password
- conf switch clockscale
- conf switch license
- conf vpt new (extended qos options not supported)
- oper cdb> (all commands in this menu)
- oper env fabric temperature
- oper flash get
- oper flash init
- oper flash put
- oper reboot
- oper upgrade
- oper version

The externalized CDB file does not contain any of the default configuration information that can not be modified, such as UPC contract 0 and the default domain. However, it does contain all of the default configuration information that can be modified, such as VP 0 on all ports, the default signalling channel on each VP 0, etc. Since these paths and channels already exist on all switches, when you copy this CDB to another switch and attempt to execute it, that switch tries to execute the commands to create these paths and channels again.

Therefore, you must either delete all of these redundant commands before copying the file to another switch, or specify the **`-ignore_errors`** option when using **`oper cdb restore`**. If you do not use the **`-ignore_errors`** option and errors occur, the errors cause the restore procedure to fail. If you use the **`-ignore_errors`** option and errors occur, you are notified of the errors. The restore procedure succeeds, but the commands that were in error do not succeed.

The externalized CDB file always contains an entry for the traffic descriptor table when the CDB is reset or initialized. This entry is externalized as a **`configuration trafdesc new`** command. This default entry must be deleted from the externalized file before restoring the CDB file.

3.1.2 Initializing the CDB

This command lets you clear all permanent information from the CDB. The switch asks you to verify this action before it re-initializes the CDB. Enter the following parameters:

```
myswitch::operation cdb> init
This command will re-initialize the CDB and reboot the switch
Do you really want to remove ALL permanent information from
the database INCLUDING the configuration of all the network
interfaces? [n] n
myswitch::operation cdb>
```

3.1.3 Resetting the CDB

This command enables you to reset the CDB. The switch cautions you that all ATM information will be deleted. Information that is retained includes such things as the IP configuration, (the switch name and interface descriptions); the ATM routing protocol information, (domain and prefix information, etc.); password and userid information; and SecurID information. The switch then asks you to confirm that resetting the CDB is the desired action. Enter the following:

```
myswitch::operation cdb> reset

********** W A R N I N G **********

This operation resets the switch configuration database.
As a result, the switch control software will be restarted.
You will lose connectivity with the switch while this
operation is progressing.

Are you sure you want to reset the CDB [n]? n
myswitch::operation cdb>
```

If you enter yes to the reset question, the switch responds as follows:

```
Are you sure you want to reset the CDB [n]? y
The switch will restart momentarily.
```

At this point, the switch resets the CDB, closes you out of all active sessions, and restarts the switch. You must then log in to AMI again to perform any more actions on the switch.

3.1.4 Restoring the Database

This command allows you to restore the switch CDB. Enter the following parameters:

```
myswitch::operation cdb> restore [-ami[-ignore_errors]] [<host>:]
<full path to backup file>
```

These parameters are defined as follows:

Parameter	Description
ami	If specified, the AMI command file is downloaded and validated, and the commands are executed. This changes the current configuration on the switch according to that file. See Section 3.1.1.1 in this manual for more information.
ignore_errors	This option only applies to the AMI command file. If this option is not specified, and if errors occur during the validation or execution of the AMI commands, the execution of the rest of the script is aborted. This is the default action. If this option is specified, and if errors occur, then the rest of the script will continue. If the console is enabled, the errors are logged to the console. It is recommended that you specify this option.
host	The IP address of the host on which the CDB file that is to be restored resides.
full path to backup file	The full path name of the CDB file that is to be restored.

If you have configured the transfer protocol to be FTP using **`conf system protocol`**, you only need to enter the command shown above to perform the CDB restore. After you enter the command shown above, you are prompted for the remote userid and password of the remote host from which you are retrieving the file.

If you have configured the transfer protocol to be TFTP (this is the default) using **`conf system protocol`**, the remote host from which the file will be retrieved must be running the TFTP server code. If you are unsure of how to do this, see the *ATM Switch Installation and Maintenance Manual* for your switch.

3.2 Displaying and Setting the Date and Time

This command allows you to display the current date and time on the switch. To display this information, enter **date** at the **operation** level.

```
myswitch::operation> date
Oct 5  08:16:36 1998
```

This command also enables you to set the current date and time on the switch.

If you wish to set a time zone, you must set the time zone using the **conf switch timezone** command before setting the date and time. The correct time zone is needed to convert the local time zone to Greenwich Mean Time (GMT).

To set or change this information, enter the following parameters:

```
myswitch::operation> date ?
myswitch::operation> date [gmt] [<mm>/<dd>/<yyyy> <hh>:<mm>:<ss>]
```

These parameters are defined as follows:

Parameter	Description
mm/dd/yyyy	The current date[1]. Enter the month, the day, and the year numerically; e.g., 9/12/1998. The month must be a value between 1-12, and the day must be a value between 1-31, and the year must be four digits long.
gmt	Specifying **gmt** displays the Greenwich Mean Time (GMT) corresponding to the local time; e.g., if your time zone is EST5EDT and **oper date** shows `Oct 2 12:44:13 1998`, then **oper date gmt** would show `Oct 2 17:44:13 1998`.
hh:mm:ss	The current local time. Enter the hour (in terms of a 24-hour clock; i.e., 1:00 pm is 13), the minutes, and the seconds. The hour must be a value between 0-23, the minutes must be a value between 0-59, and the seconds must be a value between 0-59. For example, to set the time as 2:02 pm, enter 14:02:00.

1. The date cannot be set prior to May 24, 1994, and the date cannot be set past January 18, 2038.

Ensure that the switch time and date are set correctly before enabling the call recording functionality using **`conf switch callrecord enable cr`**. Otherwise, call records will not be accurate.

Make sure that the time zone and time on the switch is set correctly when configuring Kerberos version 5 authentication (**`conf security kerberos`**). The time set on the switch must be within five minutes of the time on the KDC (or to whatever time change defined on the KDC). Otherwise, Kerberos will assume that someone is trying a replay attack and will therefore fail authentication. See Section 8.2 in Chapter 8 of Part 2 of the *AMI Configuration Commands Reference Manual* for more information on Kerberos.

If you configure a date that falls during Daylight Savings Time (dst) when you are currently in Standard Time (std), the date gets changed forward by one hour to reflect dst. For example:

```
myswitch::operation> date
Nov 19  10:03:03 1998 EST5EDT

myswitch::operation> date 05/01/1998 10:03:50

myswitch::operation> date
May 1  11:03:51 1998 EST5EDT
```

If you configure a date in std when you are currently in dst, the date gets changed backward by one hour to reflect std. For example:

```
myswitch::operation> date
May 1  11:03:51 1998 EST5EDT

myswitch::operation> date 11/19/1998 10:04:20

myswitch::operation> date
Nov 19  09:04:21 1998 EST5EDT
```

3.3 Environment Commands

These commands allow you to monitor the switch's environmental parameters. Type **`environment ?`** at the prompt at the **`operation`** level to display the available commands:

```
myswitch::operation> environment ?
  cpu                fabric>            fans               management
  power              temperature
```

The only **`environment`** command that is valid on an LE 155 or an LE 25 is **`oper env cpu`**.

3.3.1 CPU Commands

This command lets you display information about the SCP(s). Enter the following:

```
myswitch::operation environment> cpu
CPU    Type      CpuStep  State     DRAMSize   FlashSize   BoardRev  PromRev
1X     p55          68    normal    64.0M      8.0938M     A         1.0
1Y     p55          68    standby   64.0M      8.0938M     A         1.0
```

The fields in this display are defined as follows:

Field	Description
CPU	The slot in which the SCP resides. The number indicates in which switch fabric it resides (`1` in an *ASX*-200BX, *ASX*-200WG, LE 155, LE 25, *TNX*-210, *ESX*-3000, or *ASX*-4000; or `1`, `2`, `3`, or `4` in an *ASX*-1000, *ASX*-1200, or *TNX*-1100). The letter indicates in which of the two slots it resides. In an *ASX*-1000, *ASX*-1200, or *TNX*-1100, **`X`** is the top slot of the switch fabric and **`Y`** is the bottom slot of the switch fabric. In an *ASX*-200BX, **`X`** is the left slot of the switch fabric and **`Y`** is the right slot of the switch fabric. In an *ASX*-4000, **`X`** is the left SCP slot and **`Y`** is the right SCP slot.
Type	The type of processor (`i960ca`, `i960cf`, `i960ha`, `p6`, `p55, or p266`).
CpuStep	The revision level of the CPU chip.
State	The current condition of the SCP. **`normal`** means this SCP is functioning properly and this SCP is the primary (controlling) SCP if more than one is installed. **`standby`** means this is the secondary (standby) SCP if more than one is installed. **`fail`** means something is wrong with this SCP.
DRAMSize	The amount of DRAM, in Megabytes, installed on the SCP board.

Field	Description
FlashSize	The size of FLASH, in Megabytes, installed on this SCP board. If running *ForeThought* 5.3.x on an *ASX*-4000, the FLASH size displays as 8MB even though the total FLASH is 53MB. The FLASH space is distributed onto two FLASH devices: 8MB FLASH chips and 45MB FLASH card). The 45MB space is used for CDB storage only.
BoardRev	The hardware revision level of the processor's board. N/A means the revision cannot be obtained; e.g., the other SCP is running a software version that does not support this field.
PromRev	The hardware revision level of the SCP PROM. This field is only available for SCPs that are HA or later. N/A means the revision cannot be obtained; e.g., the SCP is earlier than an HA or the other SCP is running a software version that does not support this field.

This command also lets you display the MAC address of the SCP(s) as follows:

```
myswitch::> operation environment> cpu -macaddr
 CPU    MAC Address
 1X     0020480f00bb
 1Y     002048dedbef
```

The fields in this display are defined as follows:

Field	Description
CPU	This field is described in the previous table.
MAC Address	This is the Ethernet MAC address of your SCP that is used during bootp. If you connect a terminal device to the SCP's serial port, you see the Ethernet MAC address displayed during the EPROM boot sequence. See Chapter 4 in the *ATM Switch Installation and Maintenance Manual* for more information about bootp. The Ethernet MAC address also scrolls across the display LED on the SCP's front panel. See Chapter 4 in the *ATM Switch Installation and Maintenance Manual* for more information about the display LED.

This command also lets you display the serial number(s) of the installed SCP(s) as follows:

```
myswitch::operation environment> cpu -serialnum
 CPU    Serial Number
 1X     8807
 1Y     21562
```

The fields in this display are defined as follows:

Field	Description
CPU	This field is described in the previous table.
Serial Number	The serial number of the SCP. This field only applies to an *ASX*-4000.

3.3.2 Switch Fabric Operation

These commands allow you to monitor the temperature of the individual switch fabrics on an *ASX*-1000, *ASX*-1200, or *TNX*-1100 only. Typing **`fabric ?`** at the prompt at the `environment` level to display the available commands as follows:

```
myswitch::operation environment> fabric ?
  show              temperature
```

3.3.3 Showing Switch Fabric Temperature Information

This command displays the following:

- current temperatures in degrees Celsius of each installed switch fabric on an *ASX*-1000, *ASX*-1200, or *TNX*-1100
- the current state of the temperature sensor
- the current thresholds at which a temperature alarm trips and then later resets

The current temperature and state values are displayed for all installed fabrics as follows:

```
myswitch::operation environment fabric> show
Fabric      Deg C       State
1           31          normal
2           28          normal
3           37          normal
4           35          normal
Alarm/trap reset threshold (this fabric): 60 degrees C or lower
Alarm/trap trip threshold (this fabric): 65 degrees C or greater
```

The fields in this display are defined as follows:

Field	Description
Fabric	The number of the fabrics currently installed in the switch. Switch fabric 1 is in the slot labeled 1 on the enclosure, switch fabric 2 is in the slot labeled 2 on the enclosure, etc.
Deg C	The current temperature of the switch fabrics in degrees Celsius.
State	Shows **`overTemp`** if an alarm has been tripped because of this sensor, based on the trip and reset values that have been configured. Shows **`normal`** if otherwise, or if the alarm has reset.
Alarm / trap reset threshold	The temperature in ^{o}C at which an overtemperature alarm is reset. For example, if you set the reset and trip thresholds to 50 ^{o}C and 60 ^{o}C, respectively, then the alarm trips at 60 ^{o}C, and is reset when the temperature drops back down to 50 ^{o}C.
Alarm / trap trip threshold	The temperature in ^{o}C at which an overtemperature alarm trips. For example, if you set the reset and trip thresholds to 50 ^{o}C and 60 ^{o}C, respectively, the alarm trips at 60 ^{o}C, and is reset when the temperature drops back down to 50 ^{o}C.

3.3.4 Configuring the Switch Fabric Temperature Thresholds

This command allows you to set the thresholds at which a temperature alarm is tripped and then later reset on an *ASX*-1000, *ASX*-1200, or *TNX*-1100. Any temperature can cause the switch to display a state of `normal` or `overTemp`, depending on the trip and reset thresholds that you have set. For example, a temperature of 55 ^{o}C shows a state of `normal` if the trip threshold was 60 ^{o}C and the switch fabric temperature never reached 60 ^{o}C, but it would show a state of `overTemp` if the switch fabric temperature reached 60 ^{o}C, and then had dropped to 55 ^{o}C, but had not yet reached a reset threshold set at 50 ^{o}C. Enter the following:

```
myswitch::operation environment fabric> temperature <reset threshold>
<trip threshold>
```

These parameters are defined as follows:

Parameter	Description
reset threshold	The temperature in ^{o}C at which an overtemperature alarm is reset. The default is 60 ^{o}C.
trip threshold	The temperature in ^{o}C at which an overtemperature alarm trips. The default is 65 ^{o}C.

3.3.5 Fan Operation

This command enables you to display information about the fans on an *ASX*-1000, *ASX*-1200, *TNX*-1100, *ESX*-3000, or an *ASX*-4000. The following is displayed:

```
myswitch::operation environment> fans
 FanBank         FanBankState    FanType    FanRev     SerialNumber
 1               normal          1          1          98080001
 2               normal          1          1          98080002
```

The fields in these displays are defined as follows:

Field	Description
FanBank	On an *ASX*-1000, *ASX*-1200, or *TNX*-1100, this field corresponds to a single fan, indicating the number of the fan. On an *ASX*-4000, this field corresponds to a fan tray. 1 indicates the upper fan tray and 2 indicates the lower fan tray.
FanBankState	The current state of the fan. If the fan is functioning properly, it reads **normal**. If the fan has malfunctioned, it reads **failed**.
FanType	The type of fan tray installed. This field only applies to an *ASX*-4000.
FanRev	The hardware revision number of the fan tray. This field only applies to an *ASX*-4000.
Serial Number	The serial number of the fan tray. This field only applies to an *ASX*-4000.

3.3.6 Management Station/Backplane Operation

This command enables you to display information about the management station or backplane on an *ASX*-1000, *ASX*-1200, *TNX*-1100, or an *ASX*-4000. The following is displayed:

```
myswitch::operation environment> management
 Type            Revision        SerialNumber
 64              F               3956
```

The fields in these displays are defined as follows:

Field	Description
Type	The board type of management station or backplane.
Rev	The hardware revision of the management station or backplane.
Serial Number	The serial number of the management station or backplane.

The following is displayed on all other switches:

```
myswitch::operation environment> management
No management board/backplane information available
```

3.3.7 Power Supply Operation

This command lets you display information about power supplies.

This command is not available on an LE 155 or an LE 25 switch.

The following power information is displayed on an *ASX*-1000 with model A DC power supplies:

```
myswitch::operation environment> power
 PowerSupply  Type            InputState  OutputState S/N        Version
 1            ps48VDC         normal      normal      107        1
 2            ps48VDC         normal      normal      195        1
```

The following power information is displayed on an *ASX*-1000, *ASX*-1200, or a *TNX*-1100 with model B DC power supplies:

```
myswitch::operation environment> power
 PS  Type          InputState OutputState 5VoltState Current S/N  Version
 1   ps30ADC       normal     normal      normal     normal  10         1
 2   ps30ADC       normal     normal      normal     normal  10         1
```

The following power information is displayed on an *ASX*-1000 with model A AC power supplies:

```
myswitch::operation environment> power
 PowerSupply  Type            InputState  OutputState
 1            psAutoRangeAC   normal      normal
 2            psAutoRangeAC   normal      normal
```

The following power information is displayed on an *ASX*-1000, *ASX*-1200, or *TNX*-1100 with model B AC power supplies:

```
myswitch::operation environment> power
 PowerSupply  Type            InputState  OutputState S/N        Version
 1            psRM1000HA      normal      normal      12         1
 2            psRM1000HA      normal      normal      22         1
```

The following power information is displayed on an *ASX*-200BX or *TNX*-210:

```
myswitch::> operation environment> power
 PowerSupply  Type            InputState  OutputState
 1            psAutoRangeAC   normal      normal
 2            psAutoRangeAC   normal      normal
```

The following power information is displayed on an *ASX*-200WG:

```
myswitch::> operation environment> power
 PowerSupply  Type            InputState  OutputState
 1            psAutoRangeAC   normal      normal
```

The following power information is displayed on an AC-powered *ASX*-4000:

```
myswitch::> operation environment> power
 PowerSupply  Type            InputState  OutputState S/N        Version
 1            psAutoRangeAC   normal      normal      98050001   0
 2            psAutoRangeAC   normal      normal      98050002   0
 3            psAutoRangeAC   normal      normal      98050003   0
 4            psAutoRangeAC   normal      normal      98050004   0
```

The following power information is displayed on a DC-powered *ASX*-4000:

```
myswitch::> operation environment> power
 PowerSupply  Type            InputState  OutputState S/N        Version
 1            ps48VDC         normal      normal      97050001   0
 2            ps48VDC         normal      normal      97050002   0
 3            ps48VDC         normal      normal      97050003   0
 4            ps48VDC         normal      normal      97050004   0
 5            ps48VDC         normal      normal      97050005   0
```

The following power information is displayed on an *ESX*-3000:

```
hydra1::operation environment> power
 PowerSupply  Type            InputState  OutputState
 3            N/A             normal      normal
```

The fields in these displays are defined as follows:

Field	Description
PowerSupply	The slot in which the power supply resides: • On an *ASX*-200BX or *TNX*-210, 1 indicates the left power supply and 2 indicates the right power supply. • On an *ASX*-1000, *ASX*-1200, or *TNX*-1100, 1 indicates the power supply in slot 1 in the chassis and 2 indicates the power supply in slot 2 in the chassis. • On an *ASX*-4000, 1 indicates the power supply in slot 1 in the chassis (the leftmost slot), 2 indicates the power supply in slot 2 in the chassis, etc. • On a *ESX*-3000, 1 indicates the power supply in slot 1 in the chassis (the leftmost slot), 2 indicates the power supply in slot 2 in the chassis, and 3 indicates the power supply in slot 3 in the chassis (the rightmost slot).
Type	Shows whether it is an AC or a DC power supply.
InputState	Shows if the voltage coming into the power supply is normal or not.
OutputState	Shows if the voltage going out of the power supply is normal or not.
5VoltState	Shows the state of the +5V output of this power supply.
Current	Shows the state of the current on the input return path of this power supply.
S/N	Shows the serial number of the power supply.
Version	Shows the power supply's hardware version number.

3.3.8 Temperature Sensor Operation

This command enables you to display information gathered by the temperature sensors.

This command is not available on an LE 155, an LE 25, or an *ESX*-3000 switch.

The following temperature information is displayed on an *ASX*-1000, *ASX*-1200, or *TNX*-1100:

```
myswitch::operation environment> temperature
TemperatureSensor              SensorState
enclosure                      normal
power-supply-1                 normal
power-supply-2                 normal
```

The following temperature information is displayed on an *ASX*-200BX, *ASX*-200WG, or a *TNX*-210:

```
myswitch::operation environment> temperature
TemperatureSensor              SensorState
enclosure                      normal
```

The following temperature information is displayed on an *ASX*-4000:

```
myswitch::operation environment> temperature
 TemperatureSensor              SensorState
 enclosure                      normal
 power-supply-1                 normal
 power-supply-2                 normal
 power-supply-3                 normal
 power-supply-4                 normal
```

The fields in these displays are defined as follows:

Field	Description
TemperatureSensor[1]	Indicates where the temperature sensor is located on the unit.
SensorState	Shows if the temperature at the specified location is normal or not.

1. Power supply temperature sensor information is only shown on an *ASX*-1000, *ASX*-1200, *ASX*-4000, or *TNX*-1100. If this command is issued on an*ASX*-200WG, *ASX*-200BX, or on a *TNX*-210, information is shown only for the enclosure temperature sensor. No power supply temperature sensor information is displayed for these types of switches.

3.4 FLASH Operation Commands

These commands enable management of the FLASH memory system. Typing **flash ?** at the prompt at the operation level displays the **flash** commands as follows:

```
myswitch::operation> flash ?
copy            delete          dir             free
get             init            put             rename
view
```

3.4.1 Copying a File to FLASH Memory

This command allows you to copy a file within the FLASH memory system. Enter the following parameters:

```
myswitch::operation flash> copy <from> <to>
```

These parameters are defined as follows:

Parameter	Description
from	The file to be copied.
to	The file within the FLASH memory system to which the first file is copied.

3.4.2 Deleting a File or Directory from FLASH Memory

This command allows you to delete a file or directory from the FLASH memory system. Enter the following parameters:

```
myswitch::operation flash> delete <file>
```

This parameter is defined as follows:

Parameter	Description
file	The file or directory within the FLASH memory system that is to be deleted.

To delete a directory from the FLASH memory system (e.g., `FT6.0/`), you must first delete all files in that directory. For example:

1. List all directories in your FLASH memory system as follows:

```
myswitch::operation flash> dir
Size       Date         Time      Name
141        JUN-03-1998  22:21:26  LECS.CFG
0          JUL-02-1998  14:20:46  FT6.0/
6          JUL-02-1998  14:20:48  CURRENT
```

2. List all files in the directory that you want to delete as follows:

```
myswitch::operation flash> dir ft6.0
Size       Date         Time      Name
2477738    JUL-02-1998  14:20:44  FOREOS.EXE
```

3. Delete the file(s) in the directory as follows:

```
myswitch::operation flash> del ft6.0/foreos.exe
```

4. Delete the directory as follows:

```
myswitch::operation flash> del ft6.0
```

3.4.3 Displaying the FLASH Memory Directory

This command enables you to display the directory listing of the FLASH memory system. Enter the following parameters:

```
myswitch::operation flash> dir
Size        Date          Time       Name
141         JUN-03-1998   22:21:26   LECS.CFG
0           JUL-02-1998   14:20:46   FT6.0/
6           JUL-02-1998   14:20:48   CURRENT
```

The fields in this display are defined as follows:

Field	Description
Size	Shows the size of the directory or file in K.
Date	Shows the date on which the directory or file was last changed.
Time	Shows the time when the directory or file was last changed.
Name	Shows the name of the directory or file.

You can also display information about all of the files in a given directory as follows:

```
myswitch::operation flash> dir ft6.0
Size        Date          Time       Name
2477738     JUL-02-1998   14:20:44   FOREOS.EXE
```

The fields in this display are defined in the same manner as those in the previous example.

3.4.4 Displaying Free Space on the FLASH File

This command lets you display the amount of remaining free space in the FLASH memory system. Enter the following parameters:

```
myswitch::operation flash> free
There are 1891974 bytes of flash still available
```

Depending on the condition of the FLASH file system, it may take several minutes for this command to complete.

3.4.5 Getting a FLASH File

This command lets you retrieve a file from a remote host. Enter the following parameters:

```
myswitch::operation flash> get <host:remotefile> <localfile>
```

These parameters are defined as follows:

Parameter	Description
host:remotefile	The IP address of the host and file from which the file is to be retrieved.
localfile	The name of the FLASH file where the retrieved file is to be stored.

If you have configured the transfer protocol to be FTP using **`conf system protocol`**, you only need to enter the command shown above to perform the FLASH file restore. After you enter the command shown above, you are prompted for the remote userid and password of the remote host from which you are retrieving the file.

If you have configured the transfer protocol to be TFTP (this is the default) using **`conf system protocol`**, the remote host from which the FLASH file will be retrieved must be running the TFTP server code. If you are unsure of how to do this, see the *ATM Switch Installation and Maintenance Manual.*

3.4.6 Initializing the FLASH File

This command lets you initialize the FLASH file.

CAUTION

Initializing the FLASH file deletes all information from the FLASH file, including the switch software, except the CDB, which is written back to the FLASH file.

Because this action results in the removal of data, the switch asks you to verify this action before it re-initializes the FLASH file. Enter the following parameters:

```
myswitch::operation flash> init

Are you sure you want to format the flash [n]? n

myswitch::operation flash>
```

3.4.7 Putting a FLASH File on a Remote Host

This command allows you to copy a FLASH file to a remote host. Enter the following:

```
myswitch::operation flash> put <localfile> <host:remotefile>
```

These parameters are defined as follows:

Parameter	Description
localfile	The name of the FLASH file to be copied.
host:remotefile	The IP address of the host and file to which the FLASH file is to be copied.

If you have configured the transfer protocol to be FTP using **conf system protocol**, you only need to enter the command shown above to perform the FLASH backup. After you enter the command shown above, you are prompted for the remote userid and password of the remote host to which you are backing up the FLASH file.

If you have configured the transfer protocol to be TFTP (this is the default) using **conf system protocol**, the remote host to which the FLASH file will be backed up must be running the TFTP server code. If you are unsure of how to do this, see the *ATM Switch Installation and Maintenance Manual*.

If you are using TFTP to perform the FLASH file backup, you must first create an empty file in the `/tftpboot` directory on the remote host to receive the FLASH file. Use the **touch** command to do this. Then, use the **chmod** command to change the permissions of that file so that it will let the switch write the backup FLASH to that file.

Perform the following steps to back up your FLASH:

1. First, telnet to your remote host and log in.
2. Enter the following commands in sequence:

```
cd  /tftpboot
touch <backup file name>
chmod 777 <backup file name>
```

3. Then exit from the telnet session.
4. Telnet to the switch and log into AMI.
5. Enter the following command:

```
oper flash put <host>:/tftpboot/<backup file name>
```

You should receive a confirmation message that the FLASH file was successfully copied.

3.4.8 Renaming a FLASH File

This command enables you to rename a file that is in FLASH memory. Enter the following parameters:

```
myswitch::operation flash> rename <from> <to>
```

These parameters are defined as follows:

Parameter	Description
from	The current name of the file to be renamed.
to	The new name of the file to be renamed.

3.4.9 Viewing a FLASH File

This command lets you view the contents of any ASCII file that resides on the FLASH (e.g., the LECS configuration file) without having to transfer it to a workstation. Enter the following:

```
myswitch::operation flash> view <text file name>
```

These parameters are defined as follows:

Parameter	Description
text file name	The name of the ASCII file that you want to view.

CAUTION

This command does not allow you to view executable files (files with a .exe extension). If you rename such a file without a .exe extension, this command will open the file for viewing. However, viewing an executable file may reset the terminal settings.

For example, if your LECS configuration file is named `lecs.cfg`, you can enter the following to view that file on the switch:

```
myswitch::operation flash> view lecs.cfg
#
# ForeWarn Generated Configuration
#
# Parameters for elan: DEFAULT
#
.Multicast_Send_VCC_Type: Best Effort
.Maximum_Unknown_Frame_Time: 1
.LAN_Type: Ethernet/IEEE 802.3
.Maximum_Unknown_Frame_Count: 1
.VCC_TimeOut_Period: 1200
.Forward_Delay_Time: 15
.Maximum_Frame_Size: 1516
.Expected_LE_ARP_Response_Time: 1
.Path_Switching_Delay: 6
.Aging_Time: 300
.Control_TimeOut: 120
.Connection_Complete_Timer: 4
.Flush_TimeOut: 4
.Maximum_Retry_Count: 1
#
# Parameters for elan: abc
#
abc.Address: 0x47.0005.80.ffe100.0000.f21c.19da.0020481c19da.10
abc.LAN_Name: abc
_el0.Accept: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
#
# The search ordering of elan names
#
Match.Ordering: abc, default
```

If you enter an invalid file name, an error message is returned as follows:

```
myswitch::configuration lane lecs> view lesc.cfg
Could not locate file lesc.cfg in flash
```

This command only displays the contents of an ASCII file. To edit the file, you must first transfer it to a workstation and use a text editor.

3.5 Series D Network Module Test Command

This command lets you perform various shared memory ASIC self-tests on Series D network modules only.

The tests take approximately five to ten minutes to finish.

Before you can test a Series D network module, you must first take it out of service by administering it down with the following AMI command:

```
myswitch::configuration module> admin <module> (up | down)
```

These parameters are defined as follows:

Parameter	Description
module	The Series D network module that is to be administered up or down. Enter the board number and network module; e.g., 3A.
up | down	**up** brings that network module back on-line. **down** causes the designated network module to be taken off-line temporarily so that it can be tested.

For example, if you want to test module A on board 3, enter the following:

```
conf module admin 3A down
```

When this command is entered, a warning message is displayed as follows:

```
Disabling the network module will destroy all existing connections on the module.
Disable the network module [n]? y
```

Entering **n** or pressing **<ENTER>** aborts the command. Entering **y** tears down all of the existing connections and temporarily places the network module out of service. You can then test the network module using the following AMI command:

```
myswitch::operation module> test <module>
```

This parameter is defined as follows:

Parameter	Description
module	The Series D network module that is to be tested. Enter the board number and network module; e.g., 3A.

To test module A on switch fabric 3, enter the following:

oper module test 3A

You receive the following message:

```
Testing a network module may take 5-10 minutes
Start the test?  [n]? y
Press the ENTER key to abort the test!!
Testing SRAM Bank 0......
Testing SRAM Bank 1.......
DRAM.....................................................................
.........................................................................
.........................................................................
.............................................................
Network module tests successful

Do you want to abort the tests [n]?
```

To abort the self-tests, press **<ENTER>** at any time during the test. You receive the following message:

```
Do you want to abort the tests [n]?
```

Entering **n** or pressing **<ENTER>** allows you to resume the tests. Entering **y** stops the tests. You receive the following message:

```
Abort the test [n]? y
Network module test aborted.
```

When you are finished testing the network module, use the following command to put the network module back into service.

conf module admin 3A up

At that point, PVCs that are stored in the configuration database are re-established and SVCs are dynamically re-established.

3.6 Panic Acknowledgment Commands

On a rare occasion, the SCP may go into a state called panic, in which it reboots, closes a user out of session, or goes into a hung or frozen state. When the SCP returns to a normal state and an active session is running again, the first thing you should do is execute the **operation panic show** AMI command to display information about what happened to the SCP when it panicked. This information helps FORE's Technical Assistance Center (TAC) staff to diagnose the problem. Type **panic ?** at the prompt at the **operation** level to display the panic commands as follows:

```
myswitch::operation> panic ?
  action              clear               show                save
```

3.6.1 Setting the Panic Action

This command allows you to set the course of action that the SCP will take upon experiencing a panic condition. Enter the following:

```
myswitch::operation panic> action [(suspend | reboot)]
```

These parameters are defined as follows:

Parameter	Description
suspend	Indicates that the SCP will hang in a suspended state upon experiencing a panic. There is no panic record logged. This allows a way to perform debugging. It also provides a way to avoid the teardown of PVCs. PVCs are preserved so that you can choose a more convenient time for rebooting the system and restoring full functionality.
reboot	Indicates that the SCP will automatically reboot upon experiencing a panic. A panic record is logged. This is the default action.

It is highly recommended that you only use the **suspend** mode for diagnostic purposes. If **suspend** is the configured mode and the SCP panics, the SCP hangs until the user manually reboots the SCP. No automatic reboot will occur.

To display the action that is currently set, enter the following:

```
myswitch::operation panic> action
Current panic action is to reboot.
```

3.6.2 Clearing the Panic Flag

This command lets you clear the panic acknowledgment flag without viewing the contents of the panic dump file. Once the flag is cleared, you may return to normal operation of the switch.

Do not clear a panic condition until after you have performed the following three steps.

1. Use the **`operation panic show`** command in AMI to display the contents of the panic file.
2. Cut and paste this panic file information to another file on a host and save that file.
3. Send this information via e-mail to FORE's TAC along with a description of the events leading up to the panic. Ask the TAC staff to open a case for you based on that information. Once you have sent them the information, you may clear the panic record.

Enter the following parameters to clear a panic record on the controlling SCP:

```
myswitch::operation panic> clear
OK.
```

Enter the following parameters to clear a panic record on the standby SCP from the controlling SCP:

```
myswitch::operation panic> clear standby
OK.
```

The message below is shown when no panic record exists (i.e., the SCP has not experienced a panic condition).

```
myswitch::operation panic> clear
There is no panic condition to clear.
```

3.6.3 Displaying the Panic Dump File

This command lets you view the contents of the panic dump file, which contains information about what happened to the SCP when it panicked, without clearing the panic flag. This information can assist FORE's TAC staff in troubleshooting the cause of the panic. Once the flag is cleared, you may return to normal operation of the switch.

The following is an example of the kind of trace that appears on your console when a panic occurs:

```
Software version: 6.0.0 rev 1.22910 with 0 deltas

name:tWdTickle status:0x00000004 pri:0
edi:0000000000 esi:0x03e37e10 ebp:0x03e37dd0 esp:0x03e37dcc    ebx:0000000000
edx:0000000000 ecx:0000000000 eax:0000000000 eflags:0x00000246 pc:0x00136212
0. 0x00136212
1. 0x0015c8b9
2. 0x0010aa99
3. 0x001703a8
name:tLogTask status:0x00000002 pri:1
edi:0xffffffff esi:0x03e3661c ebp:0x03e363fc esp:0x03e363f0    ebx:0000000000
edx:0000000000 ecx:0000000000 eax:0000000000 eflags:0x00000202 pc:0x00170a1d
0. 0x00170a1d
1. 0x00139592
2. 0x0015004c
3. 0x001703a8
.
.
.
03b52420:  00000000 00000002 00000001 ffffffff   *................*
03b52430:  03e3661c 03e363fc 03e363f0 00000000   *.f...c...c......*
03b52440:  00000000 00000000 00000000 00000202   *................*
03b52450:  00170a1d 00139592 0015004c 001703a8   *........L.......*
```

NOTE This example trace has been truncated. An actual trace would be much longer.

If you log in to AMI and enter the following, you can display the panic record:

```
myswitch::> oper panic show
name:tWdTickle status:0x00000004 pri:0
edi:0000000000 esi:0x03e37e10 ebp:0x03e37dd0 esp:0x03e37dcc    ebx:0000000000
edx:0000000000 ecx:0000000000 eax:0000000000 eflags:0x00000246 pc:0x0013757a
0. 0x0013757a
1. 0x0015dc21
2. 0x0010ab09
3. 0x00171d48
name:tLogTask status:0x00000002 pri:1
edi:0xffffffff esi:0x03e3661c ebp:0x03e363fc esp:0x03e363f0    ebx:0000000000
edx:0000000000 ecx:0000000000 eax:0000000000 eflags:0x00000202 pc:0x001723bd
0. 0x001723bd
1. 0x0013a8fa
2. 0x001513b4
3. 0x00171d48
.
.
.

Software version: 6.0.0 rev 1.22910 with 0 deltas
The panic dump is complete.
```

Once the information has been displayed, follow the steps listed in the previous subsection for clearing a panic record.

To display the panic information on a standby SCP, enter the following:

```
myswitch::operation panic> show standby
```

The following message is displayed whenever there is no panic record:

```
myswitch::operation panic> show
Standby: There is no panic dump to show you.
```

If the switch panics, the panic record is automatically written to syslog upon reboot, provided that a syslog host had been set prior to the panic. This is especially useful if multiple panics occur, so that each is separately recorded and is not overwritten as they are when no syslog is set. For more information about setting the syslog host, see Part 2 of the *AMI Configuration Commands Reference Manual.*

3.6.4 Saving the Panic File

This command lets you save the contents of the panic dump file, which contains information about what happened to the SCP when it panicked. When you use this command, the panic file is saved as an ASCII file in FLASH. To save the panic information on the primary SCP, enter the following:

```
myswitch::operation panic> save <filename>
```

For example:

```
myswitch::operation panic> save panic_myswitch_03_20_98
```

To save the panic information on the standby SCP, enter the following:

```
myswitch::operation panic> save <filename> standby
```

Once you have saved the file, you can transfer it to a host using the **oper flash put** command as follows:

```
myswitch::operation panic> up

myswitch::operation> flash

myswitch::operation flash> put panic_myswitch_03_20_98 172.122.18.14:
panic_myswitch_03_20_98
```

Once the file is on a host, you can either attach the panic file to an e-mail and send it, or print the file and fax it to FORE Systems' TAC. This information can assist FORE's TAC in troubleshooting the cause of the panic.

If there is no file to save, then the following messages are displayed:

```
myswitch::operation panic> save panic_file
There is no panic dump to save.

myswitch::operation panic> save panic_file standby
Standby: There is no panic dump to show you.
```

3.7 Rebooting the Switch

This command enables you to reboot the SCP. You can get to this level by entering **reboot** at the operation level. You are asked to verify that you want to take this action. Enter the following parameters:

```
myswitch::operation> reboot

Are you sure you want to reboot this switch [n]? y
```

Upon reboot, the SCP immediately closes all open AMI sessions.

3.8 Upgrading the Switch

This command allows you to upgrade the software on an individual SCP.

If you want to upgrade the software on an *ASX*-1000, *ASX*-1200, or *TNX*-1100 or on both SCPs in an *ASX*-200BX or *TNX*-210, you must perform the upgrade on each SCP individually.

You can get to this level by entering **upgrade** at the operation level. Enter the following parameters:

For complete instructions about performing a software upgrade, see the *ATM Switch Installation and Maintenance Manual* for your switch.

```
myswitch::operation> upgrade <remotehost>:<full path to remotefile>
```

These parameters are defined as follows:

Parameter	Description
remotehost	The IP address of the remote host on which the upgrade file resides
full path to remotefile	The full path name of the upgrade file.

If you have configured the transfer protocol to be FTP using **conf system protocol**, you are prompted for the remote userid and password of the remote host from which you are retrieving the file. For example:

```
myswitch::operation> upgrade <remotehost>:<full path to remotefile>
  Will upgrade directly to flash
  remote userid: <remote userid>
  remote password: <remote password>
```

If you have configured the transfer protocol to be TFTP (this is the default) using **conf system protocol**, the remote host on which the upgrade file resides must be a tftpboot server. To perform the initial switch software upgrade successfully using TFTP, the bootp server and the tftpboot server must be configured properly. If you are unsure of how to do this, see the *ATM Switch Installation and Maintenance Manual* for your switch.

3.9 Displaying and Changing the Version of Software

This command allows you to display and/or change the version of software that is currently running on the SCP. The software versions in the FLASH are displayed and the current software version that the switch would use upon a reboot is displayed. When no software is stored in the FLASH and when an Ethernet boot has been performed, then nothing is displayed for the version.

To display the current version, enter the following parameters:

```
myswitch::operation> version
Software versions installed : FT6.0
Current software version is FT6.0
```

If more than one version is installed, you can type the following parameters to change the current version:

```
myswitch::operation> version [<new-version>]
```

This parameter is defined as follows:

Parameter	Description
new-version	The name of the software version with which you want to replace the current version.

ForeThought 6.0.x automatically imports configuration information when upgrading an *ASX*, *TNX*, or *ForeRunnerLE* switch from *ForeThought* 5.0.x, 5.1.x, 5.2.x, or 5.3x. To upgrade from one of the earlier *ForeThought* releases listed here, you should back up your CDB (using AMI command **oper cdb backup**), and then upgrade directly to 6.0.x (using **oper upgrade**).

Downgrades, however, do not automatically export configuration information to the earlier version. You will only be able access the switch through the serial port. The FLASH is reformatted during this process.

ForeThought 4.1.1 is the earliest release to which you can downgrade LE 155 switches that have 4 MB FLASH.

NOTE

For SCP-ASXHAs with 8 MB of FLASH, the ability to recognize dissimilar SCPs is a *ForeThought* 5.3.x feature that has been recently patched into the following older releases of dual SCP capable switch software: *ForeThought* 4.1.x, *ForeThought* 5.1.x, and *ForeThought* 5.2.x. See the *SCP-ASXHA Release Notes* for more information about dissimilar SCPs. Any attempt to operate dissimilar SCP-ASXHAs in a dual SCP configuration with a version of software that does not contain this patch will result in a switch panic or other form of non-recoverable error. Contact the FORE Systems Technical Assistance Center (TAC) if you need to obtain one of these patch builds.

If you absolutely need to downgrade a switch, you must perform the following steps on a console connected to the serial port:

1. Back up the CDB of the switch running *ForeThought* 6.0.x (using **`oper cdb backup`**).
2. Downgrade to *ForeThought* 5.3.x, 5.2.x, 5.1.x, or 5.0.x (using **`oper upgrade`**) and reboot the switch.
3. Perform a FLASH init (using **`oper flash init`**).
4. If needed, re-assign the IP address and default route information, and reboot over Ethernet.
5. Perform an **`oper upgrade`** again of the older version, but DO NOT reboot the switch.
6. Restore the CDB (using **`oper cdb restore`**) and reboot the switch.

If you have any questions about changing between software versions, contact FORE Systems' Technical Assistance Center (TAC).

NOTE

For more information about changing between multiple versions of software, see the *ATM Switch Installation and Maintenance Manual* for your switch.

CHAPTER 4 AMI Statistics Commands

This chapter contains a detailed description of the AMI statistics commands that display operational performance and error information for the various hardware and software features of the switch and the network modules. The main **statistics** menu can be found at the root level. To display the available commands, type **?** at the **statistics** level.

```
myswitch::statistics> ?
  atm>              atmroute>         cec>              cese1
  cesds1            ces               cr                board>
  fratm>            funi>             ipaccess          iwf>
  module>           nsapfilter>       oam>              port
  reset             portcard          scp>              spans
  signalling        vcc               vpc               vpt
```

Each of these commands is described in the following subsections.

NOTE

Not all of the above commands are displayed on every platform. The **cec>** commands are only displayed on the platforms that can support a CEC-Plus. The **cese1>**, **cesds1>**, and **ces>** commands are only displayed on the platforms that can support CEM network modules. The **fratm>**, **funi>**, and **iwf>** commands are only displayed on the platforms that can support *FramePlus* network modules.

4.1 ATM Statistics

This command lets you display the submenu for ATM statistics. Enter **?** at the **statistics atm** level to list the following submenu:

```
myswitch::statistics atm> ?
  inputlookuperrors>
```

4.1.1 Input Lookup Error Statistics

This command lets you display the submenu for input lookup error statistics. Enter **?** at the **atm** level to list the following submenu:

```
myswitch::statistics atm inputlookuperrors> ?
  show
```

4.1.1.1 Displaying Input Lookup Errors

This command lets you display the input lookup error statistics. Enter the following:

```
myswitch::statistics atm inputlookuperrors> show
VPI-Lookup-Errors  VCI-Lookup-Errors
128524             94
```

The fields in this display are defined as follows:

Field	Description
VPI-Lookup-Errors	The number of cells that do not match any VPI lookup tables. On an *ASX*-4000 and *ESX*-3000, this number reflects the aggregate of all of the port cards (network modules) in the switch.
VCI-Lookup-Errors	The number of cells that do not match any VCI lookup tables. On an *ASX*-4000 and *ESX*-3000, this number reflects the aggregate of all of the port cards (network modules) in the switch.

On an *ASX*-4000 or *ESX*-3000, you can display the statistics for each port card (network module). The following displays on an *ASX*-4000:

```
myswitch::statistics atm inputlookuperrors> show [all | <module>]
myswitch::statistics atm inputlookuperrors> show all
Module  VPI-Lookup-Errors  VCI-Lookup-Errors
1A      0                  0
1B      33318              94
1C      0                  0
1D      0                  0
2C      0                  0
2D      0                  0
3A      2                  0
3B      0                  0
3C      29409              0
3D      28396              0
4C      37399              0
```

The following displays on an *ESX*-3000:

```
myswitch::statistics atm inputlookuperrors> show [all | <id>]
ID      VPI-Lookup-Errors  VCI-Lookup-Errors
1       7                  0
2       0                  0
3       7                  45620
4       0                  0
5       0                  0
6       27717              5
8       41561              1283
```

The fields in this display are defined as follows:

Field	Description
Module	The individual port card (network module) for which the statistics are being displayed. This only displays on an *ASX*-4000.
ID	The individual port card (network module) identification number for which the statistics are being displayed. This only displays on an *ASX*-4000.
VPI-Lookup-Errors	The number of cells on the individual port card (network module) that do not match any VPI lookup tables.
VCI-Lookup-Errors	The number of cells on the individual port card (network module) that do not match any VCI lookup tables.

On an *ASX*-4000 and *ESX*-3000, you can display the statistics for an individual port card (network module) as follows:

```
myswitch::statistics atm inputlookuperrors> show 4c
Module  VPI-Lookup-Errors  VCI-Lookup-Errors
4C      37399              0

myswitch::statistics atm inputlookuperrors> show 5
ID      VPI-Lookup-Errors  VCI-Lookup-Errors
5       0                  0
```

The fields in this display are defined in the same manner as those in the previous example.

4.2 ATM Route Statistics

These commands let you display PNNI routing statistics. Enter **?** at the **statistics atmroute** level to list the following submenu:

```
myswitch::statistics atmroute> ?
  pnni>
```

4.2.1 PNNI Routing Statistics

These commands let you display PNNI routing statistics. Enter **?** at the **pnni** level to list the following commands:

```
myswitch::statistics atmroute pnni> ?
  link             peer             profile          sc
```

4.2.1.1 PNNI Link Statistics

This command lets you display counters for PNNI links. These counters show the number of hello, or “keep alive,” messages exchanged by neighboring nodes. Enter the following:

```
myswitch::statistics atmroute pnni> link
 Node Port VPI PortId    RcvHellos XmtHellos
 1    3A4  0   10000003  38        38
 1    3E1  0   10000020  0         306
 1    3E2  0   10000021  0         309
 1    3E4  0   10000023  0         308
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node to which the displayed link is attached.
Port	The port through which the link is attached to the node.
VPI	The virtual path number on the port on which the PNNI hello protocol is running.
PortId	The PNNI port identifier for this link.
RcvHellos	The number of hello messages this node received from the neighbor attached to this node on this interface.
XmtHellos	The number of hello messages this node sent to the neighbor attached to it on this interface.

You can also display link statistics for a specific node, port, and path as follows:

```
myswitch::statistics atmroute pnni> link [<nodeix> [<port> <vpi>]]

myswitch::statistics atmroute pnni> link 1 3A4 0
 Node Port VPI PortId    RcvHellos XmtHellos
 1    3A4  0   10000003  38        38
```

The fields in this display are defined in the same manner as in the previous example.

If PNNI has not been configured on this fabric or if there are no PNNI links attached to this switch, then the following is displayed:

```
myswitch::statistics atmroute pnni> link
No link information is available
```

4.2.1.2 PNNI Peer Statistics

This command lets you display counters for PNNI peers. These counters show the numbers of different types of messages exchanged by the peers as part of the database exchange protocol. Enter the following parameters:

```
myswitch::statistics atmroute pnni> peer
 Node PeerNodeId
 1    80:160:47.000580ffe1000000f21c1f4e.ff1c1f4e0001.00
      PortCount RcvDbsums XmtDbsums RcvPtsps XmtPtsps RcvPtseReqs XmtPtseReqs
      1         2         3         5        5        2           2
      RcvPtseAcks XmtPtseAcks
      3           2
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the local node.
PeerNodeId	The node identifier of the peer node.
PortCount	The number of ports connected to the specified peer node. Also, shows the number of hello protocols running between the two peers.
RcvDbsums	The number of database summary packets received from the peer node.
XmtDbsums	The number of database summary packets sent by this node.
RcvPtsps	The number of PNNI Topology State Packets (PTSPs) received from the peer node.
XmtPtsps	The number of PTSPs sent by this node.
RcvPtseReqs	The number of PNNI Topology State Element (PTSE) request packets received from the peer node.
XmtPtseReqs	The number of PTSE request packets sent by this node.
RcvPtseAcks	The number of PTSE acknowledgment packets received from the peer node.
XmtPtseAcks	The number of PTSE acknowledgment packets sent by this node.

You can also display peer statistics for a specific node or peer as follows:

```
myswitch::statistics atmroute pnni> peer [<nodeix> [<rmtnodeid>]]
```

If PNNI has not been configured on this fabric or if this node has no peers (neighbors), then the following is displayed:

```
myswitch::statistics atmroute pnni> peer
No peer information is available
```

4.2.1.3 PNNI Profile Usage Statistics

This command lets you display the number of times that a precomputed path defined by a profile is used. Enter the following parameters:

```
myswitch::statistics atmroute pnni> profile
 Node Profile NumberOfHits TimeSinceLastHit
 1    10      5            0d 00:45:47
 1    12      2            0d 00:23:01
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node with which this profile is associated.
Profile	The profile number to which the counter belongs.
Hits	The number of times the precomputed path defined by the profile has been used.
TimeSinceLastHit	The amount of time since the precomputed path defined by the profile has been used.

You can also display profile statistics for a specific node or profile as follows:

```
myswitch::statistics atmroute pnni> profile [<nodeix> [<profix>]]
myswitch::statistics atmroute pnni> profile 1 10
 Node Profile NumberOfHits TimeSinceLastHit
 1    10      5            0d 00:45:47
```

If PNNI has not been configured on this fabric or if you have not configured any profiles, then the following is displayed:

```
myswitch::statistics atmroute pnni> profile
No profile information is available
```

4.2.1.4 Scheduler Statistics

This command lets you display the counters in a scheduler. These counters show the load on the switch and the switch's ability to handle PNNI routing messages. Enter the following:

```
myswitch::statistics atmroute pnni> sc
 Node Events   Purges   TimeoutPurges PacketsDropped HiPriPktsDropped
 1    216      48       48            0              0
      LowPriPktsDropped NodalInfoEvents HorizLinkEvents
      0                 43              173
      UplinkEvents NodalStateEvents
      0            0
```

The fields in this display are defined as follows:

Field	Description
Node	The index number of the node.
Events	The number of scheduler events.
Purges	The number of purges.
TimeoutPurges	The number of time-out purges.
PacketsDropped	The number of packets dropped.
HiPriPktsDropped	The number of high priority packets dropped.
LowPriPktsDropped	The number of low priority packets dropped.
NodalInfoEvents	The number of events related to changes in attributes of nodes in the network.
HorizLinkEvents	The number of events related to changes in attributes of links in the network.
UplinkEvents	The number of events related to changes in attributes of uplinks in the network (if the node is part of a hierarchical PNNI network).
NodalStateEvents	The number of events related to changes in attributes of nodal state in the network (if the node is part of a hierarchical PNNI network).

You can also display scheduler statistics for a specific node as follows:

```
myswitch::statistics atmroute pnni> sc [<nodeix>]
```

If PNNI has not been configured on this fabric, then the following is displayed:

```
myswitch::statistics atmroute pnni> sc
No scheduler information is available
```

4.3 CEC Statistics

This section contains a detailed description of the statistics commands that display operational performance and error information received by the CEC-Plus.

The **statistics cec** commands are only displayed on the platforms that can support a CEC-Plus.

For more information about the CEC-Plus, see the *CEC-Plus Installation and User's Manual*.

The **cec** statistics menu is available at the main **statistics** menu.

```
myswitch::statistics> cec
```

To display the **cec** commands, a TCM must be installed in the switch and a TCM (the one in slot X or slot Y) must be selected. To select the TCM in slot X (the top slot), type **slotx** at the **cec** sublevel. To select the TCM in slot Y (the bottom slot), type **sloty** at the **cec** sublevel.

```
myswitch::statistics cec> slotx
```

After selecting a TCM, type **?** to display the available commands, as follows:

```
myswitch::statistics cec slotx> ?
  icmp              interface         ip                tcp
  udp
```

Each of these commands is described in the following subsections. The commands for both **slotx** and **sloty** are the same, but they are only described once with examples that read **slotx**.

4.3.1 ICMP Statistics

You can list ICMP statistics for the TCM by entering **icmp** at the **slotx** or **sloty** level as follows:

```
myswitch::statistics cec slotx> icmp
icmp Counter                          Value               Delta
----------------------------- ------------------- --------------------
ecpIcmpInMsgs                                   1                   0
ecpIcmpInErrors                                 0                   0
ecpIcmpInDestUnreachs                           1                   0
ecpIcmpInTimeExcds                              0                   0
ecpIcmpInParmProbs                              0                   0
ecpIcmpInSrcQuenchs                             0                   0
ecpIcmpInRedirects                              0                   0
ecpIcmpInEchos                                  0                   0
ecpIcmpInEchoReps                               0                   0
ecpIcmpInTimestamps                             0                   0
ecpIcmpInTimestampReps                          0                   0
ecpIcmpInAddrMasks                              0                   0
ecpIcmpInAddrMaskReps                           0                   0
ecpIcmpOutMsgs                                  1                   0
ecpIcmpOutErrors                                1                   0
ecpIcmpOutDestUnreachs                          1                   0
ecpIcmpOutTimeExcds                             0                   0
ecpIcmpOutParmProbs                             0                   0
ecpIcmpOutSrcQuenchs                            0                   0
ecpIcmpOutRedirects                             0                   0
ecpIcmpOutEchos                                 0                   0
ecpIcmpOutEchoReps                              0                   0
ecpIcmpOutTimestamps                            0                   0
ecpIcmpOutTimestampReps                         0                   0
ecpIcmpOutAddrMasks                             0                   0
ecpIcmpOutAddrMaskReps                          0                   0
```

The fields in this display are defined as follows:

Field	Description
ecpIcmpInMsgs	The total number of ICMP messages received. This counter includes all those counted by `icmpInErrors`.
ecpIcmpInErrors	The number of ICMP messages received but determined as having ICMP-specific errors (bad ICMP checksums, bad length, etc.).
ecpIcmpInDestUnreachs	The number of ICMP Destination Unreachable messages received.

Field	Description
ecpIcmpInTimeExcds	The number of ICMP Time Exceeded messages received.
ecpIcmpInParmProbs	The number of ICMP Parameter Problem messages received.
ecpIcmpInSrcQuenchs	The number of ICMP Source Quench messages received.
ecpIcmpInRedirects	The number of ICMP Redirect messages received.
ecpIcmpInEchos	The number of ICMP Echo (request) messages received.
ecpIcmpInEchoReps	The number of ICMP Echo Reply messages received.
ecpIcmpInTimestamps	The number of ICMP Timestamp (request) messages received.
ecpIcmpInTimestampReps	The number of ICMP Timestamp Reply messages received.
ecpIcmpInAddrMasks	The number of ICMP Address Mask Request messages received.
ecpIcmpInAddrMaskReps	The number of ICMP Address Mask Reply messages received.
ecpIcmpOutMsgs	The total number of ICMP messages which this entity attempted to send. This counter includes all those counted by icmpOutErrors.
ecpIcmpOutErrors	The number of ICMP messages which this entity did not send due to problems discovered within ICMP such as a lack of buffers. This value should not include errors discovered outside the ICMP layer such as the inability of IP to route the resultant datagram. In some implementations there may be no types of error which contribute to this counter's value.
ecpIcmpOutDestUnreachs	The number of ICMP Destination Unreachable messages sent.
ecpIcmpOutTimeExcds	The number of ICMP Time Exceeded messages sent.
ecpIcmpOutParmProbs	The number of ICMP Parameter Problem messages sent.
ecpIcmpOutSrcQuenchs	The number of ICMP Source Quench messages sent.
ecpIcmpOutRedirects	The number of ICMP Redirect messages sent. For a host, this object is always zero, since hosts do not send redirects.
ecpIcmpOutEchos	The number of ICMP Echo (request) messages sent.
ecpIcmpOutEchoReps	The number of ICMP Echo Reply messages sent.
ecpIcmpOutTimestamps	The number of ICMP Timestamp (request) messages sent.
ecpIcmpOutTimestampReps	The number of ICMP Timestamp Reply messages sent.
ecpIcmpOutAddrMasks	The number of ICMP Address Mask Request messages sent.
ecpIcmpOutAddrMaskReps	The number of ICMP Address Mask Reply messages sent.

The value column displays the current value of the counter. The delta column displays the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.3.2 Interface Statistics

You can list interface statistics for the TCM by entering **interface** at the **slotx** or **sloty** level as follows:

```
myswitch::statistics cec slotx> interface
Interface ie0 Counter                Value                Delta
------------------------------ -------------------- --------------------
ecpNetIfInOctets                          4294967295                    0
ecpNetIfInUcastPkts                             4980                    0
ecpNetIfInNUcastPkts                               0                    0
ecpNetIfInDiscards                                 0                    0
ecpNetIfInErrors                                   0                    0
ecpNetIfInUnknownProtos                            0                    0
ecpNetIfOutOctets                         4294967295                    0
ecpNetIfOutUcastPkts                            1549                    0
ecpNetIfOutNUcastPkts                              0                    0
ecpNetIfOutDiscards                                0                    0
ecpNetIfOutErrors                                  1                    0
ecpNetIfOutQLen                                    0                    0
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
ecpNetIfInOctets	The total number of octets received on the interface, including framing characters.
ecpNetIfInUcastPkts	The number of subnetwork-unicast packets delivered to a higher-layer protocol.
ecpNetIfInNUcastPkts	The number of non-unicast (i.e., subnetwork-broadcast or subnetwork-multicast) packets delivered to a higher-layer protocol.
ecpNetIfInDiscards	The number of inbound packets that were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
ecpNetIfInErrors	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
ecpNetIfInUnknownProtos	The number of packets received via the interface which were discarded because of an unknown or unsupported protocol.
ecpNetIfOutOctets	The total number of octets transmitted out of the interface, including framing characters.
ecpNetIfOutUcastPkts	The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.

Field	Description
ecpNetIfOutNUcastPkts	The total number of packets that higher-level protocols requested be transmitted to a non-unicast (i.e., a subnetwork-broadcast or subnetwork-multicast) address, including those that were discarded or not sent.
ecpNetIfOutDiscards	The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
ecpNetIfOutErrors	The number of outbound packets that could not be transmitted because of errors.
ecpNetIfOutQLen	The length of the output packet queue (in packets).

The value column displays the current value of the counter. The delta column displays the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.3.3 IP Statistics

You can display IP statistics for the TCM by entering **ip** at the **slotx** or **sloty** level as follows:

```
myswitch::statistics cec slotx> ip
ip Counter                          Value                Delta
------------------------------ -------------------- --------------------
ecpIpInReceives                                4546                    0
ecpIpInHdrErrors                                  0                    0
ecpIpInAddrErrors                                 2                    0
ecpIpForwDatagrams                                0                    0
ecpIpInUnknownProtos                              1                    0
ecpIpInDiscards                                   0                    0
ecpIpInDelivers                                3443                    0
ecpIpOutRequests                               1655                    0
ecpIpOutDiscards                                  0                    0
ecpIpOutNoRoutes                                  0                    0
ecpIpReasmReqds                                 220                    0
ecpIpReasmOKs                                   220                    0
ecpIpReasmFails                                   0                    0
ecpIpFragOKs                                      0                    0
ecpIpFragFails                                    0                    0
ecpIpFragCreates                                  0                    0
```

The fields in this display are defined as follows:

Field	Description
ecpIpInReceives	The total number of input datagrams received from interfaces, including those received in error.
ecpIpInHdrErrors	The number of input datagrams discarded due to errors in their IP headers, including bad checksums, version number mismatch, other format errors, time-to-live exceeded, errors discovered in processing their IP options, etc.
ecpIpInAddrErrors	The number of input datagrams discarded because the IP address in their IP header's destination field was not a valid address to be received at this entity. This includes invalid addresses (e.g., 0.0.0.0) and addresses of unsupported Classes (e.g., Class E). For entities which are not IP Gateways and, therefore, do not forward datagrams, this includes datagrams discarded because the destination address was not local.
ecpIpForwDatagrams	The number of input datagrams for which this entity was not their final IP destination, as a result of which an attempt was made to find a route to forward them to that final destination. In entities which do not act as IP Gateways, this counter includes only those packets which were Source-Routed via this entity, and the Source-Route option processing was successful.

Field	Description
ecpIpInUnknownProtos	The number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol.
ecpIpInDiscards	The number of input IP datagrams for which no problems were encountered to prevent their continued processing, but which were discarded (e.g., for lack of buffer space). This counter does not include any datagrams discarded while awaiting re-assembly.
ecpIpInDelivers	The total number of input datagrams successfully delivered to IP user-protocols (including ICMP).
ecpIpOutRequests	The total number of IP datagrams which local IP user-protocols (including ICMP) supplied to IP in requests for transmission. This counter does not include datagrams counted in `ipForwDatagrams`.
ecpIpOutDiscards	The number of output IP datagrams for which no problem was encountered to prevent their transmission to their destination, but which were discarded (e.g., for lack of buffer space). This counter includes datagrams counted in `ipForwDatagrams` if any such packets met this (discretionary) discard criterion.
ecpIpOutNoRoutes	The number of IP datagrams discarded because no route could be found to transmit them to their destination. This counter includes any packets counted in `ipForwDatagrams` which meet this “no-route” criterion. This includes datagrams which a host cannot route because all of its default gateways are down.
ecpIpReasmReqds	The maximum number of seconds which received fragments are held while they are awaiting reassembly at this entity.
ecpIpReasmOKs	The number of IP datagrams successfully reassembled.
ecpIpReasmFails	The number of failures detected by the IP reassembly algorithm (for whatever reason: timed out, errors, etc). This is not necessarily a count of discarded IP fragments since some algorithms (notably the algorithm in RFC-815) can lose track of the number of fragments by combining them as they are received.
ecpIpFragOKs	The number of IP datagrams that have been successfully fragmented at this entity.
ecpIpFragFails	The number of IP datagrams that have been discarded because they needed to be fragmented at this entity but could not be (e.g., because their Don’t Fragment flag was set).
ecpIpFragCreates	The number of IP datagram fragments that have been generated as a result of fragmentation at this entity.

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked it. The counters are reset when the switch is restarted.

4.3.4 TCP Statistics

You can display TCP statistics for the TCM by entering **tcp** at the **slotx** or **sloty** level as follows:

```
myswitch::statistics cec slotx> tcp
tcp Counter                          Value               Delta
---------------------------- ------------------- --------------------
ecpTcpActiveOpens                            1                   0
ecpTcpPassiveOpens                           3                   0
ecpTcpAttemptFails                           1                   0
ecpTcpEstabResets                            0                   0
ecpTcpCurrEstab                              1                   0
ecpTcpInSegs                              2183                  20
ecpTcpOutSegs                             1276                  14
ecpTcpRetransSegs                            2                   0
```

The fields in this display are defined as follows:

Field	Description
ecpTcpActiveOpens	The number of times TCP connections have made a direct transition to the SYN-SENT state from the CLOSED state.
ecpTcpPassiveOpens	The number of times TCP connections have made a direct transition to the SYN-RCVD state from the LISTEN state.
ecpTcpAttemptFails	The number of times TCP connections have made a direct transition to the CLOSED state from either the SYN-SENT state or the SYN-RCVD state, plus the number of times TCP connections have made a direct transition to the LISTEN state from the SYN-RCVD state.
ecpTcpEstabResets	The number of times TCP connections have made a direct transition to the CLOSED state from either the ESTABLISHED state or the CLOSE-WAIT state.
ecpTcpCurrEstab	The number of TCP connections for which the current state is either ESTABLISHED or CLOSE- WAIT.
ecpTcpInSegs	The total number of segments received, including those received in error. This count includes segments received on currently established connections.
ecpTcpOutSegs	The total number of segments sent, including those on current connections but excluding those containing only retransmitted octets.
ecpTcpRetransSegs	The total number of segments retransmitted; i.e., the number of TCP segments transmitted containing one or more previously transmitted octets.

The value column displays the current value of the counter. The delta column displays the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.3.5 UDP Statistics

You can display UDP statistics for the TCM by entering **udp** at the **slotx** or **sloty** level as follows:

```
myswitch::statistics cec slotx> udp
udp Counter                          Value               Delta
------------------------------ -------------------- --------------------
ecpUdpInDatagrams                                0                    0
ecpUdpNoPorts                                    0                    0
ecpUdpInErrors                                   0                    0
ecpUdpOutDatagrams                               0
```

The fields in this display are defined as follows:

Field	Description
ecpUdpInDatagrams	The total number of UDP datagrams delivered to UDP users.
ecpUdpNoPorts	The total number of received UDP datagrams for which there was no application at the destination port.
ecpUdpInErrors	The number of received UDP datagrams that could not be delivered for reasons other than the lack of an application at the destination port.
ecpUdpOutDatagrams	The total number of UDP datagrams sent from this entity.

The value column displays the current value of the counter. The delta column displays the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.4 E1 CES Statistics

This command is only available on platforms that support CEM network modules. To view statistics for E1 CES ports, enter the following at the **statistics** level:

```
myswitch::statistics> cese1
Current Statistics
Port    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 3C1     0     0     0     0     0     0     0     0     0     0
Total Statistics
Port    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 3C1     0     0     0     0     0     0     0     0     0     0
Interval Statistics
Port  Interval    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 3C1         1     0     0     0     0     0     0     0     0     0     0
 3C1         2     0     0     0     0     0     0     0     0     0     0
 3C1         3     0     0     0     0     0     0     0     0     0     0
 3C1         4     0     0     0     0     0     0     0     0     0     0
 3C1         5     0     0     0     0     0     0     0     0     0     0
Press return for more, q to quit: q
```

NOTE

Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15 minute interval. Total statistics are the accumulated values over all intervals and the current interval

`Current Statistics`, `Total Statistics`, and `Interval Statistics` are displayed for each E1 CES port. The fields in these displays are defined as follows:

Field	Description
Port	The E1 CES port for which statistics are shown.
ES	The number of Errored Seconds seen on the port.
SES	The number of Severely Errored Seconds seen on the port.
SEF	The number of Severely Errored Framing Seconds seen on the port.
UAS	The number of Unavailable Seconds seen on the port.
CSS	The number of Controlled Slip Seconds seen on the port.
PCV	The number of Path Coding Violations seen on the port.
LES[1]	The number of Line Errored Seconds seen on the port.

Field	Description
BES	The number of Bursty Errored Seconds seen on the port.
DM	The number of Degraded Minutes seen on the port.
LCV	The number of Line Coding Violations seen on the port.

[1] RFC1406 contains more detailed information about DS1/E1 line status parameters.

You can display statistics for specific E1 CES ports as follows:

```
myswitch::statistics> cese1 [<port>]
myswitch::statistics> cese1 3c1
Current Statistics
Port    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 3C1     0     0     0     0     0     0     0     0     0     0
Total Statistics
Port    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 3C1     0     0     0     0     0     0     0     0     0     0
Interval Statistics
Port  Interval    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 3C1         1     0     0     0     0     0     0     0     0     0     0
 3C1         2     0     0     0     0     0     0     0     0     0     0
 3C1         3     0     0     0     0     0     0     0     0     0     0
 3C1         4     0     0     0     0     0     0     0     0     0     0
 3C1         5     0     0     0     0     0     0     0     0     0     0
Press return for more, q to quit: q
```

4.5 DS1 CES Statistics

This command is only available on platforms that support CEM network modules. To view statistics for DS1 CES ports, enter the following at the **`statistics`** level:

```
myswitch::statistics> cesds1
Current Statistics
Port    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 1D1   351     0     0     0     0     0     0     0     0     0
Total Statistics
Port    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 1D1   351     0     1     0     0     0     1     0     0     0
Interval Statistics
Port  Interval    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 1D1         1     0     0     1     0     0     0     1     0     0     0
 1D1         2     0     0     0     0     0     0     0     0     0     0
 1D1         3     0     0     0     0     0     0     0     0     0     0
Press return for more, q to quit: q
```

Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15 minute interval. Total statistics are the accumulated values over all intervals and the current interval

`Current Statistics`, `Total Statistics`, and `Interval Statistics` are displayed for each DS1 CES port. The fields in this display are defined as follows:

Field	Description
port	The DS1 CES port for which statistics are shown.
ES	The number of Errored Seconds seen on the port.
SES	The number of Severely Errored Seconds seen on the port.
SEF	The number of Severely Errored Framing Seconds seen on the port.
UAS	The number of Unavailable Seconds seen on the port.
CSS	The number of Controlled Slip Seconds seen on the port.
PCV	The number of Path Coding Violations seen on the port.
LES[1]	The number of Line Errored Seconds seen on the port.

Field	Description
BES	The number of Bursty Errored Seconds seen on the port.
DM	The number of Degraded Minutes seen on the port.
LCV	The number of Line Coding Violations seen on the port.

[1.] RFC1406 contains more detailed information about DS1/E1 line status parameters.

You can display statistics for specific DS1 CES ports as follows:

```
myswitch::statistics> cesds1 [<port>]
myswitch::statistics> cese1 3c1
Current Statistics
Port    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 1D1   351     0     0     0     0     0     0     0     0     0
Total Statistics
Port    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 1D1   351     0     1     0     0     0     1     0     0     0
Interval Statistics
Port  Interval    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 1D1         1     0     0     1     0     0     0     1     0     0     0
 1D1         2     0     0     0     0     0     0     0     0     0     0
 1D1         3     0     0     0     0     0     0     0     0     0     0
Press return for more, q to quit: q
```

4.6 CES Statistics

This command is only available on platforms that support CEM network modules. To view general Circuit Emulation Services (CES) statistics, enter the following at the **statistics** level:

```
myswitch::statistics> ces
 Port Service  Reass Header  Pointer   Lost   Buffer    Buffer   CellLoss
    Id      Id  Cells Errors Reframes  Cells UnderFlows OverFlows  Status
   3C1    2024      0      0        0      0          0         0  no cells
   3C2    2025      0      0        0      0          0         0  no cells
```

The fields in this display are defined as follows:

Field	Description
Port Id	The CES port for which CES statistics are shown.
Service Id	The CES service ID of the CES connection for which statistics are shown.
Reass Cells	The number of cells that have been reassembled on the port.
Header Errors	The number of AAL1 header errors that have been seen on the port.
Pointer Reframes	The number of errors encountered in the AAL1 pointer.
Lost Cells	The number of cells that have been lost on the port.
Buffer UnderFlows	The number of bytes lost due to missing cells.
Buffer OverFlows	The number of extra bytes received which were not anticipated.
CellLoss Status	Indicates whether the AAL1 state machine is currently in a state where cells are not being received. Displays one of the following: `loss`, `no loss`, `idle`, or `no cells`.

You can display statistics for specific CES ports as follows:

```
myswitch::statistics> ces [<id>]
myswitch::statistics> ces 3c2
 Port Service  Reass Header  Pointer   Lost   Buffer    Buffer   CellLoss
    Id      Id  Cells Errors Reframes  Cells UnderFlows OverFlows  Status
   3C2    2025      0      0        0      0          0         0  no cells
```

The fields in this display are defined in the same manner as those in the previous example.

4.7 Call Record Statistics

You can display call record statistics by entering **cr** at the **statistics** level as follows:

```
myswitch::statistics> cr
   Up   time                          = 0 days 00:01
   Failed primary data transfers      = 0
   Failed secondary data transfers    = 0
   Calls rejected                     = 0
   Calls not recorded                 = 0
   Calls recorded                     = 2
   Skipped data transfers             = 0
   Terminating callrecords lost       = 0
```

The fields in this display are defined as follows:

Field	Description
Up time/Down time	Up time is the time, in hundredths of a second, since call records have been enabled at the primary, secondary, or both sides. Down time is the time, in hundredths of a second, since call records have been disabled.
Failed primary data transfers	The number of failed data transfers to the primary data server.
Failed secondary data transfers	The number of failed data transfers to the secondary data server.
Calls rejected	The number of calls rejected due to a failure to allocate a call record.
Calls not recorded	The number of calls accepted even when there was a failure to allocate a call record.
Calls recorded	The number of calls for which a “start” call record was successfully generated.
Skipped data transfers	The number of skipped data transfers due to the preceding data transfers not being completed within the specified recording interval.
Terminating callrecords lost	The number of terminated call records lost due to a failure to allocate a data transfer buffer.

If call records have not been configured, you receive the following message:

```
myswitch::statistics> cr
Callrecords not configured.
```

4.8 Switch Board Statistics

These commands allow you to display switch board statistics for an individual switch board. Enter **?** at the **board** level to display the available commands.

```
myswitch::statistics board> ?
  boardstats            obuf
```

4.8.1 Board Statistics

You can display switch board statistics for all switch boards on an *ASX*-4000 by entering **boardstats** at the **board** level as follows:

```
myswitch::statistics board> boardstats
Board  Statistic                      Value
1      Overflows                          0
1      UBR EPD/PPD Loss                   0
1      VBR EPD/PPD Loss                   0
1      ABR EPD/PPD Loss                   0
1      CBR EPD/PPD Loss                   0
Board  Statistic                      Value
2      Overflows                          0
2      UBR EPD/PPD Loss                   0
2      VBR EPD/PPD Loss                   0
2      ABR EPD/PPD Loss                   0
2      CBR EPD/PPD Loss                   0
Board  Statistic                      Value
3      Overflows                          0
3      UBR EPD/PPD Loss                   0
3      VBR EPD/PPD Loss                   0
3      ABR EPD/PPD Loss                   0
3      CBR EPD/PPD Loss                   0
Board  Statistic                      Value
4      Overflows                          0
4      UBR EPD/PPD Loss                   0
4      VBR EPD/PPD Loss                   0
4      ABR EPD/PPD Loss                   0
4      CBR EPD/PPD Loss                   0
```

The fields in this display are defined as follows:

Field	Description
Board	The board (switch fabric number).
Statistic	Indicates what type of statistic is being displayed.
Value	The number of cells that were lost due to overflow.

You can also display statistics for an individual board on an *ASX*-4000 as follows:

```
myswitch::statistics> boardstats [<board>]
myswitch::statistics> boardstats 1
Board  Statistic                      Value
4      Overflows                          0
4      UBR EPD/PPD Loss                   0
4      VBR EPD/PPD Loss                   0
4      ABR EPD/PPD Loss                   0
4      CBR EPD/PPD Loss                   0
```

If this command is entered on a switch other than an *ASX*-4000, the following displays:

```
myswitch::statistics board> boardstats
No board statistics are available
```

4.8.2 Output Buffer Statistics

You can display output buffer statistics about all of the network modules in an individual switch fabric.

The statistics on an *ASX*-1000 and *TNX*-1100 (with SM-1100 switch fabric) are displayed as follows:

```
myswitch::statistics board> obuf [<module>]
myswitch::statistics board> obuf
Module Priority   Status         Size  QLength Overflows
1A     UBR        disabled       4096        0         0
1A     VBR        disabled       4096        0         0
1A     ABR        disabled       4096        0         0
1A     CBR        disabled       4096        0         0
```

The statistics on an *ASX*-200BX, *ASX*-200WG, and *TNX*-210 are displayed as follows:

```
myswitch::statistics board> obuf [<module>]
Module Priority   Status         Size  QLength Overflows
1A     ABR/UBR    disabled          0        0         0
1A     CBR/VBR    disabled          0        0         0
1B     ABR/UBR    enabled         512        0         0
1B     CBR/VBR    enabled         512        0         0
1C     ABR/UBR    disabled          0        0         0
1C     CBR/VBR    disabled          0        0         0
1D     ABR/UBR    disabled          0        0         0
1D     CBR/VBR    disabled          0        0         0
```

The statistics on an *ASX*-1200 and *TNX*-1100 (with SM-1100-B switch fabric) are displayed as follows:

```
myswitch::statistics board> obuf [<module>]
ID     Priority   Status         Size  QLength  CLP Loss
1A     UBR        enabled       26832        0         0
1A     VBR        enabled       26832        0         0
1A     ABR        enabled       26832        0         0
1A     CBR        enabled       26832        0         0
1B     UBR        enabled       26832        0         0
1B     VBR        enabled       26832        0         0
1B     ABR        enabled       26832        0         0
1B     CBR        enabled       26832        0         0
1C     UBR        enabled       26832        0         0
1C     VBR        enabled       26832        0         0
1C     ABR        enabled       26832        0         0
1C     CBR        enabled       26832        0         0
1D     UBR        enabled       26832        0         0
1D     VBR        enabled       26832        0         0
1D     ABR        enabled       26832        0         0
1D     CBR        enabled       26832        0         0
1CTL   UBR        enabled       26832        0         0
1CTL   VBR        enabled       26832        0         0
1CTL   ABR        enabled       26832        0         0
1CTL   CBR        enabled       26832        0         0
```

The statistics on an *ESX*-3000 are displayed as follows:

```
myswitch::statistics board> obuf [<module>]
ID     Priority   Status         Size  QLength  CLP Loss
1      UCAST/UBR  enabled       59552        0         0
1      MCAST/UBR  enabled        3328        0         0
1      UCAST/VBR  enabled       59552        0         0
1      MCAST/VBR  enabled        3328        0         0
1      UCAST/ABR  enabled       59552        0         0
1      MCAST/ABR  enabled        3328        0         0
1      UCAST/CBR  enabled       59552        0         0
1      MCAST/CBR  enabled        3328        0         0
2      UCAST/UBR  enabled       59552        0         0
2      MCAST/UBR  enabled        3328        0         0
2      UCAST/VBR  enabled       59552        0         0
2      MCAST/VBR  enabled        3328        0         0
2      UCAST/ABR  enabled       59552        0         0
2      MCAST/ABR  enabled        3328        0         0
2      UCAST/CBR  enabled       59552        0         0
2      MCAST/CBR  enabled        3328        0         0
3      UCAST/UBR  enabled       59552        0         0
3      MCAST/UBR  enabled        3328        0         0
3      UCAST/VBR  enabled       59552        0         0
3      MCAST/VBR  enabled        3328        0         0

Press return for more, q to quit:  q
```

On an *ASX*-4000, each port card is divided into two logical network modules (A and B or C and D). The output buffer statistics for the logical network modules on an *ASX*-4000 are displayed as follows:

```
myswitch::statistics board> obuf [<module>]
Module Priority   Status         Size  QLength  CLP Loss
1A     UCAST/UBR  enabled       91136        0         0
1A     MCAST/UBR  enabled        5120        0         0
1A     UCAST/VBR  enabled       91136        0         0
1A     MCAST/VBR  enabled        5120        0         0
1A     UCAST/ABR  enabled       91136        0         0
1A     MCAST/ABR  enabled        5120        0         0
1A     UCAST/CBR  enabled       91136        0         0
1A     MCAST/CBR  enabled        5120        0         0
1B     UCAST/UBR  enabled       91136        0         0
1B     MCAST/UBR  enabled        5120        0         0
1B     UCAST/VBR  enabled       91136        0         0
1B     MCAST/VBR  enabled        5120        0         0
1B     UCAST/ABR  enabled       91136        0         0
1B     MCAST/ABR  enabled        5120        0         0
1B     UCAST/CBR  enabled       91136        0         0
1B     MCAST/CBR  enabled        5120        0         0
Press return for more, q to quit: q
```

Output buffer statistics are not available on an LE 155 or LE 25.

```
myswitch::statistics board> obuf [<module>]
No module output buffer statistics are available.
```

The fields in these displays are defined as follows:

Field	Description
Module	The number of each network module that is currently installed in the switch fabric.
Priority	The traffic priority for each queue. On an *ASX*-200BX, *ASX*-200WG, and a *TNX*-210, there are two queues. One corresponds to ABR/UBR traffic and one corresponds to CBR/VBR traffic. On an *ASX*-1000, *ASX*-1200, and a *TNX*-1100, there are four queues: one for each of the traffic types (UBR, VBR, ABR, and CBR). On an *ASX*-4000 and ESX-3000, there are 8 queues: one for each of the following traffic types: multicast UBR traffic, unicast UBR traffic, multicast VBR traffic, unicast VBR traffic, multicast ABR traffic, unicast ABR traffic, multicast CBR traffic, and unicast CBR traffic.
Status	Shows whether the buffer is enabled or disabled.

Field	Description
Size	The buffer size.
QLength	The number of cells currently in this queue. For an *ASX*-1200 or *TNX*-1100 (with SM-1100-B switch fabric), this field only displays the size of the unicast queues.
Overflows	The number of overflows in this queue. This field does not display for an *ASX*-4000 or *ESX*-3000
CLP Loss	The number of cells that were dropped for this port and priority due to the CLP (Cell Loss Priority) threshold. This field only applies to an *ASX*-1200, *TNX*-1100 (with SM-1100-B switch fabric), *ASX*-4000 or *ESX*-3000.

You can list output buffer statistics for a specific network module or network module ID as follows:

```
myswitch::statistics board> obuf [<module>]
myswitch::statistics board> obuf 1a
Module Priority   Status         Size  QLength Overflows
1A     ABR/UBR    disabled          0        0         0
1A     CBR/VBR    disabled          0        0         0
```

The fields in these display have the same meanings as the descriptions listed above for all of the network modules.

4.9 Frame Relay Statistics

These commands are only available on platforms that support *FramePlus* network modules. You can display Frame Relay statistics for the *FramePlus* network modules. Enter **?** at the **fratm** level to list the following submenu:

```
myswitch::statistics fratm> ?
  cpcs              oamf5             service           vcc
```

4.9.1 Frame Relay CPCS Statistics

You can list Frame Relay CPCS statistics for *FramePlus* network modules by entering **cpcs** at the **fratm** level as follows:

The CPCS statistics support an eight-hour sliding window of statistics, where each window or interval reflects a 15-minute period.

```
myswitch::statistics fratm> cpcs
Current Statistics
SvcId  CPIErrs LenErrs SizeErrs CRCErrs Timeout
4D1:00       0       0        0       0       0
4D1:01       0       0        0       0       0
4D1:02       0       0        0       0       0

Interval Statistics
SvcId  Interval CPIErrs LenErrs SizeErrs CRCErrs Timeout
4D1:00        1       0       0        0       0       0
4D1:01        1       0       0        0       0       0
4D1:02        1       0       0        0       0       0

Total Statistics
SvcId  CPIErrs LenErrs SizeErrs CRCErrs Timeout Intervals
4D1:00       0       0       0        0       0         1
4D1:01       0       0       0        0       0         1
4D1:02       0       0       0        0       0         1
```

Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15-minute interval. Total statistics are the accumulated values over all intervals and the current interval.

`Current Statistics`, `Interval Statistics`, and `Total Statistics` are displayed for each service. The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
Interval	The index of the current interval. The lower the index is, the newer the interval is.
CPIErrs	The number of Common Part Indicator (CPI) errors detected.
LenErrs	The number of length errors detected.
SizeErrs	The number of user payload errors detected.
CRCErrs	The number of Cyclic Redundancy Check (CRC) errors detected.
Timeout	The number of timeouts detected.

The statistics can also be displayed for just a particular service as follows:

```
myswitch::statistics fratm> cpcs [<serviceid>]
myswitch::statistics fratm> cpcs 4d1:02

Current Statistics
SvcId  CPIErrs LenErrs SizeErrs CRCErrs Timeout
4D1:02       0       0        0       0       0

Interval Statistics
SvcId  Interval CPIErrs LenErrs SizeErrs CRCErrs Timeout
4D1:02        1       0       0        0       0       0

Total Statistics
SvcId  CPIErrs LenErrs SizeErrs CRCErrs Timeout Intervals
4D1:02       0       0       0        0       0         1
```

The fields in this display are defined in the same manner as those in the previous example.

If no *FramePlus* network modules are installed, or if Frame Relay has not been configured, then the following is displayed:

```
myswitch::statistics fratm> cpcs
No Fram Cpcs statistics available
```

4.9.2 Frame Relay OAM F5 Statistics

OAM F5 AIS/RDI cell-generation rates are used to support FRF.8 applications. You can list Frame Relay OAM F5 statistics for *FramePlus* network modules by entering **oamf5** at the **fratm** level as follows:

```
myswitch::statistics fratm> oamf5
SvcId  Dlci   RxAIS   TxAIS   RxRDI   TxRDI   TimeStamp
4A1:00   40       0       0       0       0   JUL 16 12:11 1998
4A1:01   41       0       0       0       0   JUL 16 12:11 1998
4A1:02   42       0       0       0       0   JUL 16 12:11 1998
```

The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
Dlci	The Data Link Connection Identifier that identifies this Frame Relay connection.
RxAIS	The number of AIS OAM cells received on this service.
TxAIS	The number of AIS OAM cells transmitted on this service.
RxRDI	The number of RDI OAM cells received on this service.
TxRDI	The number of RDI OAM cells transmitted on this service.
TimeStamp	A starting timestamp that shows when statistics collections was enabled for the current statistics that are being counted.

The statistics can also be displayed for just a particular service and DLCI as follows:

```
myswitch::statistics fratm> oamf5 <serviceid> [<dlci>]
myswitch::statistics fratm> oamf5 4a1:00
SvcId  Dlci   RxAIS   TxAIS   RxRDI   TxRDI   TimeStamp
4A1:00   40       0       0       0       0   JUL 16 12:11 1998
```

The fields in this display are defined in the same manner as those in the previous example.

If no *FramePlus* network modules are installed, or if Frame Relay has not been configured, then the following is displayed:

```
myswitch::statistics fratm> oamf5
Searching for fratm services
No FR/ATM OAM statistics available
```

4.9.3 Frame Relay Service Statistics

You can list Frame Relay service statistics for *FramePlus* network modules by entering **`service`** at the **`fratm`** level as follows:

```
myswitch::statistics fratm> service
SvcId      Vccs  RxFrame  TxFrame RxDrpFm TxDrpFm TaggedFm TimeStamp
4A1:00        1        0        0       0       0        0 JUL 16 12:11 1998
4A1:01        1        0        0       0       0        0 JUL 16 12:11 1998
4A1:02        1        0        0       0       0        0 JUL 16 12:11 1998
```

The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
Vccs	The number of connections using this service.
RxFrame	The total number of frames accepted over this service.
TxFrame	The total number of frames transmitted over this service.
RxDrpFm	The total number of frames that were discarded over this service because of an incorrect DLCI value, or a buffer overflow, etc.
TxDrpFm	The total number of frames intended to be transmitted over this service that were dropped.
TaggedFm	The total number of frames that were tagged for potential discard after being accepted over this service.
TimeStamp	A starting timestamp that shows when statistics collections was enabled for the current statistics that are being counted.

The statistics can also be displayed for just a particular service as follows:

```
myswitch::statistics fratm> service <serviceid>
myswitch::statistics fratm> service 4a1:02
SvcId      Vccs  RxFrame  TxFrame RxDrpFm TxDrpFm TaggedFm TimeStamp
4A1:02        1        0        0       0       0        0 JUL 16 12:11 1998
```

The fields in this display are defined in the same manner as those in the previous example.

If no *FramePlus* network modules are installed, or if Frame Relay has not been configured, then the following is displayed:

```
myswitch::statistics fratm> service
Searching for fratm services
No FRATM service statistics available
```

4.9.4 Frame Relay PVC Statistics

You can list Frame Relay PVC statistics for *FramePlus* network modules by entering **vcc** at the **fratm** level as follows:

```
myswitch::statistics fratm> vcc
SvcId  dlci     Rx     Tx   Rx   Tx    Tag     Tx     Tx     Tx     Tx
            frame  frame drop drop  frame   CLP0   CLP1   drp0   drp1
4A1:00   40      0      0    0    0      0      0      0      0      0
4A1:01   41      0      0    0    0      0      0      0      0      0
4A1:02   42      0      0    0    0      0      0      0      0      0
```

The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
dlci	The Data Link Connection Identifier that identifies this Frame Relay PVC.
Rx frame	The total number of frames accepted over this PVC.
Tx Frame	The total number of frames transmitted over this PVC.
Rx drop	The total number out of the accepted frames that were discarded over this PVC because of an incorrect DLCI value, or a buffer overflow, etc.
Tx drop	The total number of frames intended to be transmitted over this PVC that were dropped. This counter generally increments when egress (ATM to Frame Relay) rate enforcement is enabled and traffic is being sent at a higher rate from the ATM side.
Tag frame	The total number of frames tagged for potential discard by this switch on this PVC.

Field	Description
Tx CLP0	The total number of CLP=0 cells that were transmitted over this PVC. This counter only applies to the ATM to Frame Relay part of the PVC.
Tx CLP1	The total number of CLP=1 cells that were transmitted over this PVC. This counter only applies to the ATM to Frame Relay part of the PVC.
Tx drp0	The total number of CLP=0 cells that were dropped on a specific PVC. This counter only applies to the ATM to Frame Relay part of the PVC.
Tx drp1	The total number of CLP=1 cells that were dropped on a specific PVC. This counter only applies to the ATM to Frame Relay part of the PVC.

The statistics can also be displayed for just a particular service and DLCI as follows:

```
myswitch::statistics fratm> vcc [<service> [<dlci>]]
myswitch::statistics fratm> vcc 4A1:00 40
SvcId  dlci     Rx     Tx   Rx   Tx    Tag     Tx     Tx     Tx     Tx
             frame  frame drop drop  frame   CLP0   CLP1   drp0   drp1
4A1:00   40      0      0    0    0      0      0      0      0      0
```

If no *FramePlus* network modules are installed, or if Frame Relay has not been configured, then the following is displayed:

```
myswitch::statistics fratm> vcc
Searching for fratm services
No FRATM VCC statistics available
```

4.10 FUNI Statistics

These commands are only available on platforms that support *FramePlus* network modules. You can display FUNI statistics for the *FramePlus* network modules. Enter **?** at the **funi** level to list the available commands:

```
myswitch::statistics funi> ?
  cpcs              service           vcc
```

4.10.1 FUNI CPCS Statistics

You can list FUNI CPCS statistics for *FramePlus* network modules by entering **cpcs** at the **funi** level as follows:

The CPCS statistics support an eight-hour sliding window of statistics, where each window or interval reflects a 15-minute period.

```
myswitch::statistics funi> cpcs
Current Statistics
SvcId  CPIErrs LenErrs SizeErrs CRCErrs Timeout
4A1:02       0       0        0       0       0
4A1:00       0       0        0       0       0
4A1:01       0       0        0       0       0

Interval Statistics
SvcId  Interval CPIErrs LenErrs SizeErrs CRCErrs Timeout
4A1:02        1       0       0        0       0       0
4A1:00        1       0       0        0       0       0
4A1:01        1       0       0        0       0       0

Total Statistics
SvcId  CPIErrs LenErrs SizeErrs CRCErrs Timeout Intervals
4A1:02       0       0       0        0       0         1
4A1:00       0       0       0        0       0         1
4A1:01       0       0       0        0       0         1
```

Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15-minute interval. Total statistics are the accumulated values over all intervals and the current interval.

`Current Statistics`, `Interval Statistics`, and `Total Statistics` are displayed for each service. The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
Interval	The index of the current interval. The lower the index is, the newer the interval is.
CPIErrs	The number of Common Part Indicator (CPI) errors detected.
LenErrs	The number of length errors detected.
SizeErrs	The number of user payload errors detected.
CRCErrs	The number of Cyclic Redundancy Check (CRC) errors detected.
Timeout	The number of timeouts detected.

The statistics can also be displayed for just a particular service as follows:

```
myswitch::statistics funi> cpcs [<serviceid>]
myswitch::statistics funi> cpcs 4a1:02
Current Statistics
SvcId  CPIErrs LenErrs SizeErrs CRCErrs Timeout
4A1:02       0       0        0       0       0

Interval Statistics
SvcId  Interval CPIErrs LenErrs SizeErrs CRCErrs Timeout
4A1:02        1       0       0        0       0       0

Total Statistics
SvcId  CPIErrs LenErrs SizeErrs CRCErrs Timeout Intervals
4A1:02       0       0       0        0       0         1
```

The fields in this display are defined in the same manner as those in the previous example.

If no *FramePlus* network modules are installed, or if FUNI has not been configured, then the following is displayed:

```
myswitch::statistics funi> cpcs
No Fram Cpcs statistics available
```

4.10.2 FUNI Service Statistics

You can list FUNI service statistics for *FramePlus* network modules by entering **service** at the **funi** level as follows:

```
myswitch::statistics funi> service
SvcId      Vccs RxFrame TxFrame RxDrpFm TxDrpFm TimeStamp
4A1:02        1       0       0       0       0 JUL 16 12:11 1998
4A1:00        1       0       0       0       0 JUL 16 12:11 1998
4A1:01        1       0       0       0       0 JUL 16 12:11 1998
```

The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
Vccs	The number of active connections using this service.
RxFrame	The total number of frames accepted over this service.
TxFrame	The total number of frames transmitted over this service.
RxDrpFm	The total number of frames that were discarded over this service because of an incorrect buffer overflow, etc.
TxDrpFm	The total number of frames that were tagged for potential discard after being accepted over this service.
TimeStamp	A starting timestamp that shows when statistics collections was enabled for the current statistics that are being counted.

The statistics can also be displayed for just a particular service as follows:

```
myswitch::statistics funi> service [<serviceid>]
myswitch::statistics funi> service 4a1:02
SvcId      Vccs RxFrame TxFrame RxDrpFm TxDrpFm TimeStamp
4A1:02        1       0       0       0       0 JUL 16 12:11 1998
```

The fields in this display are defined in the same manner as those in the previous example.

If no *FramePlus* network modules are installed, or if FUNI has not been configured, then the following is displayed:

```
myswitch::statistics funi> service
Searching for funi services
No FUNI service statistics available
```

4.10.3 FUNI PVC Statistics

You can list FUNI PVC statistics for *FramePlus* network modules by entering **vcc** at the **funi** level as follows:

```
myswitch::statistics funi> vcc
SvcId  Funi Funi     Rx     Tx   Rx   Tx     Tx     Tx   Tx   Tx
        vpi  vci  frame  frame drop drop   CLP0   CLP1 drp0 drp1
4A1:02    0   42      0      0    0    0      0      0    0    0
4A1:00    0   40      0      0    0    0      0      0    0    0
4A1:01    0   41      0      0    0    0      0      0    0    0
```

The fields in this display are defined as follows:

Field	Description
SvcId	The ID number of the service for which the statistics are shown.
Funi vpi	The output Virtual Path Identifier (VPI) of the FUNI PVC.
Funi vci	The output Virtual Channel Identifier (VCI) of the FUNI PVC.
Rx frame	The total number of frames accepted over this PVC.
Tx frame	The total number of frames transmitted over this PVC.
Rx drop	The total number out of the accepted frames that were discarded over this PVC because of a buffer overflow, etc.
Tx drop	The total number of frames intended to be transmitted over this PVC that were dropped. This counter generally increments when egress (ATM to Frame Relay) rate enforcement is enabled and traffic is being sent at a higher rate from the ATM side.
Tx CLP0	The total number of CLP=0 cells that were transmitted over this PVC. This counter only applies to the ATM to FUNI part of the PVC.
Tx CLP1	The total number of CLP=1 cells that were transmitted over this PVC. This counter only applies to the ATM to FUNI part of the PVC.
Tx drp0	The total number of CLP=0 cells that were dropped on a specific PVC. This counter only applies to the ATM to FUNI part of the PVC.
Tx drp1	The total number of CLP=1 cells that were dropped on a specific PVC. This counter only applies to the ATM to FUNI part of the PVC.

You can also display statistics for a particular service or FUNI VPI and VCI as follows:

```
myswitch::statistics funi> vcc [<serviceid> [<fvpi> [<fvci>]]]
myswitch::statistics funi> vcc 4A1:02 0 42
SvcId  Funi Funi     Rx     Tx   Rx   Tx     Tx     Tx   Tx   Tx
        vpi  vci  frame  frame drop drop   CLP0   CLP1 drp0 drp1
4A1:02    0   42      0      0    0    0      0      0    0    0
```

If no *FramePlus* network modules are installed, or if FUNI has not been configured, then the following is displayed:

```
myswitch::statistics funi> vcc
Searching for funi services
No FUNI VCC statistics available
```

4.11 IP Access Statistics

This command allows you to display the total number of IP packets that have been filtered since the switch was rebooted and to display information about the last IP packet that was dropped. Enter **ipaccess** at the **statistics** level as follows:

```
myswitch::statistics> ipaccess
Total Violations: 22
Last Violation: Source address not in filtering table
    TimeOccurred           VPI      VCI    Interface     Source
    -------------------- -------- -------- --------- ---------------
    23 days 01:10:44          N/A      N/A       ie0     172.19.4.93
```

The fields in this display are defined as follows:

Field	Description
Total Violations	The number of IP packets dropped since the switch was last rebooted.
Last Violation	The reason for dropping the last IP packet that was dropped.
TimeOccurred	The system time at which the last IP packet was dropped.
VPI	The Virtual Path Identifier corresponding to the connection on which the last IP packet was dropped.
VCI	The Virtual Channel Identifier corresponding to the connection on which the last IP packet was dropped.
Interface	The name of the interface on which the last dropped IP packet was received.
Source	The IP address contained in the source field of the header of the last IP packet that was dropped.

If no IP packets have been filtered since the switch was last rebooted, then the following is displayed:

```
myswitch::configuration statistics> ipaccess
No violations have occurred
```

4.12 IWF Statistics

These commands are only available on platforms that support *FramePlus* network modules. You can display physical layer statistics for all of the *FramePlus* network modules. Enter **?** at the **iwf** level to list the available commands:

```
myswitch::statistics iwf> ?
  ds1                e1
```

4.12.1 DS1 Statistics

You can list the DS1 physical layer statistics for an individual *FramePlus* network module by entering **ds1** at the **iwf** level as follows:

```
myswitch::statistics iwf> ds1 [<port>]
Current Statistics
Port    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 4A1   382     0     0     0     0     0     0     0     0     0

Interval Statistics
Port  Interval    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 4A1         1   901     0     0     0     0     0     0     0     0     0
 4A1         2   901     0     0     0     0     0     0     0     0     0
 4A1         3   901     0     0     0     0     0     0     0     0     0
 4A1         4   901     0     0     0     0     0     0     0     0     0
 4A1         5   901     0     0     0     0     0     0     0     0     0
 4A1         6   901     0     0     0     0     0     0     0     0     0
 4A1         7   901     0     0     0     0     0     0     0     0     0
 4A1         8   901     0     0     0     0     0     0     0     0     0
 4A1         9   901     0     0     0     0     0     0     0     0     0
 4A1        10   901     0     0     0     0     0     0     0     0     0
 4A1        11   901     0     0     0     0     0     0     0     0     0
 4A1        12   901     0     0     0     0     0     0     0     0     0
 4A1        13   901     0     0     0     0     0     0     0     0     0
 4A1        14   901     0     0     0     0     0     0     0     0     0
 4A1        15   901     0     0     0     0     0     0     0     0     2

Total Statistics
Port    ES   SES   SEF   UAS   CSS   PCV   LES   BES    DM   LCV
 4A1 73385     0     0     0     0     0     0     0     0     2
Press return for more, q to quit: q
```

Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15 minute interval. Total statistics are the accumulated values over all intervals and the current interval

`Current Statistics`, `Total Statistics`, and `Interval Statistics` are displayed for each DS1 *FramePlus* port. The fields in this display are defined as follows:

Field	Description
Port	The DS1 *FramePlus* port for which statistics are shown.
Interval	The index of the current interval. The lower the index is, the newer the interval is.
ES	The number of Errored Seconds seen on the port.
SES	The number of Severely Errored Seconds seen on the port.
SEF	The number of Severely Errored Framing Seconds seen on the port.
UAS	The number of Unavailable Seconds seen on the port.
CSS	The number of Controlled Slip Seconds seen on the port.
PCV	The number of Path Coding Violations seen on the port.
LES	The number of Line Errored Seconds seen on the port.
BES	The number of Bursty Errored Seconds seen on the port.
DM	The number of Degraded Minutes seen on the port.
LCV	The number of Line Coding Violations seen on the port.

4.12.2 E1 Statistics

You can list E1 physical layer statistics for an individual *FramePlus* network module by entering **e1** at the **iwf** level as follows:

```
myswitch::statistics iwf> e1 [<port>]
Current Statistics
Port     ES    SES    SEF    UAS    CSS    PCV    LES    BES     DM    LCV
 4D1    602      0      0      0      0      0      0      0      0      0

Interval Statistics
Port  Interval    ES    SES    SEF    UAS    CSS    PCV    LES    BES     DM    LCV
 4D1         1   901      0      0      0      0      0      0      0      0      0
 4D1         2   901      0      0      0      0      0      0      0      0      0
 4D1         3   901      0      0      0      0      0      0      0      0      0
 4D1         4   901      0      0      0      0      0      0      0      0      0
 4D1         5   870      0      0      0      0      0      0      0      0      1
Total Statistics
Port     ES    SES    SEF    UAS    CSS    PCV    LES    BES     DM    LCV
 4D1   5077      0      0      0      0      0      0      0      0      1
Press return for more, q to quit: q
```

NOTE

Current statistics are the values accumulated in the current interval. Interval statistics are the statistics associated with a given 15 minute interval. Total statistics are the accumulated values over all intervals and the current interval.

`Current Statistics`, `Total Statistics`, and `Interval Statistics` are displayed for each DS1 *FramePlus* port. The fields in this display are defined as follows

Field	Description
Port	The E1 *FramePlus* port for which statistics are shown.
Interval	The index of the current interval. The lower the index is, the newer the interval is.
ES	The number of Errored Seconds seen on the port.
SES	The number of Severely Errored Seconds seen on the port.
SEF	The number of Severely Errored Framing Seconds seen on the port.
UAS	The number of Unavailable Seconds seen on the port.
CSS	The number of Controlled Slip Seconds seen on the port.

Field	Description
PCV	The number of Path Coding Violations seen on the port.
LES	The number of Line Errored Seconds seen on the port.
BES	The number of Bursty Errored Seconds seen on the port.
DM	The number of Degraded Minutes seen on the port.
LCV	The number of Line Coding Violations seen on the port.

These commands allow you to display network module statistics. Type **?** at the **module** level to display the list of available subcommands.

```
myswitch::statistics module> ?
  traffic            module
```

4.12.3 Network Module Traffic Statistics

This command allows you to display traffic statistics about all of the network modules or about a specific network module.

The following is displayed for Series C network modules:

```
myswitch::statistics module> traffic
 Module Model Ucasts Mcasts  MOuts  Cells Shared   Used
 1B         2     30      1      6      0   7392      4
 1C         2     20      1      4      0   8928      4
```

The following is displayed for Series LC and Series LE network modules, and logical network modules on Series 1 port cards:

```
myswitch::statistics module> traffic
 Module Model Ucasts Mcasts  Cells Shared   Used
 2B         2     16      1      0  21916      1
 2D       N/A      5      0    N/A    N/A    N/A
```

NOTE

The `Model`, `Cells`, `Shared`, and `Used` fields are not applicable to Series 1 OC-48c port cards.

The following is displayed for Series D network modules:

```
myswitch::statistics module> traffic
 Module Model Ucasts Mcasts  MOuts  Cells Shared   Used
 1C         1      5      0      0      0  15344    N/A
```

The fields in these displays are defined as follows:

Field	Description
Module	The shared memory network module for which information is being displayed.
Model	The traffic memory model being used for this shared memory network module.
Ucasts	The number of unicast connections that are currently active on this shared memory network module.
Mcasts	The number of multicast connections that are currently active on this shared memory network module.
MOuts	The number of multicast outputs that are currently active on this shared memory network module. This field does not apply to Series LC and Series LE network modules or Series 1 port cards.
Cells	The number of cells currently in the dedicated queues and in the shared memory for this network module.
Shared	The amount of shared memory that is configured for this network module.
Used	The amount of shared memory that is currently being used on this network module. This field does not apply to Series D network modules.

You can display traffic statistics for specific network modules as follows:

```
myswitch::statistics module> traffic [<module>]
myswitch::statistics module> traffic 1c
 Module Model Ucasts Mcasts  MOuts  Cells Shared   Used
 1C         1      5      0      0      0  15344    N/A
```

4.12.4 Network Module Statistics

You can list network module statistics about the uptime of all of the network modules in an individual switch fabric by entering **module** at the **module** level.

```
myswitch::statistics module> module
Module Uptime
1C     3d:20:46
1D     3d:20:46
```

The fields in this display are defined as follows:

Field	Description
Module	The number of each network module that is currently installed in the switch fabric. The number designates which switch fabric it is. The letter shows the position of the network module in the switch fabric.
Uptime	The length of time that this network module has been in its current state.

You can display uptime statistics for a specific network module as follows:

```
myswitch::statistics module> module [<module>]
myswitch::statistics module> module 1c
Module Uptime
1C     3d:20:46
```

4.13 NSAP Filter Statistics

These commands let you display NSAP address filtering statistics. Enter **?** at the **nsapfilter** level to display the available commands.

```
myswitch::statistics nsapfilter> ?
  calls            lastfailure
```

4.13.1 NSAP Filtering Statistics

You can display NSAP address filtering statistics by entering **calls** at the **nsapfilter** level as follows:

```
myswitch::statistics nsapfilter> calls
Port  VPI Direction   Accept   Reject Unmatched
----  --- ---------   ------   ------ ---------
 1A1    0  incoming        0        0         0
 1A1    0  outgoing        0        0         0
 1A2    0  incoming        0        0         0
 1A2    0  outgoing        0        0         0
 1A3    0  incoming        0        0         0
 1A3    0  outgoing        0        0         0
 1A4    0  incoming        0        0         0
 1A4    0  outgoing        0        0         0
```

The fields in this display are defined as follows:

Field	Description
Port	The port number of the interface.
VPI	The virtual path number of the interface.
Direction	Shows if this is an incoming or outgoing interface.
Accept	The total number of calls that have been accepted by the NSAP address filtering feature on this interface.
Reject	The total number of calls that have been rejected by the NSAP address filtering feature on this interface because the supplied address matched a template in the NSAP address filtering table for which the action was to reject the call.
Unmatched	The total number of calls that have been rejected by the NSAP address filtering feature on this interface because the supplied address did not match any templates in the NSAP address filtering table.

You can also display NSAP filter statistics for just an individual port or port and path as follows:

```
myswitch::statistics nsapfilter> calls [<port> [<vpi>]]
myswitch::statistics nsapfilter> calls 1A2 0
Port  VPI Direction   Accept   Reject Unmatched
----  --- ---------   ------   ------ ---------
 1A2    0  incoming        0        0         0
 1A2    0  outgoing        0        0         0
```

The fields in this display are defined in the same manner as those in the previous example.

4.13.2 NSAP Filter Last Failure Statistics

You can display statistics about the last failed call attempt by entering **lastfailure** at the **nsapfilter** level as follows:

```
myswitch::statistics nsapfilter> lastfailure
                                              Source      Destination
Direction Template Name                 Port   VPI  Port   VPI
        0        0 *Unknown*            1A1      0  1A1      0
Source NSAP:      00000000000000000000000000000000000000000
Destination NSAP: 00000000000000000000000000000000000000000
```

The fields in this display are defined as follows:

Field	Description
Direction	Shows whether the incoming or the outgoing filter rejected the last call attempt. 0 means no calls have been rejected since the switch was last rebooted.
Template	The index number of the template that rejected the last call attempt. If the call was rejected because its addresses were not known, then a 0 is displayed.
Name	The name of the template that rejected the last call attempt. If there is no name assigned to the template, then Unknown is displayed.
Source Port	The incoming port number of the last failed call attempt.
Source VPI	The incoming virtual path number of the last failed call attempt.
Destination Port	The outgoing port number of the last failed call attempt.
Destination VPI	The outgoing virtual path number of the last failed call attempt.
Source NSAP	The source address of the last failed call attempt.
Destination NSAP	The destination address of the last failed call attempt.

4.14 OAM Statistics

When a physical layer fault (loss of carrier, loss of frame, etc.) is detected on a port that has AIS/RDI (Alarm Indication Signal)/(Remote Defect Indication) enabled, OAM cells are generated for all through paths, originating paths, PVCs, and PNNI SPVCs that originate on that port. If a virtual path AIS condition is indicated (by receipt of F4 AIS cells on a terminating path), OAM cells are generated for only that path and for channels (PVCs and PNNI SPVCs) that originate on that path.

An AIS is sent in the downstream direction (away from the failure). Receiving an AIS cell indicates that a physical layer failure condition is present upstream from the receiver. An RDI cell is sent toward the failure when a physical fault or AIS condition is detected on the virtual path and channel. Receiving an RDI cell indicates that a fault exists in the transit pathway of the virtual connection described by the RDI cell.

Currently, AIS/RDI OAM cell generation is supported only for point-to-point connections.

To display the submenu for OAM statistics, enter **?** at the **statistics oam** level as follows:

```
myswitch::statistics oam> ?
  f4                f5
```

4.14.1 F4 Statistics

The F4 cell is an OAM cell that reports alarm conditions which are relevant to virtual paths. You can display F4 statistics by entering **f4** at the **statistics oam** level as follows:

```
myswitch::statistics oam> f4
 Input      Output        TxAIS     RxAIS     TxRDI     RxRDI
 Port  VPI  Port  VPI     Cells     Cells     Cells     Cells
 1B2     0  orig/term       N/A         0         5         0
 1B4     0  orig/term       N/A         5         2         0
 1B6     0  orig/term       N/A         0         0         6
 1B2    10  1A2    10         8       N/A       N/A       N/A
```

The fields in this display are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number for this port.
Output Port	The outgoing port number if it is a through path. Shows orig/term if it is an originating or terminating path (virtual path terminator).
Output VPI	The outgoing virtual path number for this port if it is a through path. Shows orig/term if it is an originating or terminating path (virtual path terminator).
TxAIS Cells	The number of AIS OAM cells sent on this path and port.
RxAIS Cells	The number of AIS OAM cells received on this path and port.
TxRDI Cells	The number of AIS OAM cells sent on this path and port.
RxRDI Cells	The number of RDI OAM cells received on this path and port.

This command is valid only if AIS/RDI OAM cell generation has been enabled. If it is not enabled on any ports, then the following is displayed:

```
No OAM path information available
```

You can also display F4 statistics for a specific port or for a specific port and path as follows:

```
myswitch::statistics oam> f4 [<port> [<vpi>]]
myswitch::statistics oam> f4 1B4 0
 Input      Output        TxAIS     RxAIS     TxRDI     RxRDI
 Port  VPI  Port  VPI     Cells     Cells     Cells     Cells
 1B4     0  orig/term       N/A         5         2         0
```

The fields in this display are defined in the same manner as those in the previous example.

4.14.2 F5 Statistics

The F5 cell is an OAM cell that reports alarm conditions which are relevant to virtual channels. You can display F5 statistics by entering **f5** at the **statistics oam** level as follows:

```
myswitch::statistics oam> f5
 Input           Output            TxAIS
 Port  VPI  VCI  Port  VPI  VCI    Cells
 1B2     0  100  1A1     0  100       17
 1B2     0  110  1A2     0  110        2
```

The fields in this display have the following meanings:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number for this port.
Input VCI	The incoming virtual channel number for this port.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number for this port.
Output VCI	The outgoing virtual channel number for this port.
TxAIS Cells	The number of AIS OAM cells sent on this path, port, and channel.

This command is valid only if AIS/RDI OAM cell generation has been enabled. If it is not enabled on any ports, then the following is displayed:

```
No OAM channel information available
```

You can also display F5 statistics for a specific port or for a specific port and path as follows:

```
myswitch::statistics oam> f5 [<port> [<vpi>]][<vci>]]]
myswitch::statistics oam> f5 1B2 100
 Input           Output            TxAIS
 Port  VPI  VCI  Port  VPI  VCI    Cells
 1B2     0  100  1A1     0  100       17
```

The fields in this display are defined in the same manner as those in the previous example.

4.15 Port Statistics

You can display port statistics about all of the ports in an individual switch fabric by entering **port** at the **statistics** level as follows:

```
myswitch::statistics> port
     Input            Output                Cells       Cells
Port VPs  VCs     BW VPs  VCs     BW    Received Transmitted ErrSecs Overflows
1A1    1    7   0.8K   1    7   3.4M       20452       20670       0         0
1A2    1    6   0.8K   1    6   0.8K           0       19662       0         0
1A3    1    6   0.8K   1    6   0.8K           0       19662       0         0
1A4    1    6   0.8K   1    6   0.8K           0       19662       0         0
1CTL   2   31   0.0K   1   38   0.0K      256444           0       0         0
```

The fields in this display are defined as follows:

Field	Description
Port	The port number.
Input VPs	The total number of incoming VPCs and VPTs that exist on this port. On *ASX*-200BXs, *ASX*-1000s, *ASX*-1200s, and *TNX*-1100s, there is an extra VP on the control port that is used for transmitting VP level (F4) fault management OAM cells.
Input VCs	The total number of incoming virtual channels that exist on this port.
Input BW	The amount of bandwidth currently being used by all of the incoming VPCs and VPTs on this port.
Output VPs	The total number of outgoing VPCs and VPTs that exist on this port.
Output VCs	The total number of outgoing virtual channels that exist on this port.
Output BW	The amount of bandwidth currently being used by all of the outgoing VPCs and VPTs on this port.
Cells Received	The number of cells received on this port.
Cells Transmitted	The number of cells transmitted on this port.
ErrSecs	The number of seconds in which errored cells were dropped by this port.
Overflows	The number of cells dropped on this port because the output buffer was full.

You can also display statistics about a particular kind of network module or a specific port on a network module. Additionally, you can display port traffic statistics for a specified port. Enter the following parameters to display your choices:

```
myswitch::statistics> port [(ds1 | ds3 | e1 | e3 | j2 | sonet | tp25 | fabric | traffic)]
[<port>]
```

See the following subsections for more information about each of these options.

4.15.1 DS1 Port Statistics

You can display statistics about all of the DS1 network modules in an individual switch fabric by entering **ds1** at the **statistics port** level. This command is available only when at least one DS1 network module is installed in the switch fabric.

```
myswitch::statistics> port ds1
ds1 Port 1A1 Counter                Value           Delta
------------------------------  --------------  --------------
ds1FramingLOSs                          109356               0
ds1FramingLCVs                               0               0
ds1FramingFERRs                              0               0
ds1FramingOOFs                               0               0
ds1FramingAISs                               0               0
ds1FramingYellowAlarms                       0               0
ds1FramingRedAlarms                          0               0
ds1FramingBEEs                               0               0
ds1FramingPRBSs                              0               0
ds1FramingBERs                               0               0
ds1PlcpBIP8s                                 0               0
ds1PlcpFERRs                                 0               0
ds1PlcpFEBEs                                 0               0
ds1PlcpLOFs                                  0               0
ds1PlcpYellows                               0               0
ds1AtmHCSs                                   0               0
ds1AtmRxCells                                0               0
ds1AtmTxCells                           377119               0
ds1AtmUHCSs                                  0               0
ds1AtmCHCSs                                  0               0
ds1AtmLCDs                                   0               0
```

NOTE

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted or when a network module is replaced.

NOTE

The PLCP counters increment only when the DS1 network module is running in the PLCP mode, but the HCS counter always increments, regardless of which mode is running. The PLCP counters do not apply to Series D DS1 network modules.

The fields in this display are defined as follows:

Field	Description
ds1FramingLOSs	The number of seconds in which Loss Of Signal (LOS) errors have been detected.
ds1FramingLCVs	The number of Line Code Violations (LCV) that have been detected.
ds1FramingFERRs	The number of DS1 framing error (FERR) events that have been detected.
ds1FramingOOFs	The number of DS1 Out Of Frame (OOF) error events that have been detected.
ds1FramingAISs	The number of seconds in which Alarm Indication Signals (AIS) were detected by the DS1 Receive Framer block. AIS means an upstream failure has been detected by the far end.
ds1FramingYellowAlarms	The number of seconds in which Yellow Alarm events have been detected.
ds1FramingRedAlarms	The number of seconds in which Red Alarm events have been detected.
ds1FramingBEEs	The number of Bit Encoding Error (BEE) events that have been detected.
ds1FramingPRBSs	The number of seconds in which Pseudo Random Bit Sequence (PRBS) patterns have been detected.
ds1FramingBERs	The number of PRBS Bit Error events that have been detected.
ds1PlcpBIP8s	The number of BIP-8 (Bit Interleaved Parity-8) error events. The BIP-8 is calculated over the Path Overhead field and the associated ATM cell of the previous PLCP frame. A BIP-N is a method of error monitoring. An N-bit code is generated by the transmitting equipment in such a manner that the first bit of the code provides even parity over the first bit of all N-bit sequences in the previous VT SPE, the second bit provides even parity over the second bits of all N-bit sequences within the specified portion, etc.
ds1PlcpFERRs	The number of Physical Layer Convergence Protocol (PLCP) octet error events.
ds1PlcpFEBEs	The number of ATM Far End Block Error (FEBE) events.
ds1PlcpLOFs	The number of seconds in which Loss Of Frame (LOF) errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. LOF is declared when an Out Of Frame state persists for more than 1ms. LOF is removed when an in-frame state persists for more than 12ms.
ds1PlcpYellows	The number of seconds in which Yellow alarm errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. A yellow alarm is asserted when 10 consecutive yellow signal bits are set to logical 1. Yellow signals are used to alert upstream terminals of a downstream failure in order to initiate trunk conditioning on the failure circuit.
ds1AtmHCSs	The number of header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.

Field	Description
ds1AtmRxCells	The number of ATM cells that were received, not including idle / unassigned cells.
ds1AtmTxCells	The number of ATM cells that were sent, not including idle / unassigned cells.
ds1AtmUHCSs	The number of uncorrectable header check sequence (UHCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
ds1AtmCHCSs	The number of correctable header check sequence (CHCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
ds1AtmLCDs	The number of seconds in which Loss of Cell Delineation (LCD) has occurred. An LCD defect is detected when an out of cell delineation state has persisted for 4ms. An LCD defect is cleared when the sync state has been maintained for 4ms.

4.15.2 DS3 Port Statistics

You can list statistics about all of the DS3 network modules in an individual switch fabric by entering **ds3** at the **statistics port** level. This command is available only when at least one DS3 network module is installed in the switch fabric.

```
myswitch::statistics> port ds3
ds3 Port 1C1 Counter                Value           Delta
-----------------------------  --------------  --------------
ds3FramingLOSs                           0               0
ds3FramingLCVs                        1504               0
ds3FramingSumLCVs                      633               0
ds3FramingFERRs                       1218               0
ds3FramingOOFs                           1               0
ds3FramingFERFs                          0               0
ds3FramingAISs                           0               0
ds3FramingPbitPERRs                    106               0
ds3FramingCbitPERRs                    102               0
ds3FramingFEBEs                      43035               0
ds3FramingIDLEs                          0               0
ds3PlcpFERRs                          3503               0
ds3PlcpLOFs                              4               0
ds3PlcpBIP8s                          1379               0
ds3PlcpFEBEs                        128338               0
ds3PlcpYellows                           0               0
ds3AtmHCSs                            1153               0
ds3AtmRxCells                          704               0
ds3AtmTxCells                         8959               0
```

NOTE

All of the PLCP counters listed above increment only when the DS3 network module is running in the PLCP mode. However, the HCS counter always increments, regardless of which mode is running.

The fields in this display are defined as follows:

Field	Description
ds3FramingLOSs	The number of seconds in which Loss Of Signal (LOS) errors were detected by the DS3 Receive Framer block.
ds3FramingLCVs	The number of Line Code Violations (LCV) detected by the DS3 Receive Framer block.
ds3FramingSumLCVs	The number of DS3 information blocks (85 bits) which contain one or more Line Code Violations (LCV).
ds3FramingFERRs	The number of DS3 framing error (FERR) events.
ds3FramingOOFs	The number of seconds in which DS3 Out Of Frame (OOF) error events occurred.
ds3FramingFERFs	The number of seconds in which a Far End Receive Failure (FERF) state has been detected by the DS3 Receive Framer block. The FERF signal alerts the upstream terminal that a failure has been detected along the downstream line.
ds3FramingAISs	The number of seconds in which Alarm Indication Signals (AIS) were detected by the DS3 Receive Framer block. AIS means an upstream failure has been detected by the far end.
ds3FramingPbitPERRs	The number of P-bit parity error (PERR) events.
ds3FramingCbitPERRs	The number of C-bit parity error (PERR) events.
ds3FramingFEBEs	The number of DS3 far end block error (FEBE) events.
ds3FramingIDLEs	The number of seconds in which an IDLE signal was detected by the DS3 Receive Framer block.
ds3PlcpFERRs	The number of Physical Layer Convergence Protocol (PLCP) octet error events.
ds3PlcpLOFs	The number of seconds in which Loss Of Frame (LOF) errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. LOF is declared when an Out-Of-Frame state persists for more than 1ms. LOF is removed when an in-frame state persists for more than 12ms.
ds3PlcpBIP8s	The number of BIP-8 (Bit Interleaved Parity-8) error events. The BIP-8 is calculated over the Path Overhead field and the associated ATM cell of the previous PLCP frame. A BIP-N is a method of error monitoring. An N-bit code is generated by the transmitting equipment in such a manner that the first bit of the code provides even parity over the first bit of all N-bit sequences in the previous VT SPE, the second bit provides even parity over the second bits of all N-bit sequences within the specified portion, etc.
ds3PlcpFEBEs	The number of ATM Far End Block Error (FEBE) events.

Field	Description
ds3PlcpYellows	The number of seconds in which Yellow alarm errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. A yellow alarm is asserted when 10 consecutive yellow signal bits are set to logical 1. Yellow signals are used to alert upstream terminals of a downstream failure in order to initiate trunk conditioning on the failure circuit.
ds3AtmHCSs	The number of the header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
ds3AtmRxCells	The number of ATM cells that were received, not including idle / unassigned cells.
ds3AtmTxCells	The number of ATM cells that were sent, not including idle / unassigned cells.

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted or when a network module is replaced.

4.15.3 E1 Port Statistics

You can display statistics about all of the E1 network modules in an individual switch fabric by entering **e1** at the **statistics port** level. This command is available only when at least one E1 network module is installed in the switch fabric.

```
myswitch::statistics> port e1
e1 Port 1D1 Counter                  Value           Delta
-----------------------------  --------------  --------------
e1FramingLCVs                              0               0
e1FramingFERRs                             0               0
e1FramingFEBEs                             0               0
e1FramingCRCs                              0               0
e1FramingOOFs                              1               0
e1FramingLOSs                              0               0
e1FramingAISs                              0               0
e1FramingAISDs                             0               0
e1FramingRedAlarms                         0               0
e1FramingYellowAlarms                      0               0
e1PlcpBIP8s                                0               0
e1PlcpFERRs                                0               0
e1PlcpFEBEs                                0               0
e1PlcpLOFs                               844              17
e1PlcpYellows                              0               0
e1AtmHCSs                                  0               0
e1AtmRxCells                           19007             264
e1AtmTxCells                           19352             264
e1AtmUHCSs                                 0               0
e1AtmCHCSs                                 0               0
e1AtmLCHDs                                 0               0
Press return for more, q to quit: q
```

The PLCP counters increment only when the E1 network module is running in the PLCP mode, but the HCS counter always increments, regardless of which mode is running. The PLCP counters do not apply to Series D E1 network modules at all.

The fields in this display are defined as follows:

Field	Description
e1FramingLCVs	The number of Line Code Violations (LCV) detected by the E1 Receive Framer block.
e1FramingFERRs	The number of E1 framing error (FERR) events.
e1FramingFEBEs	The number of E1 far end block errors.
e1FramingCRCs	The number of cyclic redundancy check errors.
e1FramingOOFs	The number of OOF (loss of basic frame alignment) errors that have been detected.
e1FramingLOSs	The number of seconds in which LOS (loss of signal) error events occurred.
e1FramingAISs	The number of seconds in which AIS (alarm indication signal) error events occurred.
e1FramingAISDs	The number of seconds in which AISD (unframed pattern of all ones) error events occurred.
e1FramingRedAlarms	The number of seconds in which Red Alarm events were experienced.
e1FramingYellowAlarms	The number of seconds in which Yellow Alarm events were experienced.
e1PlcpBIP8s	The number of BIP-8 (Bit Interleaved Parity-8) error events. The BIP-8 is calculated over the Path Overhead field and the associated ATM cell of the previous PLCP frame. A BIP-N is a method of error monitoring. An N-bit code is generated by the transmitting equipment in such a manner that the first bit of the code provides even parity over the first bit of all N-bit sequences in the previous VT SPE, the second bit provides even parity over the second bits of all N-bit sequences within the specified portion, etc.
e1PlcpFERRs	The number of Physical Layer Convergence Protocol (PLCP) octet error events.
e1PlcpFEBEs	The number of ATM Far End Block Error (FEBE) events.
e1PlcpLOFs	The number of seconds in which Loss Of Frame (LOF) errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. OOF is declared when an error is detected in both the A1 and A2 octets or when 2 consecutive POHID octets are found in error. LOF is declared when an OOF state persists for more than 20ms. LOF is removed upon finding two valid consecutive sets of framing (A1 and A2) octets and two valid sequential path overhead identifier octets.
e1PlcpYellows	The number of seconds in which Yellow alarm errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. A yellow alarm is asserted when 10 consecutive yellow signal bits are set to logical 1. Yellow signals are used to alert upstream terminals of a downstream failure in order to initiate trunk conditioning on the failure circuit.
e1AtmHCSs	The number of header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
e1AtmRxCells	The number of ATM cells that were received, not including idle / unassigned cells.
e1AtmTxCells	The number of ATM cells that were sent, not including idle / unassigned cells.
e1AtmUHCSs	The number of uncorrectable header check sequence (UHCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.

Field	Description
e1AtmCHCSs	The number of correctable header check sequence (CHCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
e1AtmLCDs	The number of seconds in which Loss of Cell Delineation (LCD) has occurred. An LCD defect is detected when an out of cell delineation state has persisted for 4ms. An LCD defect is cleared when the sync state has been maintained for 4ms.

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted or when a network module is replaced.

4.15.4 E3 Port Statistics

You can display statistics about all of the E3 network modules in an individual switch fabric by entering **e3** at the **statistics port** level. This command is available only when at least one E3 network module is installed in the switch fabric.

```
myswitch::statistics> port e3
e3 Port 1D1 Counter                 Value           Delta
------------------------------  --------------  --------------
e3FramingLOSs                          85974               0
e3FramingLCVs                     3684415794               0
e3FramingFERRs                      85173622               0
e3FramingOOFs                          85974               0
e3FramingFERFs                             0               0
e3FramingAISs                              0               0
e3FramingBIP8s                     636877586               0
e3FramingFEBEs                       2465566               0
e3PlcpFERRs                                0               0
e3PlcpLOFs                            171950               0
e3PlcpBIP8s                                0               0
e3PlcpFEBEs                                0               0
e3PlcpYellows                              0               0
e3AtmHCSs                                  0               0
e3AtmRxCells                               0               0
e3AtmTxCells                          281929               0
Press return for more, q to quit: q
```

NOTE

All of the PLCP counters listed above increment only when the E3 network module is running in the PLCP mode. However, the HCS counter always increments, regardless of which mode is running.

The fields in this display are defined as follows:

Field	Description
e3FramingLOSs	The number of seconds in which Loss Of Signal (LOS) errors were detected by the E3 Receive Framer block.
e3FramingLCVs	The number of Line Code Violations (LCV) that were detected by the E3 Receive Framer block.
e3FramingFERRs	The number of E3 framing error (FERR) events.
e3FramingOOFs	The number of seconds in which E3 Out Of Frame (OOF) error events were experienced.
e3FramingFERFs	The number of seconds in which Far End Receive Failures for a port configured with HCS framing were experienced. Indicates the number of seconds in which Remote Alarm Indications for a port configured with PLCP framing were experienced.
e3FramingAISs	The number of seconds in which Alarm Indication Signals (AIS) were detected by the E3 Receive Framer block. AIS indicates that an upstream failure has been detected by the far end.
e3FramingFEBEs	The number of E3 far end block error (FEBE) events.
e3FramingBIP8s	The number of E3 G.832 BIP-8 errors. This counter is only valid for a port using HCS framing.
e3PlcpFERRs	The number of Physical Layer Convergence Protocol (PLCP) octet error events.
e3PlcpLOFs	The number of seconds in which Loss Of Frame (LOF) errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. LOF is declared when an Out-Of-Frame state persists for more than 1ms. LOF is removed when an in-frame state persists for more than 12ms.
e3PlcpBIP8s	The number of BIP-8 (Bit Interleaved Parity-8) error events. The BIP-8 is calculated over the Path Overhead field and the associated ATM cell of the previous PLCP frame. A BIP-N is a method of error monitoring. An N-bit code is generated by the transmitting equipment in such a manner that the first bit of the code provides even parity over the first bit of all N-bit sequences in the previous VT SPE, the second bit provides even parity over the second bits of all N-bit sequences within the specified portion, etc.
e3PlcpFEBEs	The number of ATM Far End Block Error (FEBE) events.
e3PlcpYellows	The number of seconds in which Yellow alarm errors were detected by the PLCP (Physical Layer Convergence Protocol) receiver. Yellow alarm is asserted when 10 consecutive yellow signal bits are set to logical 1. Yellow signals are used to alert upstream terminals of a downstream failure in order to initiate trunk conditioning on the failure circuit.

Field	Description
e3AtmHCSs	The number of header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
e3AtmRxCells	The number of ATM cells that were received, not including idle / unassigned cells.
e3AtmTxCells	The number of ATM cells that were sent, not including idle / unassigned cells.

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted or when a network module is replaced.

4.15.5 J2 Port Statistics

You can display statistics about all of the J2 network modules in an individual switch fabric by entering **j2** at the **statistics port** level. This command is available only when at least one J2 network module is installed in the switch.

```
myswitch::statistics> port j2
j2 Port 1A1 Counter                  Value           Delta
-----------------------------  --------------  --------------
j2B8ZSCodingErrors                       255               0
j2CRC5Errors                               0               0
j2FramingErrors                            0               0
j2RxLossOfFrame                            0               0
j2RxLossOfClock                            0               0
j2RxAIS                                    0               0
j2TxLossOfClock                            0               0
j2RxRemoteAIS                              0               0
j2AtmHCSs                                  0               0
j2AtmRxCells                          136924               0
j2AtmTxCells                          120988               0
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
j2B8ZSCodingErrors	The number of B8ZS coding violation errors.
j2CRC5Errors	The number of CRC-5 received errors.
j2FramingErrors	The number of framing patterns received in error.
j2RxLossOfFrame	The number of seconds during which the receiver was experiencing Loss Of Frame.
j2RxLossOfClock	The number of seconds during which the receiver was not observing transitions on the received clock signal.
j2RxAIS	The number of seconds during which the receiver detected an Alarm Indication Signal.
j2TxLossOfClock	The number of seconds during which the transmitter experienced Loss Of Clock.
j2RxRemoteAIS	The number of seconds during which the receiver observed the Alarm Indication Signal in the m-bits channel.
j2AtmHCSs	The number of header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
j2AtmRxCells	The number of ATM cells that were received.
j2AtmTxCells	The number of ATM cells that were transmitted.

4.15.6 SONET Port Statistics

You can display statistics about all of the SONET network modules on an individual switch fabric by entering **sonet** at the **statistics port** level. This command is available only when at least one SONET (OC-3c, OC-12c, OC-48c, or UTP) network module is installed.

```
myswitch::statistics> port sonet
sonet Port 1D1 Counter              Value           Delta
------------------------------  --------------  --------------
sonetSectionBIPs                 1571776380          863766
sonetSectionLOSs                      32745              18
sonetSectionLOFs                      32745              18
sonetLineBIPs                             0               0
sonetLineFEBEs                            0               0
sonetLineAISs                         32745              18
sonetLineRDIs                             0               0
sonetPathBIPs                             0               0
sonetPathFEBEs                            0               0
sonetPathLOPs                             0               0
sonetPathAISs                         32745              18
sonetPathRDIs                         32745              18
sonetPathUNEQs                            0               0
sonetPathPLMs                             0               0
sonetAtmCorrectableHCSs                   0               0
sonetAtmUncorrectableHCSs                 0               0
sonetAtmLCDs                          32745              18
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
sonetSectionBIPs	The number of Section BIP-8 (Bit Interleaved Parity) errors that have been detected. The calculated BIP-8 code is compared with the BIP-8 code extracted from the B1 byte of the following frame. Differences indicate that a section level bit error has occurred.
sonetSectionLOSs	The number of seconds in which Loss Of Signal (LOS) has occurred. A LOS is declared when 20 +/- 3ms of all zeros patterns is detected. LOS is cleared when two valid framing words are detected and during the intervening time no LOS condition is detected.
sonetSectionLOFs	The number of seconds in which Loss Of Frame (LOF) has occurred. A LOF is declared when an out-of-frame (OOF) condition persists for 3ms. It is cleared when an in-frame condition persists for 3ms. While in-frame, the framing bytes (A1, A2) in each frame are compared against the expected pattern. OOF is declared when four consecutive frames containing one or more framing pattern errors have been received.

Field	Description
sonetLineBIPs	The number of Line BIP-24 (Bit Interleaved Parity) errors that have been detected. The calculated BIP-24 code is based on the line overhead and synchronous payload envelope (SPE) of the STS-3c stream. The line BIP-24 code is a bit interleaved parity calculation using even parity. The calculated code is compared with the BIP-24 code extracted from the B2 bytes of the following frame. Differences indicate that a line layer bit error has occurred.
sonetLineFEBEs	The number of line Far End Block Errors (FEBE) that have been detected.
sonetLineAISs	The number of seconds in which line Alarm Indication Signal (AIS) has occurred. A line AIS is asserted when a 111 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. It is removed when any pattern other than 111 is detected in these bits for five consecutive frames.
sonetLineRDIs	The number of seconds in which a line Remote Defect Indication (RDI) has occurred. A line RDI is asserted when a 110 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. It is removed when any pattern other than 110 is detected in these bits for five consecutive frames.
sonetPathBIPs	The number of Path BIP-8 (Bit Interleaved Parity) errors that have been detected. A path BIP-8 error is detected by comparing the path BIP-8 byte (B3) extracted from the current frame, to the path BIP-8 computed for the previous frame.
sonetPathFEBEs	The number of path Far End Block Errors (FEBE) that have been detected. FEBEs are detected by extracting the 4-bit FEBE field from the path status byte (G1). The valid range for the 4-bit field is between 0000 and 1000, representing zero to eight errors. Other values are interpreted as zero errors.
sonetPathLOPs	The number of seconds in which path Loss Of Pointer (LOP) has occurred. A path LOP is detected when a “normal pointer value” is not found in eight consecutive frames. It is cleared when a “normal pointer value” is found for three consecutive frames.
sonetPathAISs	The number of seconds in which a path Alarm Indication Signal (AIS) has occurred. A path AIS is asserted when an all-ones pattern is detected in the pointer bytes (H1 and H2) for three consecutive frames and is cleared when a valid pointer is found for three consecutive frames. AIS means an upstream failure has been detected.
sonetPathRDIs	The number of seconds in which a path Remote Defect Indication (RDI) alarm has occurred. A path RDI is detected by extracting bit 5 of the path status byte. If bit 5 is high for 10 consecutive frames, then an RDI alarm is declared. An RDI alarm is cleared when bit 5 is low for 10 consecutive frames. RDI signals are used to alert upstream terminals of a downstream failure in order to initiate trunk conditioning on the failure circuit.
sonetPathUNEQs	The number of seconds in which a path UNEQ defect has occurred. A path UNEQ defect is detected when the STS Signal label (C2 byte) == 0x00.
sonetPathPLMs	The number of seconds in which a Path Label Mismatch (PLM) defect has occurred. A PLM defect is detected when the STS Signal label (C2 bytes) != 0x00, 0x01, 0x13, 0xFC, or 0xFF.
sonetAtmCorrectableHCSs	The number of correctable Header Check Sequence (HCS) error events that occurred. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.

Field	Description
sonetAtmUncorrectable-HCSs	The number of uncorrectable Header Check Sequence (HCS) error events that occurred. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
sonetAtmLCDs	The number of seconds in which a Loss of Cell Delineation (LCD) has occurred. An LCD defect is detected when an out of cell delineation state has persisted for 4ms. An LCD defect is cleared when the sync state has been maintained for 4ms.

4.15.7 TP25 Port Statistics

You can display statistics about all of the TP25 network modules in an individual switch fabric by entering **tp25** at the **statistics port** level. The following TP25 command is available only when at least one TP25 network module is installed in the switch fabric.

```
myswitch::statistics> port tp25
tp25 Port 1A1 Counter               Value           Delta
-----------------------------  --------------  --------------
tp25ErrorSymbol                    40452300               0
tp25AtmHCSs                               8               0
tp25AtmRxCells                        13722               0
tp25AtmTxCells                            0               0
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
tp25ErrorSymbol	The number of undefined symbols received.
tp25AtmHCSs	The number of header check sequence (HCS) error events. The HCS is a CRC-8 calculation over the first 4 octets of the ATM cell header.
tp25AtmRxCells	The number of ATM cells that were received.
tp25AtmTxCells	The number of ATM cells that were transmitted.

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted or when a network module is replaced.

4.15.8 Fabric Port Statistics

Fabric port counters record the number of CAC (Connection Admission Control) failures, VPI allocation failures, VCI allocation failures, and connection setup errors for each port. Each port counter maintains all errors of that type that occurred on that port or on any path on that port. The counters are direction specific, meaning that errors that occurred on the input side are differentiated from errors that occurred on the output side. You can display fabric statistics about all of the ports in a switch fabric by entering **`fabric`** at the **`statistics port`** level.

```
myswitch::statistics> port fabric
        InputFailures                OutputFailures
Port    CAC    VPI    VCI  Setup    CAC    VPI    VCI  Setup
2A1       0      0      0      0      0      0      0      0
2A2       0      0      0      0      0      0      0      0
2A3       0      0      0      0      0      0      0      0
2A4       0      0     50      0      0      0      0      0
2E1       0      0      0      0      0      0      0      0
2E3       0      0      0      0      0      0      0      0
2E4       0      0      0      0      0      0      0      0
2CTL      0      0      0      0      0      0      0      0
```

The fields in this display are defined as follows:

Field	Description
Port	The port number.
Input Failures CAC	The number of input CAC failures on this port. These failures occur when there is not enough input bandwidth on the link or on an input path of that link for a connection.
Input Failures VPI	The number of input VPI allocation failures on this port that occur when an input VPI cannot be allocated because the VPI is already in use, because the VPI is out of range, or because no more VPIs are available for allocation.
Input Failures VCI	The number of input VCI allocation failures on this port that occur when an input VCI cannot be allocated on a path because the VCI is already in use, because the VCI is out of range, or because no more VCIs are available for allocation on the input path.
Input Failures Setup	The number of input connection setup failures on this port that occur if the connection cannot be set up on the fabric because the output network module cannot support the connection for various reasons, or because a connection ID cannot be allocated on an *ASX*-1000, *ASX*-1200, or *TNX*-1100 fabric.
Output Failures CAC	The number of output CAC failures on this port that occur when there is not enough output bandwidth on the link or on a path of that link for a connection.
Output Failures VPI	The number of output VPI allocation failures on this port that occur when an output VPI cannot be allocated because the VPI is already in use, because the VPI is out of range, or because no more VPIs are available for allocation.

Field	Description
Output Failures VCI	The number of output VCI allocation failures on this port that occur when an output VCI cannot be allocated on a path because the VCI is already in use, because the VCI is out of range, or because no more VCIs are available for allocation on the output path.
Output Failures Setup	The number of output connection setup failures on this port that occur if the connection cannot be set up on the fabric because the output network module cannot support the connection for various reasons, or because a connection ID cannot be allocated on an *ASX*-1000, *ASX*-1200, or *TNX*-1100 fabric.

You can also display fabric statistics for just a specified port in a switch fabric as follows:

```
myswitch::statistics> port fabric 2A4
        InputFailures                OutputFailures
Port    CAC    VPI    VCI  Setup    CAC    VPI    VCI  Setup
2A4       0      0     50      0      0      0      0      0
```

These fields are defined in the same manner as those in the previous example.

4.15.9 Traffic Port Statistics

You can display traffic statistics about all of the ports in a switch fabric by entering **`traffic`** at the **`statistics port`** level. The following is displayed for Series C network modules:

```
myswitch::statistics> port traffic
                   Cells           Cells           Cells
Port Priority    Current     Transmitted            Lost
1A1  ABR-UBR           0              65               0
1A1  VBR               0           16988               0
1A1  CBR               0               0               0
1A2  ABR-UBR           0              68               0
1A2  VBR               0           15890               0
1A2  CBR               0               0               0
1A3  ABR-UBR           0              12               0
1A3  VBR               0           20800               0
1A3  CBR               0               0               0
1A4  ABR-UBR           0              12               0
1A4  VBR               0           20800               0
1A4  CBR               0               0               0
1B1  ABR-UBR           0              12               0
1B1  VBR               0          113401               0
1B1  CBR               0               0               0
Press return for more, q to quit:
```

You can also display traffic statistics for just a specified port. Enter the following parameters:

```
myswitch::statistics> port traffic 1a1
                    Cells           Cells           Cells
Port Priority     Current     Transmitted            Lost
1A1  ABR-UBR            0              65               0
1A1  VBR                0           16988               0
1A1  CBR                0               0               0
```

The following is displayed for Series LC network modules, Series LE network modules on an LE 155, and logical network modules on Series 1 port cards:

```
myswitch::statistics> port traffic
                    Cells       Cells       Cells  CellsLost  CellsLost
Port Priority     Current Transmitted        Lost     Intent   Unintent
1B1  ABR                0           0           0          0          0
1B1  VBR                0         559           0          0          0
1B1  CBR                0           0           0          0          0
1B1  UBR                0         115           0          0          0
1B2  ABR                0           0           0          0          0
1B2  VBR                0         527           0          0          0
1B2  CBR                0           0           0          0          0
1B2  UBR                0         109           0          0          0
1B3  ABR                0           0           0          0          0
1B3  VBR                0         528           0          0          0
1B3  CBR                0           0           0          0          0
1B3  UBR                0         109           0          0          0
Press return for more, q to quit: q
```

The fields in these displays are defined as follows:

Field	Description
Port	The port number.
Priority	The traffic type for this port.
Cells Current	The number of cells currently in shared memory for this port and priority.
Cells Transmitted	The number of cells transmitted out this port for this priority.
Cells Lost	The number of cells for this port and priority dropped by the output network module.
CellsLost Intent	The number of cells that were dropped for this port and priority queue due to EPD (Early Packet Discard) or PPD (Partial Packet Discard). This field applies only to Series LC and Series LE network modules and logical network modules on Series 1 port cards.
CellsLost Unintent	The number of cells that were dropped for this port and priority queue due to output memory shortages or the CLP (Cell Loss Priority) threshold. This field applies only to Series LC and Series LE network modules and logical network modules on Series 1 port cards.

This command does not apply to Series 1 OC-48c port cards.

The following is displayed for Series LE network modules on an LE 25. In this example, the VBR traffic on module 1A has been placed in the high priority queue using **`conf module traffic le vbrqueue`** *<module>* **`rt`**. The VBR traffic on module 1B is in the low priority queue.

```
myswitch::statistics> port traffic
                   Cells       Cells      Cells  CellsLost  CellsLost
Port Priority    Current Transmitted       Lost     Intent   Unintent
1A1  CBR-VBR           0           0          0          0          0
1A1  ABR-UBR           0         559          0          0          0
1A2  CBR-VBR           0           0          0          0          0
1A2  ABR-UBR           0         115          0          0          0
1A3  CBR-VBR           0           0          0          0          0
1A3  ABR-UBR           0         527          0          0          0
1A4  CBR-VBR           0           0          0          0          0
1A4  ABR-UBR           0         109          0          0          0
1B1  CBR               0           0          0          0          0
1B1  VBR-ABR-UBR       0         528          0          0          0
1B2  CBR               0           0          0          0          0
1B2  VBR-ABR-UBR       0         109          0          0          0
Press return for more, q to quit: q
```

These fields are defined in the same manner as those in the previous example.

The following is displayed for Series D network modules:

```
myswitch::statistics> port traffic
              Cells            CellsLost
Port Class  Current      Tx    EPD  CLP0+1   CLP1    VC   Overflow    PPD
2B1  ABR          0       0      0       0      0     0          0      0
2B1  VBR          0     504      0       0      0     0          0      0
2B1  CBR          0       0      0       0      0     0          0      0
2B1  UBR          2  31.91M      0       0      0     0          0      0
```

The fields in these displays are defined as follows:

Field	Description
Port	The port number.
Class	The traffic type for this port.
Cells Current	The number of cells currently in shared memory for this port and class.
Cells Tx[1]	The number of cells transmitted out this port for this class for both CLP0+1 and CLP1 cells.
CellsLost EPD	The first cell of each packet lost on this port for this class because of EPD.
CellsLost CLP0+1	The first cell of each packet lost on this port for this class because the per-port, per-class CLP=0+1 threshold was exceeded.
CellsLost CLP1	The first cell of each packet lost on this port for this class because the per-port, per-class CLP=1 threshold was exceeded.
CellsLost VC	The first cell lost on this port for this class because the per-VC CLP=1 and CLP=0+1 thresholds were exceeded.
CellsLost Overflow	The first cell of each packet lost on this port for this class because shared memory was full.
CellsLost PPD	The total number of cells (except the first cell of each packet) lost because of EPD, because the per-port, per-class CLP=0+1 threshold was exceeded, because the per-port, per-class CLP=1 threshold was exceeded, because the per-VC CLP=1 and CLP=0+1 thresholds were exceeded, or because shared memory was full.

1. This number may be less than the total cells transmitted by all VCs on this port. This is because on a multicast connection with multiple outputs to the same port, each cell is counted only once at the port level for all legs of the connection.

4.16 Resetting Statistic Counters

This feature lets you reset all of the SNMP-based statistic counters while the switch is running. When any changes are made using these commands, a time-stamped message is sent to syslog which includes the user ID and the command issued.

```
myswitch::statistics> reset (all | port <port> | show | none)
```

These commands only reset SNMP variables of the type COUNTER. They do not work for SNMP variables of the type UNSIGNED INT. This includes some of the dynamic counters, such as the PNNI counters (e.g., **`stat atmr pnni profile`** or **`stat atmr pnni sc`**).

These commands do not reset the VCC indexed counters nor gauged values. Gauged values are those statistics that display real-time information. These values can increase or decrease depending on the current conditions (e.g., values under **`conf vpt show`**).

This feature is useful for checking the statistics after a configuration change without disrupting the other switch functions.

4.16.1 Resetting All Counters

The **`stat reset all`** command allows you to reset all statistic counters and all delta variables on the switch to 0.

```
myswitch::statistics> reset all
```

4.16.2 Resetting Counters for a Specific Port

The **`stat reset port`** *<port>* command allows you to reset all statistic counters and all delta variables for the specified port to 0. For example, enter the following:

```
myswitch::statistics> reset port 1b4
```

4.16.3 Displaying Counter Information

The **stat reset show** command allows you to display information about the statistic counters as follows:

```
myswitch::statistics> reset show
Current system uptime:
     5 days 12:54
Elapsed time since last global counter reset:
     0 days 00:01
Elapsed time since last port counter reset:
2A1  0 days 00:01
2A2  0 days 00:01
2A3  0 days 00:01
2A4  0 days 00:01
2B1  0 days 00:01
2B2  0 days 00:01
2B3  0 days 00:01
2B4  0 days 00:01
2B5  0 days 00:01
2B6  0 days 00:01
2B7  0 days 00:01
2B8  0 days 00:01
2C1  0 days 00:01
2C2  0 days 00:01
2C3  0 days 00:01
2C4  0 days 00:01
2D1  0 days 00:01
2D2  0 days 00:01
2D3  0 days 00:01
2D4  0 days 00:01
2E1  0 days 00:01
2E3  0 days 00:01
2E4  0 days 00:01
2CTL 0 days 00:01
```

4.16.4 Restoring the Reset Counters

The **stat reset none** command allows you to delete the current deltas and restore the counters to the previous values as if the counters had never been reset. Enter the following:

```
myswitch::statistics> reset none
```

4.17 Port Card Statistics

You can list port card statistics about the uptime of all of the *ESX*-3000 port cards by entering **portcard** at the **statistics** level.

This command is only valid for an *ESX*-3000.

```
myswitch::statistics> portcard
PortCard    Uptime
2            0d:02:21
5            3d:24:15
```

The fields are defined as follows:

Field	Description
Portcard	The number of each port card that is currently installed in the *ESX*-3000.
Uptime	The length of time that this port card has been in its current state.

You can also display portcard statistics for a specific portcard. Enter the following parameters:

```
myswitch::statistics> portcard [<portcard>]
myswitch::statistics> portcard 5
PortCard    Uptime
5            3d:24:15
```

If this command is entered on a switch that is not an *ESX*-3000, the following is displayed:

```
myswitch::statistics> portcard
No table information for portcard is available.
```

4.18 SCP Statistics

These commands let you display statistics gathered by the switch control processor (SCP). Enter **?** at the **statistics scp** level to list the following submenu:

```
myswitch::statistics scp> ?
  aal0              aal4              aal5              atminterface
  ctlport           icmp              interface         ip
  tcp               udp
```

See the following subsections for more information about each of these commands.

4.18.1 AAL0 Statistics

You can display AAL0 statistics for an SCP by entering **aal0** at the statistics level as follows:

```
myswitch::statistics scp> aal0
Interface              XmtCell         RcvCell         CellDsc
asx0                         0               0               0
qaa0                         0               0               0
qaa1                         0               0               0
qaa2                         0               0               0
qaa3                         0               0               0
```

The fields in this display are defined as follows:

Field	Description
Interface	The AAL0 interface.
XmtCell	The number of transmitted cells.
RcvCell	The number of received cells.
CellDsc	The number of discarded cells.

To display AAL0 statistics for a specific interface, enter the following parameters:

```
myswitch::statistics scp> aal0 [<interface>]
myswitch::statistics scp> aal0 qaa0
Interface              XmtCell         RcvCell         CellDsc
qaa0                         0               0               0
```

4.18.2 AAL4 Statistics

You can display AAL4 statistics for an SCP by entering **aal4** at the **scp** level as follows:

```
myswitch::statistics scp> aal4
Intfce    XmtCell    RcvCell XmtPDU  RcvPDU  CRCErrs  SARErrs   CSErrs CellDsc
asx0       120617      27227  46.8M    9.6M        0        0        0    0.0K
qaa0       120617      27227  46.8M    9.6M        0        0        0    0.0K
qaa1       120617      27227  46.8M    9.6M        0        0        0    0.0K
qaa2       120617      27227  46.8M    9.6M        0        0        0    0.0K
qaa3       120628      27229  46.8M    9.6M        0        0        0    0.0K
```

The fields in this display are defined as follows:

Field	Description
Intfce	The AAL4 interface.
XmtCell	The number of transmitted cells.
RcvCell	The number of received cells.
XmtPDU	The number of PDU packets transmitted.
RcvPDU	The number of PDU packets received.
CRCErrs	The number of CRC errors.
SARErrs	The number of segmentation and reassembly errors.
CSErrs	The number of convergence sublayer errors.
CellDsc	The number of discarded cells.

To display AAL4 statistics for a specific interface, enter the following parameters:

```
myswitch::statistics scp> aal4 [<interface>]
myswitch::statistics scp> aal4 asx0
Intfce    XmtCell    RcvCell XmtPDU  RcvPDU  CRCErrs  SARErrs   CSErrs CellDsc
asx0       120617      27227  46.8M    9.6M        0        0        0    0.0K
```

4.18.3 AAL5 Statistics

You can display AAL5 statistics for an SCP. This display shows both cell and packet counts to the IP interfaces on the SCP. Run this command several times successively and note the increases in the `XmtCell` and `RcvCell` fields, which indicate the traffic flow in the SCP. Enter **`aal5`** at the **`scp`** level as follows:

```
myswitch::statistics scp> aal5
Intfce    XmtCell    RcvCell XmtPDU  RcvPDU  CRCErrs   CSErrs CellDsc   PDUDsc
asx0       279848     214912  49.5M   32.8M        2        0   18.7K        0
qaa0       279848     214913  49.5M   32.8M        2        0   18.7K        0
qaa1       279848     214913  49.5M   32.8M        2        0   18.7K        0
qaa2       279848     214915  49.5M   32.8M        2        0   18.7K        0
qaa3       279848     214915  49.5M   32.8M        2        0   18.7K        0
```

The fields in this display are defined as follows:

Field	Description
Intfce	The AAL5 interface.
XmtCell	The number of transmitted cells.
RcvCell	The number of received cells.
XmtPDU	The number of PDU packets transmitted.
RcvPDU	The number of PDU packets received.
CRCErrs	The number of CRC errors.
CSErrs	The number of convergence sublayer errors.
CellDsc	The number of discarded cells.
PDUDsc	The number of discarded PDU packets.

You can also display AAL5 statistics for a specific interface as follows:

```
myswitch::statistics scp> aal5 [<interface>]
myswitch::statistics scp> aal5 qaa0
Intfce    XmtCell    RcvCell XmtPDU  RcvPDU  CRCErrs   CSErrs CellDsc   PDUDsc
qaa0       279848     214913  49.5M   32.8M        2        0   18.7K        0
```

4.18.4 ATM Interface Statistics

You can display ATM statistics for an SCP. This shows cell counts and counts of invalid VPI/VCI values received by the SCP. Enter **atminterface** at the **scp** level as follows:

```
myswitch::statistics scp> atminterface
Interface    XmtCell    RcvCell    VPI-OOR    VPI-Noc    VCI-OOR    VCI-Noc
asx0        23162276   21187910          0          0          0          1
qaa0        23162276   21187911          0          0          0          1
qaa1        23162276   21187912          0          0          0          1
qaa2        23162287   21187913          0          0          0          1
qaa3        23162287   21187914          0          0          0          1
```

The fields in this display are defined as follows:

Field	Description
Interface	The ATM interface.
XmtCell	The number of transmitted cells.
RcvCell	The number of received cells.
VPI-OOR	The number of VPIs out of range.
VPI-Noc	The number of VPIs with no connection which means that there is no mapping entry listed for them.
VCI-OOR	The number of VCIs out of range.
VCI-Noc	The number of VCIs with no connection which means that there is no mapping entry listed for them.

You can also display ATM statistics for a specific interface as follows:

```
myswitch::statistics scp> atminterface [<interface>]
myswitch::statistics scp> atminterface asx0
Interface    XmtCell    RcvCell    VPI-OOR    VPI-Noc    VCI-OOR    VCI-Noc
asx0        23162276   21187910          0          0          0          1
```

4.18.5 Control Port Statistics

You can list the control port statistics for an SCP by entering **ctlport** at the **scp** level as follows:

```
myswitch::statistics scp> ctlport
Interface        Framing-Errors      CRC-Errors
asx0                          0               0
qaa0                          0               0
qaa1                          0               0
qaa2                          0               0
qaa3                          0               0
```

The fields in this display are defined as follows:

Field	Description
Interface	The control port interface.
Framing-Errors	The number of ATM cells received with incorrect physical layer framing.
CRC-Errors	The number of ATM cells received with bad header CRCs.

You can also list the control port statistics for a specific interface as follows:

```
myswitch::statistics scp> ctlport [<interface>]
myswitch::statistics scp> ctlport qaa1
Interface        Framing-Errors      CRC-Errors
qaa1                          0               0
```

4.18.6 ICMP Statistics

You can list ICMP statistics for an SCP by entering **icmp** at the **scp** level as follows:

```
myswitch::statistics scp> icmp
icmp Counter                          Value               Delta
----------------------------- -------------------- --------------------
icmpInMsgs                                   815                    2
icmpInErrors                                   0                    0
icmpInDestUnreachs                            13                    0
icmpInTimeExcds                                0                    0
icmpInParmProbs                                0                    0
icmpInSrcQuenchs                               0                    0
icmpInRedirects                                0                    0
icmpInEchos                                  802                    2
icmpInEchoReps                                 0                    0
icmpInTimestamps                               0                    0
icmpInTimestampReps                            0                    0
icmpInAddrMasks                                0                    0
icmpInAddrMaskReps                             0                    0
icmpOutMsgs                                  802                    2
icmpOutErrors                                  0                    0
icmpOutDestUnreachs                            0                    0
icmpOutTimeExcds                               0                    0
icmpOutParmProbs                               0                    0
icmpOutSrcQuenchs                              0                    0
icmpOutRedirects                               0                    0
icmpOutEchos                                   0                    0
icmpOutEchoReps                              802                    2
icmpOutTimestamps                              0                    0
icmpOutTimestampReps                           0                    0
icmpOutAddrMasks                               0                    0
icmpOutAddrMaskReps                            0                    0
```

The fields in this display are defined as follows:

Field	Description
icmpInMsgs	The total number of ICMP messages which the entity received. This counter includes all those counted by `icmpInErrors`.
icmpInErrors	The number of ICMP messages which the entity received but determined as having ICMP-specific errors (bad ICMP checksums, bad length, etc.).
icmplnDestUnreachs	The number of ICMP Destination Unreachable messages received.
icmpInTimeExcds	The number of ICMP Time Exceeded messages received.

Field	Description
icmpInParmProbs	The number of ICMP Parameter Problem messages received.
icmpInSrcQuenchs	The number of ICMP Source Quench messages received.
icmpInRedirects	The number of ICMP Redirect messages received.
icmpInEchos	The number of ICMP Echo (request) messages received.
icmpInEchoReps	The number of ICMP Echo Reply messages received.
icmpInTimestamps	The number of ICMP Timestamp (request) messages received.
icmpInTimestampReps	The number of ICMP Timestamp Reply messages received.
icmpInAddrMasks	The number of ICMP Address Mask Request messages received.
icmpInAddrMaskReps	The number of ICMP Address Mask Reply messages received.
icmpOutMsgs	The total number of ICMP messages which this entity attempted to send. This counter includes all those counted by `icmpOutErrors`.
icmpOutErrors	The number of ICMP messages which this entity did not send due to problems discovered within ICMP such as a lack of buffers. This value should not include errors discovered outside the ICMP layer such as the inability of IP to route the resultant datagram. In some implementations there may be no types of error which contribute to this counter's value.
icmpOutDestUnreachs	The number of ICMP Destination Unreachable messages sent.
icmpOutTimeExcds	The number of ICMP Time Exceeded messages sent.
icmpOutParmProbs	The number of ICMP Parameter Problem messages sent.
icmpOutSrcQuenchs	The number of ICMP Source Quench messages sent.
icmpOutRedirects	The number of ICMP Redirect messages sent. For a host, this object is always zero, since hosts do not send redirects.
icmpOutEchos	The number of ICMP Echo (request) messages sent.
icmpOutEchoReps	The number of ICMP Echo Reply messages sent.
icmpOutTimestamps	The number of ICMP Timestamp (request) messages sent.
icmpOutTimestampReps	The number of ICMP Timestamp Reply messages sent.
icmpOutAddrMasks	The number of ICMP Address Mask Request messages sent.
icmpOutAddrMaskReps	The number of ICMP Address Mask Reply messages sent.

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.18.7 Interface Statistics

You can list interface statistics for an SCP by entering **interface** at the **scp** level as follows:

```
myswitch::statistics scp> interface
Interface lo0 Counter                Value               Delta
----------------------------- ------------------- --------------------
ifInOctets                          1211364                20944
ifInUcastPkts                          3933                   68
ifInNUcastPkts                            0                    0
ifInDiscards                              0                    0
ifInErrors                                0                    0
ifInUnknownProtos                         0                    0
ifOutOctets                         1211364                20944
ifOutUcastPkts                         3933                   68
ifOutNUcastPkts                           0                    0
ifOutDiscards                             0                    0
ifOutErrors                               0                    0
ifOutQLen                                 0                    0

Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
ifInOctets	The total number of octets received on the interface, including framing characters.
ifInUcastPkts	The number of subnetwork-unicast packets delivered to a higher-layer protocol.
ifInNUcastPkts	The number of non-unicast (i.e., subnetwork-broadcast or subnetwork-multicast) packets delivered to a higher-layer protocol.
ifInDiscards	The number of inbound packets that were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
ifInErrors	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
ifInUnknownProtos	The number of packets received via the interface which were discarded because of an unknown or unsupported protocol.
ifOutOctets	The total number of octets transmitted out of the interface, including framing characters.
ifOutUcastPkts	The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.

Field	Description
ifOutNUcastPkts	The total number of packets that higher-level protocols requested be transmitted to a non-unicast (i.e., a subnetwork-broadcast or subnetwork-multicast) address, including those that were discarded or not sent.
ifOutDiscards	The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
ifOutErrors	The number of outbound packets that could not be transmitted because of errors.
ifOutQLen	The length of the output packet queue (in packets).

The value column displays the current value of the counter. The delta column displays the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

You can display the SCP statistics of a specific interface as follows:

```
myswitch::statistics scp> interface [<interface>]
myswitch::statistics scp> interface ie0
Interface ie0 Counter                Value                Delta
------------------------------ -------------------- --------------------
ifInOctets                          1211364                20944
ifInUcastPkts                          3933                   68
ifInNUcastPkts                            0                    0
ifInDiscards                              0                    0
ifInErrors                                0                    0
ifInUnknownProtos                         0                    0
ifOutOctets                         1211364                20944
ifOutUcastPkts                         3933                   68
ifOutNUcastPkts                           0                    0
ifOutDiscards                             0                    0
ifOutErrors                               0                    0
ifOutQLen                                 0                    0
```

4.18.8 IP Statistics

You can display IP statistics for an SCP by entering **ip** at the **scp** level as follows:

```
myswitch::statistics scp> ip
ip Counter                          Value               Delta
------------------------------ ------------------- --------------------
ipInReceives                                74056                  11
ipInHdrErrors                                   0                   0
ipInAddrErrors                                  0                   0
ipForwDatagrams                                 0                   0
ipInUnknownProtos                               0                   0
ipInDiscards                                    0                   0
ipInDelivers                                74056                  11
ipOutRequests                                   0                   0
ipOutDiscards                                   0                   0
ipOutNoRoutes                                   0                   0
ipReasmReqds                                    0                   0
ipReasmOKs                                      0                   0
ipReasmFails                                    0                   0
ipFragOKs                                       0                   0
ipFragFails                                     0                   0
ipFragCreates                                   0                   0
```

The fields in this display are defined as follows:

Field	Description
ipInReceives	The total number of input datagrams received from interfaces, including those received in error.
ipInHdrErrors	The number of input datagrams discarded due to errors in their IP headers, including bad checksums, version number mismatch, other format errors, time-to-live exceeded, errors discovered in processing their IP options, etc.
ipInAddrErrors	The number of input datagrams discarded because the IP address in their IP header's destination field was not a valid address to be received at this entity. This count includes invalid addresses (e.g., 0.0.0.0) and addresses of unsupported Classes (e.g., Class E). For entities which are not IP Gateways and, therefore, do not forward datagrams, this counter includes datagrams discarded because the destination address was not a local address.
ipForwDatagrams	The number of input datagrams for which this entity was not their final IP destination, as a result of which an attempt was made to find a route to forward them to that final destination. In entities which do not act as IP Gateways, this counter includes only those packets which were Source-Routed via this entity, and the Source-Route option processing was successful.

Field	Description
ipInUnknownProtos	The number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol.
ipInDiscards	The number of input IP datagrams for which no problems were encountered to prevent their continued processing, but which were discarded (e.g., for lack of buffer space). This counter does not include any datagrams discarded while awaiting re-assembly.
ipInDelivers	The total number of input datagrams successfully delivered to IP user-protocols (including ICMP).
ipOutRequests	The total number of IP datagrams which local IP user-protocols (including ICMP) supplied to IP in requests for transmission. This counter does not include datagrams counted in ipForwDatagrams.
ipOutDiscards	The number of output IP datagrams for which no problem was encountered to prevent their transmission to their destination, but which were discarded (e.g., for lack of buffer space). This counter includes datagrams counted in ipForwDatagrams if any such packets met this (discretionary) discard criterion.
ipOutNoRoutes	The number of IP datagrams discarded because no route could be found to transmit them to their destination. This counter includes any packets counted in ipForwDatagrams which meet this “no-route” criterion. This includes datagrams which a host cannot route because all of its default gateways are down.
ipReasmReqds	The maximum number of seconds which received fragments are held while they are awaiting reassembly at this entity.
ipReasmOKs	The number of IP datagrams successfully reassembled.
ipReasmFails	The number of failures detected by the IP reassembly algorithm (for whatever reason: timed out, errors, etc). This is not necessarily a count of discarded IP fragments since some algorithms (notably the algorithm in RFC-815) can lose track of the number of fragments by combining them as they are received.
ipFragOKs	The number of IP datagrams that have been successfully fragmented at this entity.
ipFragFails	The number of IP datagrams that have been discarded because they needed to be fragmented at this entity but could not be; e.g., their Don’t Fragment flag was set.
ipFragCreates	The number of IP datagram fragments that have been generated as a result of fragmentation at this entity.

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked it. The counters are reset when the switch is restarted.

4.18.9 TCP Statistics

You can display TCP statistics for an SCP by entering **tcp** at the **scp** level as follows:

```
myswitch::statistics scp> tcp
tcp Counter                          Value               Delta
---------------------------- -------------------- --------------------
tcpActiveOpens                                 0                    0
tcpPassiveOpens                               20                    0
tcpAttemptFails                                0                    0
tcpEstabResets                                 1                    0
tcpCurrEstab                                   2                    0
tcpInSegs                                   4307                   10
tcpOutSegs                                  3290                    7
tcpRetransSegs                                 0                    0
```

The fields in this display are defined as follows:

Field	Description
tcpActiveOpens	The number of times TCP connections have made a direct transition to the SYN-SENT state from the CLOSED state.
tcpPassiveOpens	The number of times TCP connections have made a direct transition to the SYN-RCVD state from the LISTEN state.
tcpAttemptFails	The number of times TCP connections have made a direct transition to the CLOSED state from either the SYN-SENT state or the SYN-RCVD state, plus the number of times TCP connections have made a direct transition to the LISTEN state from the SYN-RCVD state.
tcpEstabResets	The number of times TCP connections have made a direct transition to the CLOSED state from either the ESTABLISHED state or the CLOSE-WAIT state.
tcpCurrEstab	The number of TCP connections for which the current state is either ESTABLISHED or CLOSE- WAIT.
tcpInSegs	The total number of segments received, including those received in error. This count includes segments received on currently established connections.
tcpOutSegs	The total number of segments sent, including those on current connections but excluding those containing only retransmitted octets.
tcpRetransSegs	The total number of segments retransmitted; i.e., the number of TCP segments transmitted containing one or more previously transmitted octets.

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.18.10 UDP Statistics

You can display UDP statistics for an SCP by entering **udp** at the **scp** level as follows:

```
myswitch::statistics scp> udp
udp Counter                          Value               Delta
---------------------------- ------------------- --------------------
udpInDatagrams                           36364                   2
udpNoPorts                               34954                   0
udpInErrors                                  0                   0
udpOutDatagrams                          35964                   2
```

The fields in this display are defined as follows:

Field	Description
udpInDatagrams	The total number of UDP datagrams delivered to UDP users.
udpNoPorts	The total number of received UDP datagrams for which there was no application at the destination port.
udpInErrors	The number of received UDP datagrams that could not be delivered for reasons other than the lack of an application at the destination port.
udpOutDatagrams	The total number of UDP datagrams sent from this entity.

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

4.19 SPANS Statistics

You can list SPANS statistics by entering **spans** at the **statistics** level as follows:

```
myswitch::statistics> spans
Port 1B1 VPI 0 Counter                          Value                Delta
------------------------------    -------------------- --------------------
sigPathVCCs                                         4                    0
sigPathRestarts                                    61                    0
sigPathCallsCompletions                          1988                    2
sigPathCallsFailures                                5                    0
sigPathCallsRejections                              9                    0
sigPathSpansTransmittedMessages               1131685                   68
sigPathSpansReceivedMessages                  1121794                   70
sigPathClsTransmittedMessages                    3073                    3
sigPathClsReceivedMessages                     127008                   43
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
sigPathVCCs	The number of VCCs on this signalling path.
sigPathRestarts	The number of times this switch has lost and regained contact with the other side of the connection.
sigPathCallsCompletions	The number of signalling requests that were successfully completed.
sigPathCallsFailures	The number of failed signalling calls.
sigPathCallsRejections	The number of rejected requests.
sigPathSpansTransmittedMessages	The number of SPANS messages that were sent.
sigPathSpansReceivedMessages	The number of SPANS messages that were received.
sigPathClsTransmittedMessages	The number of connectionless messages that were sent.
sigPathClsReceivedMessages	The number of connectionless messages that were received.

You can also list SPANS statistics for a specific port and VPI as follows:

```
myswitch::statistics> spans [<port>] [<vpi>]
myswitch::statistics> spans 1b2 20
Port 1B2 VPI 20 Counter                          Value                Delta
-------------------------------    -------------------- --------------------
sigPathVCCs                                          4                    0
sigPathRestarts                                     61                    0
sigPathCallsCompletions                           1988                    2
sigPathCallsFailures                                 5                    0
sigPathCallsRejections                               9                    0
sigPathSpansTransmittedMessages                1131685                   68
sigPathSpansReceivedMessages                   1121794                   70
sigPathClsTransmittedMessages                     3073                    3
sigPathClsReceivedMessages                      127008                   43
```

4.20 Signalling Statistics

You can display signalling statistics by entering **signalling** at the **statistics** level as follows:

```
myswitch::statistics> signalling
Port 4A1  VPI 0 Counter                          Value                Delta
---------------------------------- ---------------- --------------------
q2931Calls                                          36                    2
q2931Restarts                                        0                    0
q2931CallsCompletions                               36                    2
q2931CallsFailures                                   0                    0
q2931CallsRejections                                 0                    0
q2931TransmittedMessages                            40                   11
q2931ReceivedMessages                               51                    3

Press return for more, q to quit:
Port 4A2 VPI 0  Counter                          Value                Delta
---------------------------------- ---------------- --------------------
q2931Calls                                           0                    0
q2931Restarts                                        0                    0
q2931CallsCompletions                               36                    2
q2931CallsFailures                                   0                    0
q2931CallsRejections                                 0                    0
q2931TransmittedMessages                             0                   11
q2931ReceivedMessages                               40                    3

Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
q2931Calls	The number of calls on this signalling channel.
q2931Restarts	The number of times the switch has lost and regained contact with the remote signalling entity on this channel.
q2931CallsCompletions	The number of successfully completed calls on this signalling channel.
q2931CallsFailures	The number of call failures on this signalling channel.
q2931CallsRejections	The number of connections on this signalling channel that were rejected by the far end.
q2931TransmittedMessages	The total number of signalling messages that have been transmitted over this signalling channel.
q2931ReceivedMessages	The total number of signalling messages that have been received on this signalling channel.

The value column shows the current value of the counter. The delta column shows the change in the counter since the last time you checked this value. The counters are reset when the switch is restarted.

You can display signalling statistics for a specific port and VPI as follows:

```
myswitch::statistics> signalling [<port> [<vpi>]]
myswitch::statistics> signalling 1d2 20
Port 1D2  VPI 20 Counter                        Value                Delta
-------------------------------- ---------------- --------------------
q2931Calls                                        36                    2
q2931Restarts                                      0                    0
q2931CallsCompletions                             36                    2
q2931CallsFailures                                 0                    0
q2931CallsRejections                               0                    0
q2931TransmittedMessages                          40                   11
q2931ReceivedMessages                             51                    3
```

4.21 VCC Statistics

You can display virtual channel statistics by entering **vcc** at the **statistics** level as follows:

```
myswitch::statistics> vcc
Input          Output                          Cells       Cells
Port VPI  VCI Port VPI  VCI  Uptime       Received   Rejected
1A1    0    5 1CTL   0   34  0d:03:22        24123          0
1A1    0   14 1CTL   0   33  0d:03:22        29056          0
1A1    0   15 1CTL   0   32  0d:03:22        67821          0
1A1    0   16 1CTL   0   53  0d:03:22         9250          0
1A2    0    5 1CTL   0   37  0d:03:22            0          0
1A2    0   14 1CTL   0   36  0d:03:22            0          0
1A2    0   15 1CTL   0   35  0d:03:22            0          0
1A2    0   16 1CTL   0   54  0d:03:22            0          0
1A3    0    5 1CTL   0   40  0d:03:22            0          0
1A3    0   14 1CTL   0   39  0d:03:22            0          0
1A3    0   15 1CTL   0   38  0d:03:22            0          0
1A3    0   16 1CTL   0   55  0d:03:22            0          0
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Input VCI	The incoming virtual channel number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Output VCI	The outgoing virtual channel number.
Uptime	The length of time that this virtual channel has been in its current state.
Cells Received	The total (aggregate) number of cells that were transferred over this channel.
Cells Rejected	The total (aggregate) number of cells over this channel that were rejected (dropped) by the hardware due to a traffic policing violation. This does not include any cells that may have been tagged with CLP=1 by the policer, only cells that were discarded.

You can also display virtual channel statistics for a specific port, for a port and path, or for a port, path, and channel. Enter the following parameters:

```
myswitch::statistics> vcc [traffic [Qlen]] [<port> [<vpi> [<vci>]]]
myswitch::statistics> vcc 1a1 0 15
Input         Output                          Cells      Cells
Port VPI  VCI Port VPI  VCI  Uptime       Received   Rejected
1A1    0   15 1CTL   0   32  0d:03:22        67821          0
```

The fields in this display are defined in the same manner as those in the previous example. You can also show VCC traffic statistics for individual network modules. The fields that are displayed vary depending on the type of network module on which the connections are output. This command does not apply to Series C network modules. If the connections are output on a Series LC or Series LE network module, or a logical network module on a Series 1 port card, then the display is similar to the following:

```
myswitch::statistics> vcc traffic
Input         Output              Cells  CellsLost  CellsLost       Cells
Port VPI  VCI Port VPI  VCI        Lost     Intent   Unintent Transmitted
2E1    0  719 2C1    0  248           0          0          0         870
2E1    0  720 2C1    0  249           0          0          0          64
2E1    0  721 2C1    0  250           0          0          0          35
2E1    0  722 2C1    0  251           0          0          0         243
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Input VCI	The incoming virtual channel number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Output VCI	The outgoing virtual channel number.
Cells Lost	The number of cells on this channel that were dropped by the output network module.
CellsLost Intent	The number of cells dropped on this channel due to EPD (Early Packet Discard) or PPD (Partial Packet Discard). This field does not apply to Series 1 OC-48c port cards.
CellsLost Unintent	The number of cells dropped on this channel due to output memory shortages or the CLP (Cell Loss Priority) threshold. This field does not apply to Series 1 OC-48c port cards.
Cells Transmitted	The number of cells transmitted out this channel.

If the connections are output on a Series D network module, then the display varies depending on whether or not the module packet counter is disabled.

If the module packet counter is disabled under **conf module traffic d aal5pktcount** (the default setting), then the following is displayed:

```
myswitch::statistics> vcc traffic 1a1
Input    Output              CellsTx          CellsLost
Port VPI VCI Port VPI VCI    CLP0    CLP1    EPD CLP0+1   CLP1 Unintent  Intent
1CTL   0 130 1A1    0   5       2       0      0      0      0        0       0
1CTL   0 129 1A1    0  15      64       0      0      0      0        0       0
1CTL   0 131 1A1    0  16      96       0      0      0      0        0       0
```

If the module packet counter is enabled under **conf module traffic d aal5pktcount**, the CLP0 and CLP1 cells are combined into a single CLP0+1 Tx count as follows:

```
myswitch::statistics> vcc traffic 1a1
Input    Output              Cells Packets    CellsLost
Port VPI VCI Port VPI VCI      Tx      Tx    EPD CLP0+1   CLP1 Unintent  Intent
1CTL   0 110 1A1    0   5      18       0      0      0      0        0       0
1CTL   0 109 1A1    0  15   27568       0      0      0      0        0       0
1CTL   0 111 1A1    0  16   18850       0      0      0      0        0       0
```

The fields in these displays are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Input VCI	The incoming virtual channel number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Output VCI	The outgoing virtual channel number.
Cells Tx CLP0	Counts the number of CLP=0 cells transmitted on this channel.
Cells Tx CLP1	Counts the number of CLP=1 cells transmitted on this channel.
Cells Tx	Counts the number of CLP0+1 cells transmitted on this channel.
Packets Tx	Counts the number of packets transmitted on this channel.
Cells Lost EPD	For AAL5 traffic, counts only the first cell of each packet dropped on this channel due to EPD (Early Packet Discard). For non-AAL5 traffic, this counter is not incremented.

Field	Description
Cells Lost CLP0+1	For AAL5 traffic, counts only the first cell of each packet lost on this channel when the per-VC CLP=0+1 threshold is exceeded. All remaining cells are counted under the `CellsLost Intent` counter. For non-AAL5 traffic, counts all cells lost on this channel when the per-VC CLP=0+1 threshold is exceeded.
Cells Lost CLP1	For AAL5 traffic, counts only the first cell of each packet lost on this channel when the per-VC CLP=1 threshold is exceeded. All remaining cells are counted under the `CellsLost Intent` counter. For non-AAL5 traffic, counts all cells lost on this channel when the per-VC CLP=1 threshold is exceeded.
CellsLost Unintent	For AAL5 traffic, counts only the first cell of each packet lost on this channel when output shared memory is full or when the per-port / per-priority CLP (Cell Loss Priority) thresholds are exceeded. All remaining cells are counted under the `CellsLost Intent` counter. For non-AAL5 traffic, counts all cells lost on this channel when output shared memory is full or when the per-port / per-priority CLP (Cell Loss Priority) thresholds are exceeded.
CellsLost Intent	For AAL5 traffic, counts the first cell of each packet dropped on this channel due to PPD (Partial Packet Discard). For non-AAL5 traffic, this counter is not incremented.

If the connections are output on a Series D network module, then there is also an option for displaying the current per-connection queue length. Enter the following parameters:

```
myswitch::statistics> vcc [traffic [Qlen]] [<port> [<vpi> [<vci>]]]
myswitch::statistics> vcc traffic Qlen 1a1
Input    Output
Port VPI VCI Port VPI VCI   Qlen
1CTL   0 130 1A1    0   5      0
1CTL   0 129 1A1    0  15      0
1CTL   0 131 1A1    0  16      0
```

The fields in these displays are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Input VCI	The incoming virtual channel number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Output VCI	The outgoing virtual channel number.
Qlen	The current queue length.

4.22 VPC Statistics

You can display virtual path statistics by entering **vpc** at the **statistics** level as follows:

This command shows statistics for through paths only. To display statistics for originating and terminating paths, use the **stat vpt** command.

```
myswitch::statistics> vpc
Input      Output                          Cells          Cells
Port  VPI  Port  VPI  Uptime            Received       Rejected
1C1   100  1E4   100  4d:21:22                 0              0
1C2   115  1E4   115  4d:16:35                 0              0
1E4   100  1C1   100  4d:21:22                 0              0
1E4   115  1C2   115  4d:16:35                 0              0
```

The fields in this display are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Uptime	The length of time that this virtual path has been in its current state.
Cells Received	The total (aggregate) number of cells that were transferred over this path.
Cells Rejected	The total (aggregate) number of cells over this path that were rejected (dropped) by the hardware due to a traffic policing violation. This does not include any cells that may have been tagged with CLP=1 by the policer, only cells that were discarded.

If no vpcs have been configured, the following message is displayed:

```
myswitch::statistics> vpc
No virtual path connection input statistics are available
```

You can also display virtual path statistics for a specific port, or for a port and path. Enter the following parameters:

```
myswitch::statistics> vpc [traffic [Qlen]] [<port> [<vpi>]]
myswitch::statistics> vpc 1c1 100
Input      Output                          Cells           Cells
Port  VPI  Port  VPI  Uptime            Received        Rejected
1C1   100  1E4   100  4d:21:22                 0               0
1E4   100  1C1   100  4d:21:22                 0               0
```

The fields in this display are defined in the same manner as those in the previous example.

You can also display virtual path traffic statistics for individual network modules. The fields that are displayed vary depending on the type of network module on which the connections are output. This command does not apply to Series C network modules. If the connections are output on Series LC or LE network modules or network modules on Series 1 port cards, then the display is similar to the following:

```
myswitch::statistics> vpc traffic
Input      Output          Cells  CellsLost  CellsLost       Cells
Port  VPI  Port  VPI        Lost     Intent   Unintent Transmitted
1C1    87  1D1    87           0        N/A        N/A     6704864
1C3    95  1D2    95           0        N/A        N/A     8243008
```

The fields in this display are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Cells Lost	The number of cells on this path that were dropped by the output network module.
CellsLost Intent	The number of cells dropped on this path due to EPD (Early Packet Discard) or PPD (Partial Packet Discard). This field does not apply to Series 1 OC-48c port cards.
CellsLost Unintent	The number of cells dropped on this path due to output memory shortages or the CLP (Cell Loss Priority) threshold. This field does not apply to Series 1 OC-48c port cards.
Cells Transmitted	The number of cells transmitted out this path for this priority.

If the connections are output on a Series D network module, then the display will vary depending on whether or not the module packet counter is disabled.

If the module packet counter is disabled, then the following is displayed:

```
myswitch::statistics> vpc traffic 1a1
Input      Output       CellsTx          CellsLost
Port  VPI  Port  VPI    CLP0    CLP1     EPD  CLP0+1    CLP1 Unintent  Intent
1A1     1  1A2     1       0       0     N/A       0       0        0     N/A
1A1     2  1A3     2       0       0     N/A       0       0        0     N/A
```

If the module packet counter is enabled, then the following is displayed:

```
myswitch::statistics> vpc traffic 1a1
Input      Output      Cells Packets     CellsLost
Port  VPI  Port  VPI      Tx      Tx     EPD  CLP0+1    CLP1 Unintent  Intent
1A1     1  1A2     1       0       0     N/A       0       0        0     N/A
1A1     2  1A3     2       0       0     N/A       0       0        0     N/A
```

The fields in these displays are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Cells Tx CLP0	The number of CLP=0 cells on this path that were transmitted.
Cells Tx CLP1	The number of CLP=1 cells on this path that were transmitted.
Packets Tx	The number of transmitted packets on this path.
Cells Lost EPD	The number of cells dropped on this path due to EPD (Early Packet Discard).
Cells Lost CLP0+1	The number of cells lost on this path due to the per-VC CLP=0+1 threshold.
Cells Lost CLP1	The number of cells lost on this path due to the per-VC CLP=1 threshold.
CellsLost Unintent	The number of cells dropped on this path due to output memory shortages or the per-port / per-priority CLP (Cell Loss Priority) thresholds.
CellsLost Intent	The number of cells dropped on this path due to PPD (Partial Packet Discard).

If the connections are output on a Series D network module, then there is also an option for displaying the current per-connection queue length. Enter the following parameters:

```
myswitch::statistics> vpc [traffic [Qlen]] [<port> [<vpi>]]
myswitch::statistics> vpc traffic Qlen 1a1
Input      Output
Port  VPI  Port  VPI   Qlen
1A1     1  1A2     1      0
1A1     2  1A3     2      0
```

The fields in these displays are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Qlen	The current queue length.

4.23 VPT Statistics

You can display virtual path terminator statistics by entering **vpt** at the **statistics** level as follows:

This command shows statistics for originating and terminating paths. To display statistics for through paths, use the **stat vpc** command.

```
myswitch::statistics> vpt
Input      Output                      Cells      Cells
Port  VPI  Port  VPI  Uptime       Received   Rejected
1A1     0  terminate  0d:01:46        17716          0
1A2     0  terminate  0d:01:46        13962          0
1A3     0  terminate  0d:01:46            0          0
1A4     0  terminate  0d:01:46            0          0
1B1     0  terminate  0d:01:46       120685          0
1B2     0  terminate  0d:01:46        18767          0
1B3     0  terminate  0d:01:46            0          0
1B4     0  terminate  0d:01:46       121127          0
1CTL    0  terminate  0d:01:47       533219          0
originate  1A1     0  0d:01:46          N/A        N/A
originate  1A2     0  0d:01:46          N/A        N/A
originate  1A3     0  0d:01:46          N/A        N/A
originate  1A4     0  0d:01:46          N/A        N/A
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
Input Port	The incoming port number.
Input VPI	The incoming virtual path number.
Output Port	The outgoing port number.
Output VPI	The outgoing virtual path number.
Uptime	The length of time that this virtual path has been in its current state.
Cells Received	The total (aggregate) number of cells that were transferred over this path.
Cells Rejected	The total (aggregate) number of cells over this path that were rejected (dropped) by the hardware due to a traffic policing violation. This does not include any cells that may have been tagged with CLP=1 by the policer, only cells that were discarded.

You can also display vpt statistics for just an individual port or path as follows:

```
myswitch::statistics> vpt [<port> [<vpi>]]
myswitch::statistics> vpt 1a2
Input      Output                    Cells      Cells
Port  VPI  Port  VPI  Uptime       Received   Rejected
1A2     0  terminate  0d:01:46        13962          0
originate  1A2     0  0d:01:46          N/A        N/A
```

The fields in this display are defined in the same manner as those in the previous example.

You can also display fabric path counters for the vpts. Fabric path counters record the number of CAC (Connection Admission Control) failures, VPI allocation failures, VCI allocation failures, and connection setup errors for each path. Each path counter only records errors that occurred on that path. The counters are direction specific, meaning that errors that occurred on the input side are differentiated from errors that occurred on the output side. Enter the following parameters:

```
myswitch::statistics> vpt [fabric]
myswitch::statistics> vpt 2
Input      Output        Failures
Port  VPI  Port  VPI     CAC    VCI  Setup
2A1     0  terminate       0      0      0
2A2     0  terminate       0      0      0
2A3     0  terminate       0      0      0
2A4     0  terminate       0     50      0
2B1     0  terminate       0      0      0
2B2     0  terminate       0      1      0
2B3     0  terminate       0      0      0
2CTL    0  terminate       0      0      0
originate  2A1     0       0      0      0
originate  2A2     0       0      0      0
originate  2A3     0       0      0      0
originate  2A4     0       0      0      0
originate  2B1     0       0      0      0
originate  2B2     0       0      0      0
Press return for more, q to quit: q
```

The fields in this display are defined as follows:

Field	Description
Input Port	Shows the incoming port number for a terminating path and shows **originate** for an originating path.
Input VPI	Shows the incoming virtual path number for a terminating path and shows **originate** for an originating path.
Output Port	Shows the outgoing port number for an originating path and shows **terminate** for a terminating path.
Output VPI	Shows the outgoing virtual path number for an originating path and shows **terminate** for a terminating path.
Failures CAC	The number of CAC (Connection Admission Control) failures on this path. If it is an elastic, terminating path, these failures occur if there is not enough bandwidth on the input path or link for the connection. If it is an elastic, originating path, these failures occur if there is not enough bandwidth on the output path or link for the connection.
Failures VCI	The number of VCI allocation failures on this path. These failures occur when an input VCI cannot be allocated because the VCI is already in use, because the VCI is out of range, or because no more VCIs are available for allocation on the path.
Failures Setup	The number of connection setup failures on this path. These failures occur if the connection cannot be set up on the fabric because the output network module cannot support the connection for various reasons, or because a connection ID cannot be allocated on an *ASX*-1000, *ASX*-1200, or *TNX*-1100 fabric.

Acronyms

The networking terms in the following list are defined in the Glossary of this manual. Glossary items are listed alphabetically according to the full term.

AAL	ATM Adaptation Layer
ABR	Available Bit Rate
ACM	Address Complete Message
ACR	Allowable Cell Rate
ADPCM	Adaptive Differential Pulse Code Modulation
AHFG	ATM-attached Host Functional Group
AIMUX	ATM Inverse Multiplexing
AIS	Alarm Indication Signal
AMI	Alternate Mark Inversion
AMI	ATM Management Interface
ANSI	American National Standards Institute
APCM	Adaptive Pulse Code Modulation
API	Application Program Interface
APP	Application Program
APS	Automatic Protection Switching
ARP	Address Resolution Protocol
ASCII	American Standard Code for Information Interchange
ATDM	Asynchronous Time Division Multiplexing
ATM	Asynchronous Transfer Mode
AUI	Attachment User Interface
B8ZS	Bipolar 8 Zero Substitution
BCOB	Broadband Connection Oriented Bearer
BCOB-A	Bearer Class A
BCOB-C	Bearer Class C
BCOB-X	Bearer Class X
BECN	Backward Explicit Congestion Notification
BER	Bit Error Rate
BES	Bursty Errored Seconds
BGP	Border Gateway Protocol
B-ICI	B-ISDN Inter-Carrier Interface.
BIP	Bit Interleaved Parity
B-ISDN	Broadband Integrated Services Digital Network
B-ISUP	Broadband ISDN User's Part
BITS	Building Integrated Timing Supply
BNC	Bayonet-Neill-Concelman

BPDU	Bridge Protocol Data Unit
bps	Bits per Second
BPV	Bipolar Violation
B-TE	Broadband Terminal Equipment
BUS	Broadcast and Unknown Server
CAC	Connection Admission Control
CAS	Channel Associated Signaling
CBDS	Connectionless Broadband Data Service
CBR	Constant Bit Rate
CCITT	International Telephone and Telegraph Consultative Committee
CCS	Common Channel Signaling
CDV	Cell Delay Variation
CE	Connection Endpoint
CEI	Connection Endpoint Identifier
CES	Circuit Emulation Service
CGA	Carrier Group Alarm
CIP	Carrier Identification Parameter
CIR	Committed Information Rate
CLIP	Classical IP
CLP	Cell Loss Priority
CLR	Cell Loss Ratio-1-15
CLS	Connectionless service
CMIP	Common Management Interface Protocol
CMR	Cell Misinsertion Rate
CPE	Customer Premise Equipment
CRA	Cell Rate Adaptation
CRC	Cyclic Redundancy Check
CRS	Cell Relay Service
CS	Controlled Slip, **or** Convergence Sublayer
CSU	Channel Service Unit
CTD	Cell Transfer Delay
CTS	Clear To Send
DACS	Digital Access and Cross-Connect System
DARPA	Defense Advanced Research Projects Agency
DCC	Data Country Code
DCE	Data Communications Equipment
DCS	Digital Cross-connect System
DES	Destination End Station
DFA	DXI Frame Address
DLCI	Data Link Connection Identifier
DNS	Domain Naming System
DSn	Digital Standard n (n=0, 1, 1C, 2, and 3)

DSR	Data Set Ready
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EEPROM	Electrically Erasable Programmable Read Only Memory
EFCI	Explicit Forward Congestion Indication
EGP	Exterior Gateway Protocol
EIA	Electronics Industries Association
EISA	Extended Industry Standard Architecture
ELAN	Emulated Local Area Network
EMI	Electromagnetic Interference
EPROM	Erasable Programmable Read Only Memory
EQL	Equalization
ER	Explicit Rate
ES	End System, **or** Errored Second
ESF	Extended Super Frame
ESI	End System Identifier
EXZ	Excessive Zeroes (Error Event)
FC	Face Contact
FCC	Federal Communications Commission
FCS	Frame Check Sequence
FDDI	Fiber Distributed Data Interface
FDM	Frequency Division Multiplexing
FEBE	Far End Block Error
FEC	Forward Error Correction
FECN	Forward Explicit Congestion Notification
FERF	Far End Receive Failure
FIFO	First-In, First-Out
FRS	Frame-Relay Service
FTP	File Transfer Protocol
FT-PNNI	*ForeThought* PNNI
FUNI	Frame-Based UNI
GCAC	Generic Connection Admission Control
GCRA	Generic Cell Rate Algorithm
GFC	Generic Flow Control
HDB3	High Density Bipolar
HDLC	High Level Data Link Control
HEC	Header Error Control
HIPPI	High Performance Parallel Interface
HSSI	High-Speed Serial Interface
ICMP	Internet Control Message Protocol
IDU	Interface Data Unit
IEEE	Institute of Electrical and Electronics Engineers

IETF	Internet Engineering Task Force
ILMI	Interim Local Management Interface
IP	Internet Protocol
IPX	Internetwork Packet Exchange
IS	Intermediate system
ISDN	Integrated Services Digital Network
ISO	International Standards Organization
ITU-T	International Telecommunication Union Telecommunication
IWF	Interworking Function
IXC	Interexchange Carriers
JPEG	Joint Photographic Experts Group
Kbps	Kilobits per second
LAN	Local Area Network
LANE	LAN Emulation
LAPB	Link Access Procedure, Balanced
LATA	Local Access and Transport Area
LBO	Line Build Out
LCV	Line Code Violations
LE_ARP	LAN Emulation Address Resolution Protocol
LEC	LAN Emulation Client
LECS	LAN Emulation Configuration Server
LES	LAN Emulation Server
LLC	Logical Link Control
LOF	Loss Of Frame
LOP	Loss Of Pointer
LOS	Loss Of Signal
LSB	Least Significant Bit
MAC	Media Access Control
MAN	Metropolitan Area Network
MAU	Media Attachment Unit
MBS	Maximum Burst Size
MCDV	Maximum Cell Delay Variance
MCLR	Maximum Cell Loss Ratio
MCR	Minimum Cell Rate
MCTD	Maximum Cell Transfer Delay
MIB	Management Information Base
MIC	Media Interface Connector
MID	Message Identifier
MMF	Multimode Fiber Optic Cable
MPEG	Motion Picture Experts Group
MPOA	Multiprotocol over ATM
MSB	Most Significant Bit
MTU	Maximum Transmission Unit

NM	Network Management Entity
NML	Network Management Layer
NMS	Network Management Station
NNI	Network-to-Network Interface or Network Node Interface
NPC	Network Parameter Control
NRZ	Non Return to Zero
NRZI	Non Return to Zero Inverted
NSAP	Network Service Access Point
NTSC	National TV Standards Committee
OAM	Operation and Maintenance Cell
OC-n	Optical Carrier level-n
OID	Object Identifier
OOF	Out-of-Frame
OSI	Open Systems Interconnection
OSPF	Open Shortest Path First Protocol
OUI	Organizationally Unique Identifier
PAD	Packet Assembler Disassembler
PAL	Phase Alternate Line
PBX	Private Branch Exchange
PCI	Peripheral Component Interconnect
PCM	Pulse Code Modulation
PCR	Peak Cell Rate
PDN	Public Data Network
PDU	Protocol Data Unit
PHY	Physical Layer
ping	Packet Internet Groper
PLCP	Physical Layer Convergence Protocol
PLP	Packet Level Protocol
PM	Physical Medium
PMD	Physical Medium Dependent
PNNI	Private Network Node Interface or Private Network-to-Network Interface
PPP	Point-to-Point Protocol
PROM	Programmable Read-Only Memory
PRS	Primary Reference Source
PSN	Packet Switched Network
PT	Payload Type
PVC	Permanent Virtual Circuit (or Channel)
PVCC	Permanent Virtual Channel Connection
PVPC	Permanent Virtual Path Connection
QD	Queuing Delay
QoS	Quality of Service
RD	Routing Domain
RFCs	Requests For Comment

RFI	Radio Frequency Interference
RIP	Routing Information Protocol
RISC	Reduced Instruction Set Computer
RTS	Request To Send
SA	Source Address
SA	Source MAC Address
SAP	Service Access Point
SAR	Segmentation And Reassembly
SC	Structured Cabling, **or** Structured Connectors, **or** Stick and Click
SCR	Sustainable Cell Rate
SCSI	Small Computer Systems Interface
SDLC	Synchronous Data Link Control
SDU	Service Data Unit
SEAL	Simple and Efficient Adaptation Layer
SECAM	Systeme En Coleur Avec Memoire
SEL	Selector
SES	Severely Errored Seconds
SF	Super Frame
SGMP	Simple Gateway Management Protocol
SIR	Sustained Information Rate
SLIP	Serial Line IP
SMDS	Switched Multimegabit Data Service
SMF	Single Mode Fiber
SMTP	Simple Mail Transfer Protocol
SNA	Systems Network Architecture
SNAP	SubNetwork Access Protocol
SNI	Subscriber Network Interface
SNMP	Simple Network Management Protocol
SONET	Synchronous Optical Network
SPANS	Simple Protocol for ATM Network Signalling
SPARC	Scalable Processor Architecture Reduced instruction set Computer
SPE	Synchronous Payload Envelope
SPVC	Smart PVC
SS7	Signaling System No. 7
SSCOP	Service Specific Connection Oriented Protocol
SSCS	Service Specific Convergence Sublayer
ST	Straight Tip, **or** Stick and Turn
STM	Synchronous Transfer Mode
STP	Shielded Twisted Pair, Spanning Tree Protocol
STS	Synchronous Transport Signal

SVC	Switched Virtual Circuit (or Channel)
SVCC	Switched Virtual Channel Connection
SVPC	Switched Virtual Path Connection
TAXI	Transparent Asynchronous Transmitter / Receiver Interface
TC	Transmission Convergence
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol / Internet Protocol
TCR	Tagged Cell Rate
TCS	Transmission Convergence Sublayer
TDM	Time Division Multiplexing
TE	Terminal Equipment
TFTP	Trivial File Transfer Protocol
TM	Traffic Management
UAS	Unavailable Seconds
UBR	Unspecified Bit Rate
UDP	User Datagram Protocol
UNI	User-to-Network Interface
UPC	Usage Parameter Control
UTOPIA	Universal Test & Operations Interface for ATM
UTP	Unshielded Twisted Pair
VBR	Variable Bit Rate
VC	Virtual Channel (or Circuit)
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VCL	Virtual Channel Link
VINES	Virtual Network Software
VLAN	Virtual Local Area Network
VP	Virtual Path
VPC	Virtual Path Connection
VPDN	Virtual Private Data Network
VPI	Virtual Path Identifier
VPL	Virtual Path Link
VPN	Virtual Private Network
VPT	Virtual Path Terminator
VS/VD	Virtual Source / Virtual Destination
VT	Virtual Tributary
WAN	Wide-Area Network
ZBTSI	Zero Byte Time Slot Interchange

Glossary

10Base-T - a 10 Mbps baseband Ethernet specification utilizing twisted-pair cabling (Category 3, 4, or 5). 10BaseT, which is part of the IEEE 802.3 specification, has a distance limit of approximately 100 meters per segment.

802.1d Spanning Tree Bridging - the IEEE standard for bridging; a MAC layer standard for transparently connecting two or more LANs (often called subnetworks) that are running the same protocols and cabling. This arrangement creates an extended network, in which any two workstations on the linked LANs can share data.

802.3 Ethernet - the IEEE standard for Ethernet; a physical-layer standard that uses the CSMA / CD access method on a bus-topology LAN.

802.5 Token Ring - the IEEE physical-layer standard that uses the token-passing access method on a ring-topology LAN.

AAL Connection - an association established by the AAL between two or more next higher layer entities.

Adapter - A fitting that supplies a passage between two sets of equipment when they cannot be directly interconnected.

Adaptive Differential Pulse Code Modulation (ADPCM) - A technique that allows analog voice signals to be carried on a 32K bps digital channel. Sampling is done at 8Hz with 4 bits used to describe the difference between adjacent samples.

Adaptive Pulse Code Modulation (APCM) - A technique that effectively reduces occupied bandwidth per active speaker by reducing sampling rates during periods of overflow peak traffic.

Address - A unique identity of each network station on a LAN or WAN.

Address Complete Message (ACM) - A B-ISUP call control message from the receiving exchange to sending exchange indicating the completion of address information.

Address Mask - a bit mask used to identify which bits in an address (usually an IP address) are network significant, subnet significant, and host significant portions of the complete address. This mask is also known as the subnet mask because the subnetwork portion of the address can be determined by comparing the binary version of the mask to an IP address in that subnet. The mask holds the same number of bits as the protocol address it references.

Address Prefix - A string of 0 or more bits up to a maximum of 152 bits that is the lead portion of one or more ATM addresses.

Address Resolution - The procedure by which a client associates a LAN destination with the ATM address of another client or the BUS.

Address Resolution Protocol (ARP) - a method used to resolve higher level protocol addressing (such as IP) into the appropriate header data required for ATM; i.e., port, VPI, and VCI; also defines the AAL type to be used.

Agent - a component of network- and desktop-management software, such as SNMP, that gathers information from MIBs.

alarm - an unsolicited message from a device, typically indicating a problem with the system that requires attention.

Alarm Indication Signal (AIS) - In T1, an all ones condition used to alert a receiver that its incoming signal (or frame) has been lost. The loss of signal or frame is detected at the receiving end, and the failed signal is replaced by all the ones condition which the receiver interprets as an AIS. The normal response to this is AIS is for the receiving end to generate a yellow alarm signal as part of its transmission towards the faulty end. (The AIS itself is sometimes called a Blue Signal).

A-Law - The PCM coding and companding standard used in Europe.

Allowable Cell Rate (ACR) - parameter defined by the ATM Forum for ATM traffic management. ACR varies between the MCR and the PCR, and is dynamically controlled using congestion control mechanisms.

Alternate Mark Inversion (AMI) - A line coding format used on T1 facilities that transmits ones by alternate positive and negative pulses.

Alternate Routing - A mechanism that supports the use of a new path after an attempt to set up a connection along a previously selected path fails.

American National Standards Institute (ANSI) - a private organization that coordinates the setting and approval of some U.S. standards. It also represents the United States to the International Standards Organization.

American Standard Code for Information Interchange (ASCII) - a standard character set that (typically) assigns a 7-bit sequence to each letter, number, and selected control characters.

AppleTalk - a networking protocol developed by Apple Computer for communication between Apple's products and other computers. Independent of the network layer, AppleTalk runs on LocalTalk, EtherTalk and TokenTalk.

Application Layer - Layer seven of the ISO reference model; provides the end-user interface.

Application Program (APP) - a complete, self-contained program that performs a specific function directly for the user.

Application Program Interface (API) - a language format that defines how a program can be made to interact with another program, service, or other software; it allows users to develop custom interfaces with FORE products.

Assigned Cell - a cell that provides a service to an upper layer entity or ATM Layer Management entity (ATMM-entity).

asxmon - a FORE program that repeatedly displays the state of the switch and its active ports.

Asynchronous Time Division Multiplexing (ATDM) - a multiplexing technique in which a transmission capability is organized into a priori, unassigned time slots. The time slots are assigned to cells upon request of each application's instantaneous real need.

Asynchronous Transfer Mode (ATM) - a transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.

ATM Adaptation Layer (AAL) - the AAL divides user information into segments suitable for packaging into a series of ATM cells. AAL layer types are used as follows:

AAL-1 - constant bit rate, time-dependent traffic such as voice and video
AAL-2 - still undefined; a placeholder for variable bit rate video transmission
AAL-3/4 - variable bit rate, delay-tolerant data traffic requiring some sequencing and/or error detection support (originally two AAL types, connection-oriented and connectionless, which have been combined)
AAL-5 - variable bit rate, delay-tolerant, connection-oriented data traffic requiring minimal sequencing or error detection support

ATM Address - Defined in the UNI Specification as 3 formats, each having 20 bytes in length.

ATM Forum - an international non-profit organization formed with the objective of accelerating the use of ATM products and services through a rapid convergence of interoperability specifications. In addition, the Forum promotes industry cooperation and awareness.

ATM Inverse Multiplexing (AIMUX) - A device that allows multiple T1 or E1 communications facilities to be combined into a single broadband facility for the transmission of ATM cells.

ATM Layer link - a section of an ATM Layer connection between two adjacent active ATM Layer entities (ATM-entities).

ATM Link - a virtual path link (VPL) or a virtual channel link (VCL).

ATM Management Interface (AMI) - the user interface to FORE Systems' *ForeThought* switch control software (SCS). AMI lets users monitor and change various operating configurations of FORE Systems switches and network module hardware and software, IP connectivity, and SNMP network management.

ATM Peer-to-Peer Connection - a virtual channel connection (VCC) or a virtual path connection (VPC) directly established, such as workstation-to-workstation. This setup is not commonly used in networks.

ATM Traffic Descriptor - a generic list of parameters that can be used to capture the intrinsic traffic characteristics of a requested ATM connection.

ATM User-to-User Connection - an association established by the ATM Layer to support communication between two or more ATM service users (i.e., between two or more next higher layer entities or between two or more ATM entities). The communication over an ATM Layer connection may be either bidirectional or unidirectional. The same Virtual Channel Identifier (VCI) is used for both directions of a connection at an interface.

atmarp - a FORE program that shows and manipulates ATM ARP entries maintained by the given device driver. This is also used to establish PVC connections.

ATM-attached Host Functional Group (AHFG) - The group of functions performed by an ATM-attached host that is participating in the MPOA service.

atmconfig - a FORE program used to enable or disable SPANS signalling.

atmstat - a FORE program that shows statistics gathered about a given adapter card by the device driver. These statistics include ATM layer and ATM adaptation layer cell and error counts. This can also be used to query other hosts via SNMP.

Attachment User Interface (AUI) - IEEE 802.3 interface between a media attachment unit (MAU) and a network interface card (NIC). The term AUI can also refer to the rear panel port to which an AUI cable might attach.

Auto-logout - a feature that automatically logs out a user if there has been no user interface activity for a specified length of time.

Automatic Protection Switching (APS) - Equipment installed in communications systems to detect circuit failures and automatically switch to redundant, standby equipment.

Available Bit Rate (ABR) - a type of traffic for which the ATM network attempts to meet that traffic's bandwidth requirements. It does not guarantee a specific amount of bandwidth and the end station must retransmit any information that did not reach the far end.

Backbone - the main connectivity device of a distributed system. All systems that have connectivity to the backbone connect to each other, but systems can set up private arrangements with each other to bypass the backbone to improve cost, performance, or security.

Backplane - High-speed communications line to which individual components are connected.

Backward Explicit Congestion Notification (BECN) - A Resource Management cell type generated by the network or the destination, indicating congestion or approaching congestion for traffic flowing in the direction opposite that of the BECN cell.

Bandwidth - usually identifies the capacity or amount of data that can be sent through a given circuit; may be user-specified in a PVC.

Baud - unit of signalling speed, equal to the number of discrete conditions or signal events per second. If each signal event represents only one bit, the baud rate is the same as bps; if each signal event represents more than one bit (such as a dibit), the baud rate is smaller than bps.

Bayonet-Neill-Concelman (BNC) - a bayonet-locking connector used to terminate coaxial cables. BNC is also referred to as Bayonet Network Connector.

Bipolar 8 Zero Substitution (B8ZS) - a technique used to satisfy the ones density requirements of digital T-carrier facilities in the public network while allowing 64 Kbps clear channel data. Strings of eight consecutive zeroes are replaced by an eight-bit code representing two intentional bipolar pulse code violations (000V10V1).

Bipolar Violation (BPV) - an error event on a line in which the normal pattern of alternating high (one) and low (zero) signals is disrupted. A bipolar violation is noted when two high signals occur without an intervening low signal, or vice versa.

B-ISDN Inter-Carrier Interface (B-ICI) - An ATM Forum defined specification for the interface between public ATM networks to support user services across multiple public carriers.

Bit Error Rate (BER) - A measure of transmission quality, generally shown as a negative exponent, (e.g., 10^{-7} which means 1 out of 10^{7} bits [1 out of 10,000,000 bits] are in error).

Bit Interleaved Parity (BIP) - an error-detection technique in which character bit patterns are forced into parity, so that the total number of one bits is always odd or always even. This is accomplished by the addition of a one or zero bit to each byte, as the byte is transmitted; at the other end of the transmission, the receiving device verifies the parity (odd or even) and the accuracy of the transmission.

Bit Robbing - The use of the least significant bit per channel in every sixth frame for signaling.

Bit Stuffing - A process in bit-oriented protocols where a zero is inserted into a string of ones by the sender to prevent the receiver from interpreting valid user data (the string of ones) as control characters (a Flag character for instance).

Border Gateway Protocol (BGP) - used by gateways in an internet connecting autonomous networks. It is derived from experiences learned using the EGP.

bps - bits per second

Bridge - a device that expands a Local Area Network by forwarding frames between data link layers associated with two separate cables, usually carrying a common protocol. Bridges can usually be made to filter certain packets (to forward only certain traffic).

Bridge Protocol Data Unit (BPDU) - A message type used by bridges to exchange management and control information.

Broadband - a service or system requiring transmission channels capable of supporting rates greater than the Integrated Services Digital Network (ISDN) primary rate.

Broadband Access - an ISDN access capable of supporting one or more broadband services.

Broadband Connection Oriented Bearer (BCOB) - Information in the SETUP message that indicates the type of service requested by the calling user.

BCOB-A (Bearer Class A) - Indicated by ATM end user in SETUP message for connection-oriented, constant bit rate service. The network may perform internetworking based on AAL information element (IE).

BCOB-C (Bearer Class C) - Indicated by ATM end user in SETUP message for connection-oriented, variable bit rate service. The network may perform internetworking based on AAL information element (IE).

BCOB-X (Bearer Class X) - Indicated by ATM end user in SETUP message for ATM transport service where AAL, traffic type and timing requirements are transparent to the network.

Broadband Integrated Services Digital Network (B-ISDN) - a common digital network suitable for voice, video, and high-speed data services running at rates beginning at 155 Mbps.

Broadband ISDN User's Part (B-ISUP) - A protocol used to establish, maintain and release broadband switched network connections across an SS7 / ATM network.

Broadband Terminal Equipment (B-TE) - An equipment category for B-ISDN which includes terminal adapters and terminals.

Broadcast - Data transmission to all addresses or functions.

Broadcast and Unknown Server (BUS) - in an emulated LAN, the BUS is responsible for accepting broadcast, multicast, and unknown unicast packets from the LECs to the broadcast MAC address (FFFFFFFFFFFF) via dedicated point-to-point connections, and forwarding the packets to all of the members of the ELAN using a single point-to-multipoint connection.

Brouter (bridging/router) - a device that routes some protocols and bridges others based on configuration information.

Buffer - A data storage medium used to compensate of a difference in rate of data flow or time of occurrence of events when transmitting data from one device to another.

Building Integrated Timing Supply (BITS) - a master timing supply for an entire building, which is a master clock and its ancillary equipment. The BITS supplies DS1 and / or composite clock timing references for synchronization to all other clocks and timing sources in that building.

Bursty Errored Seconds (BES) - a BES contains more than 1 and fewer than 320 path coding violation error events, and no severely errored frame or AIS defects. Controlled slips are not included in determining BESs.

Bursty Second - a second during which there were at least the set number of BES threshold event errors but fewer than the set number of SES threshold event errors.

Byte - A computer-readable group of bits (normally 8 bits in length).

Call - an association between two or more users or between a user and a network entity that is established by the use of network capabilities. This association may have zero or more connections.

Carrier - a company, such as any of the "baby Bell" companies, that provide network communications services, either within a local area or between local areas.

Carrier Group Alarm (CGA) - A service alarm generated by a channel bank when an out-of-frame (OOF) condition exists for some predetermined length of time (generally 300 milliseconds to 2.5 seconds). The alarm causes the calls using a trunk to be dropped and trunk conditioning to be applied.

Carrier Identification Parameter (CIP) - A 3 or 4 digit code in the initial address message identifying the carrier to be used for the connection.

cchan - a FORE program that manages virtual channels on a *ForeRunner* switch running `asxd`.

Cell - an ATM Layer protocol data unit (PDU). The basic unit of information transported in ATM technology, each 53-byte cell contains a 5-byte header and a 48-byte payload.

Cell Delay Variation (CDV) - a quantification of cell clumping for a connection. The cell clumping CDV (yk) is defined as the difference between a cell's expected reference arrival time (ck) and its actual arrival time (ak). The expected reference arrival time (ck) of cell k of a specific connection is max. T is the reciprocal of the negotiated peak cell rate.

Cell Delineation - the protocol for recognizing the beginning and end of ATM cells within the raw serial bit stream.

Cell Header - ATM Layer protocol control information.

Cell Loss Priority (CLP) - the last bit of byte four in an ATM cell header; indicates the eligibility of the cell for discard by the network under congested conditions. If the bit is set to 1, the cell may be discarded by the network depending on traffic conditions.

Cell Loss Ratio - In a network, cell loss ratio is (1-x/y), where y is the number of cells that arrive in an interval at an ingress of the network; and x is the number of these y cells that leave at the egress of the network element.

Cell Loss Ratio (CLR) - CLR is a negotiated QoS parameter and acceptable values are network specific. The objective is to minimize CLR provided the end-system adapts the traffic to the changing ATM layer transfer characteristics. The Cell Loss Ratio is defined for a connection as: Lost Cells/Total Transmitted Cells. The CLR parameter is the value of CLR that the network agrees to offer as an objective over the lifetime of the connection. It is expressed as an order of magnitude, having a range of 10-1 to 10-15 and unspecified.

Cell Misinsertion Rate (CMR) - the ratio of cells received at an endpoint that were not originally transmitted by the source end in relation to the total number of cells properly transmitted.

Cell Rate Adaptation (CRA) - a function performed by a protocol module in which empty cells (known as unassigned cells) are added to the output stream. This is because there always must be a fixed number of cells in the output direction; when there are not enough cells to transmit, unassigned cells are added to the output data stream.

Cell Relay Service (CRS) - a carrier service which supports the receipt and transmission of ATM cells between end users in compliance with ATM standards and implementation specifications.

Cell Transfer Delay - the transit delay of an ATM cell successfully passed between two designated boundaries. See CTD.

Cell Transfer Delay (CTD) - This is defined as the elapsed time between a cell exit event at the measurement point 1 (e.g., at the source UNI) and the corresponding cell entry event at the measurement point 2 (e.g., the destination UNI) for a particular connection. The cell transfer delay between two measurement points is the sum of the total inter-ATM node transmission delay and the total ATM node processing delay.

Channel - A path or circuit along which information flows.

Channel Associated Signaling (CAS) - a form of circuit state signaling in which the circuit state is indicated by one or more bits of signaling status sent repetitively and associated with that specific circuit.

Channel Bank - A device that multiplexes many slow speed voice or data conversations onto high speed link and controls the flow.

Channel Service Unit (CSU) - An interface for digital leased lines which performs loopback testing and line conditioning.

Channelization - capability of transmitting independent signals together over a cable while still maintaining their separate identity for later separation.

Circuit - A communications link between points.

Circuit Emulation Service (CES) - The ATM Forum circuit emulation service interoperability specification specifies interoperability agreements for supporting Constant Bit Rate (CBR) traffic over ATM networks that comply with the other ATM Forum interoperability agreements. Specifically, this specification supports emulation of existing TDM circuits over ATM networks.

Classical IP (CLIP) - IP over ATM which conforms to RFC 1577.

Clear to Send (CTS) - and RS-232 modem interface control signal (sent from the modem to the DTE on pin 5) which indicates that the attached DTE may begin transmitting; issuance in response to the DTE's RTS.

Clocking - Regularly timed impulses.

Closed User Group - A subgroup of network users that can be its own entity; any member of the subgroup can only communicate with other members of that subgroup.

Coaxial Cable - Coax is a type of electrical communications medium used in the LAN environment. This cable consists of an outer conductor concentric to an inner conductor, separated from each other by insulating material, and covered by some protective outer material. This medium offers large bandwidth, supporting high data rates with high immunity to electrical interference and a low incidence of errors. Coax is subject to distance limitations and is relatively expensive and difficult to install.

Cold Start Trap - an SNMP trap which is sent after a power-cycle (see *trap*).

Collision - Overlapping transmissions that occur when two or more nodes on a LAN attempt to transmit at or about the same time.

Committed Information Rate (CIR) - CIR is the information transfer rate which a network offering Frame Relay Services (FRS) is committed to transfer under normal conditions. The rate is averaged over a minimum increment of time.

Common Channel Signaling (CCS) - A form signaling in which a group of circuits share a signaling channel. Refer to SS7.

Common Management Interface Protocol (CMIP) - An ITU-TSS standard for the message formats and procedures used to exchange management information in order to operate, administer maintain and provision a network.

Concatenation - The connection of transmission channels similar to a chain.

Concentrator - a communications device that offers the ability to concentrate many lower-speed channels into and out of one or more high-speed channels.

Configuration - The phase in which the LE Client discovers the LE Service.

Congestion Management - traffic management feature that helps ensure reasonable service for VBR connections in an ATM network, based on a priority, sustained cell rate (SCR), and peak cell rate (PCR). During times of congestion, bandwidth is reduced to the SCR, based on the priority of the connection.

Connection - the concatenation of ATM Layer links in order to provide an end-to-end information transfer capability to access points.

Connection Admission Control (CAC) - the procedure used to decide if a request for an ATM connection can be accepted based on the attributes of both the requested connection and the existing connections.

Connection Endpoint (CE) - a terminator at one end of a layer connection within a SAP.

Connection Endpoint Identifier (CEI) - an identifier of a CE that can be used to identify the connection at a SAP.

Connectionless Broadband Data Service (CBDS) - A connectionless service similar to Bellcore's SMDS defined by European Telecommunications Standards Institute (ETSI).

Connectionless Service - a type of service in which no pre-determined path or link has been established for transfer of information, supported by AAL 4.

Connectionless Service (CLS) - A service which allows the transfer of information among service subscribers without the need for end-to- end establishment procedures.

Connection-Oriented Service - a type of service in which information always traverses the same pre-established path or link between two points, supported by AAL 3.

Constant Bit Rate (CBR) - a type of traffic that requires a continuous, specific amount of bandwidth over the ATM network (e.g., digital information such as video and digitized voice).

Controlled Slip (CS) - a situation in which one frame's worth of data is either lost or replicated. A controlled slip typically occurs when the sending device and receiving device are not using the same clock.

Convergence Sublayer (CS) - a portion of the AAL. Data is passed first to the CS where it is divided into rational, fixed-length packets or PDUs (Protocol Data Units). For example, AAL 4 processes user data into blocks that are a maximum of 64 kbytes long.

Corresponding Entities - peer entities with a lower layer connection among them.

cpath - a FORE program used to manage virtual paths on a *ForeRunner* switch running asxd.

cport - a FORE program that monitors and changes the state of ports on a *ForeRunner* switch running asxd.

Cross Connection - a mapping between two channels or paths at a network device.

Customer Premise Equipment (CPE) - equipment that is on the customer side of the point of demarcation, as opposed to equipment that is on a carrier side. See also point of demarcation.

Cut Through - Establishment of a complete path for signaling and / or audio communications.

Cyclic Redundancy Check (CRC) - an error detection scheme in which a number is derived from the data that will be transmitted. By recalculating the CRC at the remote end and comparing it to the value originally transmitted, the receiving node can detect errors.

D3/D4 - Refers to compliance with AT&T TR (Technical Reference) 62411 definitions for coding, supervision, and alarm support. D3 / D4 compatibility ensures support of digital PBXes, M24 services, Megacom services, and Mode 3 D3 / D4 channel banks at DS-1 level.

D4 Channelization - refers to compliance with AT&T Technical Reference 62411 regarding DS1 frame layout (the sequential assignment of channels and time slot numbers within the DS1).

D4 Framed/Framing Format - in T1, a 193-bit frame format in which the 193rd bit is used for framing and signaling information (the frame / framing bit). To be considered in support of D4 Framing, a device must be able to synchronize and frame-up on the 193rd bit.

Data Communications Equipment (DCE) - a definition in the RS232C standard that describes the functions of the signals and the physical characteristics of an interface for a communication device such as a modem.

Data Country Code (DCC) - This specifies the country in which an address is registered. The codes are given in ISO 3166. The length of this field is two octets. The digits of the data country code are encoded in Binary Coded Decimal (BCD) syntax. The codes will be left justified and padded on the right with the hexadecimal value “F” to fill the two octets.

Data Link - Communications connection used to transmit data from a source to a destination.

Data Link Connection Identifier (DLCI) - connection identifier associated with frame relay packets that serves the same functions as, and translates directly to, the VPI / VCI on an ATM cell.

Data Link Layer - Layer 2 of the OSI model, responsible for encoding data and passing it to the physical medium. The IEEE divides this layer into the LLC (Logical Link Control) and MAC (Media Access Control) sublayers.

Data Set Ready (DSR) - an RS-232 modem interface control signal (sent from the modem to the DTE on pin 6) which indicates that the modem is connected to the telephone circuit. Usually a prerequisite to the DTE issuing RTS.

Data Terminal Equipment (DTE) - generally user devices, such as terminals and computers, that connect to data circuit-terminating equipment. They either generate or receive the data carried by the network.

Data Terminal Ready (DTR) - an RS232 modem interface control signal (sent from the DTE to the modem on pin 20) which indicates that the DTE is ready for data transmission and which requests that the modem be connected to the telephone circuit.

Datagram - a packet of information used in a connectionless network service that is routed to its destination using an address included in the datagram's header.

DECnet - Digital Equipment Corporation's proprietary LAN.

Defense Advanced Research Projects Agency (DARPA) - the US government agency that funded the ARPANET.

Demultiplexing - a function performed by a layer entity that identifies and separates SDUs from a single connection to more than one connection (see *multiplexing*).

Destination End Station (DES) - An ATM termination point which is the destination for ATM messages of a connection and is used as a reference point for ABR services. See SES.

Digital Access and Cross-Connect System (DACS) - Digital switching system for routing T1 lines, and DS-0 portions of lines, among multiple T1 ports.

Digital Cross-connect System (DCS) - an electronic patch panel used to route digital signals in a central office.

Digital Standard n (0, 1, 1C, 2, and 3) (DSn) - a method defining the rate and format of digital hierarchy, with asynchronous data rates defined as follows:

DS0	64kb / s	1 voice channel
DS1	1.544Mb / s	24 DS0s
DS1C	3.152 Mb / s	2 DS1s
DS2	6.312 Mb / s	4 DS1s
DS3	44.736 Mb / s	28 DS1s

Synchronous data rates (SONET) are defined as:

STS-1 / OC-1	51.84 Mb / s	28 DS1s or 1 DS3
STS-3 / OC-3	155.52 Mb / s	3 STS-1s byte interleaved
STS-3c / OC-3c	155.52 Mb / s	Concatenated, indivisible payload
STS-12 / OC-12	622.08 Mb / s	12 STS-1s, 4 STS-3cs, or any mixture
STS-12c / OC-12c	622.08 Mb / s	Concatenated, indivisible payload
STS-48 / OC-48	2488.32 Mb / s	48 STS-1s, 16 STS-3cs, or any mixture

DIP (Dual In-line Package) Switch - a device that has two parallel rows of contacts that let the user switch electrical current through a pair of those contacts to on or off. They are used to reconfigure components and peripherals.

Domain Name Server - a computer that converts names to their corresponding Internet numbers. It allows users to telnet or FTP to the name instead of the number.

Domain Naming System (DNS) - the distributed name and address mechanism used in the Internet.

Duplex - Two way communication.

DXI - a generic phrase used in the full names of several protocols, all commonly used to allow a pair of DCE and DTE devices to share the implementation of a particular WAN protocol. The protocols define the packet formats used to transport data between DCE and DTE devices.

DXI Frame Address (DFA) - a connection identifier associated with ATM DXI packets that serves the same functions as, and translates directly to, the VPI/VCI on an ATM cell.

Dynamic Allocation - A technique in which the resources assigned for program execution are determined by criteria applied at the moment of need.

E.164 - A public network addressing standard utilizing up to a maximum of 15 digits. ATM uses E.164 addressing for public network addressing.

E1 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 2.048 Mbps. E1 lines can be leased for private use from common carriers.

E3 - Wide-area digital transmission scheme used predominantly in Europe that carries data at a rate of 34.368 Mbps. E3 lines can be leased for private use from common carriers.

Edge Device - A physical device which is capable of forwarding packets between legacy interworking interfaces (e.g., Ethernet, Token Ring, etc.) and ATM interfaces based on data-link and network layer information but which does not participate in the running of any network layer routing protocol. An Edge Device obtains forwarding descriptions using the route distribution protocol.

elarp - a FORE program that shows and manipulates MAC and ATM address mappings for LAN Emulation Clients (LECs).

elconfig - a FORE program that shows and modifies LEC configuration. Lets the user set the NSAP address of the LAN Emulation Configuration Server, display the list of Emulated LANs configured in the LECS for this host, display the list of ELANs locally configured along with the membership state of each, and locally administer ELAN membership.

Electrically Erasable Programmable Read Only Memory (EEPROM) - an EPROM that can be cleared with electrical signals rather than the traditional ultraviolet light.

Electromagnetic Interference (EMI) - signals generated and radiated by an electronic device that cause interference with radio communications, among other effects.

Electronics Industries Association (EIA) - a USA trade organization that issues its own standards and contributes to ANSI; developed RS-232. Membership includes USA manufacturers.

Embedded SNMP Agent - an SNMP agent can come in two forms: embedded or proxy. An embedded SNMP agent is integrated into the physical hardware and software of the unit.

Emulated Local Area Network (ELAN) - A logical network initiated by using the mechanisms defined by LAN Emulation. This could include ATM and legacy attached end stations.

End System (ES) - a system where an ATM connection is terminated or initiated (an originating end system initiates the connection; a terminating end system terminates the connection).

End System Identifier (ESI) - This identifier distinguishes multiple nodes at the same level in case the lower level peer group is partitioned.

End-to-End Connection - when used in reference to an ATM network, a connection that travels through an ATM network, passing through various ATM devices and with endpoints at the termination of the ATM network.

Enterprise - Terminology generally referring to customers with multiple, non-contiguous geographic locations.

Equalization (EQL) - the process of compensating for line distortions.

Erasable Programmable Read Only Memory (EPROM) - A PROM which may be erased and rewritten to perform new or different functions (normally done with a PROM burner).

Errored Second (ES) - a second during which at least one code violation occurred.

Ethernet - a 10-Mbps, coaxial standard for LANs in which all nodes connect to the cable where they contend for access.

Excessive Zeroes (EXZ) Error Event - An Excessive Zeroes error event for an AMI-coded signal is the occurrence of more than fifteen contiguous zeroes. For a B8ZS coded signal, the defect occurs when more than seven contiguous zeroes are detected.

Explicit Forward Congestion Indication (EFCI) - the second bit of the payload type field in the header of an ATM cell, the EFCI bit indicates network congestion to receiving hosts. On a congested switch, the EFCI bit is set to “1” by the transmitting network module when a certain number of cells have accumulated in the network module's shared memory buffer. When a cell is received that has its EFCI bit set to “1,” the receiving host notifies the sending host, which should then reduce its transmission rate.

Explicit Rate (ER) - The Explicit Rate is an RM-cell field used to limit the source ACR to a specific value. It is initially set by the source to a requested rate (such as PCR). It may be subsequently reduced by any network element in the path to a value that the element can sustain. ER is formatted as a rate.

Extended Industry Standard Architecture (EISA) - bus architecture for desktop computers that provides a 32-bit data passage and maintains compatibility with the ISA or AT architecture.

Extended Super Frame (ESF) - a T1 framing format that utilizes the 193rd bit as a framing bit, but whose Superframe is made up of 24 frames instead of 12 as in D4 format. ESF also provides CRC error detection and maintenance data link functions.

Exterior Gateway Protocol (EGP) - used by gateways in an internet, connecting autonomous networks.

Fairness - related to Generic Flow Control, fairness is defined as meeting all of the agreed quality of service requirements by controlling the order of service for all active connections.

Far End Block Error (FEBE) - an error detected by extracting the 4-bit FEBE field from the path status byte (G1). The legal range for the 4-bit field is between 0000 and 1000, representing zero to eight errors. Any other value is interpreted as zero errors.

Far End Receive Failure (FERF) - a line error asserted when a 110 binary pattern is detected in bits 6, 7, 8 of the K2 byte for five consecutive frames. A line FERF is removed when any pattern other than 110 is detected in these bits for five consecutive frames.

Far-End - in a relationship between two devices in a circuit, the far-end device is the one that is remote.

Face Contact (FC) - Designation for fiber optic connector designed by Nippon Telegraph and Telephone which features a movable anti-rotation key allowing good repeatable performance despite numerous mating. Normally referred to as Fiber Connector, FC actually stands for Face Contact and sometimes linked with PC (Point Contact), designated as FC or FC-PC.

FCC Part 68 - The FCC rules regulating the direct connection of non-telephone company provided equipment to the public telephone network.

Federal Communications Commission (FCC) - a board of commissioners appointed by the President under the Communications Act of 1934, with the authority to regulate all interstate telecommunications originating in the United States, including transmission over phone lines.

Fiber Distributed Data Interface (FDDI) - high-speed data network that uses fiber-optic as the physical medium. Operates in similar manner to Ethernet or Token Ring, only faster.

File Transfer Protocol (FTP) - a TCP/IP protocol that lets a user on one computer access, and transfer data to and from, another computer over a network. ftp is usually the name of the program the user invokes to accomplish this task.

First-In, First-Out (FIFO) - method of coordinating the sequential flow of data through a buffer.

Flag - a bit pattern of six binary "1"s bounded by a binary "0" at each end (forms a 0111 1110 or Hex "7E"). It is used to mark the beginning and/or end of a frame.

Flow Control - The way in which information is controlled in a network to prevent loss of data when the receiving buffer is near its capacity.

***ForeThought* PNNI (FT-PNNI) -** a FORE Systems routing and signalling protocol that uses private ATM (NSAP) addresses; a precursor to ATM Forum PNNI (see PNNI).

Forward Error Correction (FEC) - A technique used by a receiver for correcting errors incurred in transmission over a communications channel without requiring retransmission of any information by the transmitter; typically involves a convolution of the transmitted bits and the appending of extra bits by both the receiver and transmitter using a common algorithm.

Forward Explicit Congestion Notification (FECN) - Bit set by a Frame Relay network to inform data terminal equipment (DTE) receiving the frame that congestion was experienced in the path from source to destination. DTE receiving frames with the FECN bit set can request that higher-level protocols take flow control action as appropriate.

Fractional T1 - the use of bandwidth in 64Kbps increments up to 1.544Mbps from a T1 facility.

Frame - a variable length group of data bits with a specific format containing flags at the beginning and end to provide demarcation.

Frame Check Sequence (FCS) - In bit-oriented protocols, a 16-bit field that contains transmission error checking information, usually appended to the end of the frame.

Frame Relay - a fast packet switching protocol based on the LAPD protocol of ISDN that performs routing and transfer with less overhead processing than X.25.

Frame Synchronization Error - an error in which one or more time slot framing bits are in error.

Frame-Based UNI (FUNI) - An ATM switch-based interface which accepts frame-based ATM traffic and converts it into cells.

Frame-Relay Service (FRS) - A connection oriented service that is capable of carrying up to 4096 bytes per frame.

Framing - a protocol that separates incoming bits into identifiable groups so that the receiving multiplexer recognizes the grouping.

Frequency Division Multiplexing (FDM) - a method of dividing an available frequency range into parts with each having enough bandwidth to carry one channel.

Gbps - gigabits per second (billion)

Generic Cell Rate Algorithm (GCRA) - an algorithm which is employed in traffic policing and is part of the user / network service contract. The GCRA is a scheduling algorithm which ensures that cells are marked as conforming when they arrive when expected or later than expected and non-conforming when they arrive sooner than expected.

Generic Connection Admission Control (GCAC) - This is a process to determine if a link has potentially enough resources to support a connection.

Generic Flow Control (GFC) - the first four bits of the first byte in an ATM cell header. Used to control the flow of traffic across the User-to-Network Interface (UNI), and thus into the network. Exact mechanisms for flow control are still under investigation and no explicit definition for this field exists at this time. (This field is used only at the UNI; for NNI-NNI use (between network nodes), these four bits provide additional network address capacity, and are appended to the VPI field.)

GIO - a proprietary bus architecture used in certain Silicon Graphics, Inc. workstations.

Header - protocol control information located at the beginning of a protocol data unit.

Header Error Control (HEC) - a CRC code located in the last byte of an ATM cell header that is used for checking cell header integrity only.

High Density Bipolar (HDB3) - A bipolar coding method that does not allow more than 3 consecutive zeroes.

High Level Data Link Control (HDLC) - An ITU-TSS link layer protocol standard for point-to-point and multi-point communications.

High Performance Parallel Interface (HIPPI) - ANSI standard that extends the computer bus over fairly short distances at speeds of 800 and 1600 Mbps.

High-Speed Serial Interface (HSSI) - a serial communications connection that operates at speeds of up to 1.544 Mbps.

Host - In a network, the primary or controlling computer in a multiple computer installation.

HPUX - the Hewlett-Packard version of UNIX.

Hub - a device that connects several other devices, usually in a star topology.

I/O Module - FORE's interface cards for the LAX-20 LAN Access Switch, designed to connect Ethernet, Token Ring, and FDDI LANs to *ForeRunner* ATM networks.

Institute of Electrical and Electronics Engineers (IEEE) - the world's largest technical professional society. Based in the U.S., the IEEE sponsors technical conferences, symposia & local meetings worldwide, publishes nearly 25% of the world's technical papers in electrical, electronics & computer engineering, provides educational programs for members, and promotes standardization.

IEEE 802 - Standards for the interconnection of LAN computer equipment. Deals with the Data Link Layers of the ISO Reference Model for OSI.
IEEE 802.1 - Defines the high-level network interfaces such as architecture, internetworking and network management.
IEEE 802.2 - Defines the Logical Link Control interface between the Data Link and Network Layers.
IEEE 802.3 - Defines CSMA / CD (Ethernet).
IEEE 802.4 - Defines the token-passing bus.
IEEE 802.5 - Defines the Token Ring access methodology. This standard incorporates IBM's Token Ring specifications.
IEEE 802.6 - Defines Metropolitan Area Networks.
IEEE 802.7 - The broadband technical advisory group.
IEEE 802.8 - The fiber optics technical advisory group.
IEEE 802.9 - Defines integrated data and voice networks.

Integrated Services Digital Network (ISDN) - an emerging technology that is beginning to be offered by the telephone carriers of the world. ISDN combines voice and digital network services into a single medium or wire.

Interexchange Carriers (IXC) - Long-distance communications companies that provide service between Local Access Transport Areas (LATAs).

Interface Data - the unit of information transferred to / from the upper layer in a single interaction across a SAP. Each Interface Data Unit (IDU) controls interface information and may also contain the whole or part of the SDU.

Interface Data Unit (IDU) - The unit of information transferred to / from the upper layer in a single interaction across the SAP. Each IDU contains interface control information and may also contain the whole or part of the SDU.

Interim Local Management Interface (ILMI) - the standard that specifies the use of the Simple Network Management Protocol (SNMP) and an ATM management information base (MIB) to provide network status and configuration information.

Intermediate System (IS) - a system that provides forwarding functions or relaying functions or both for a specific ATM connection. OAM cells may be generated and received.

International Standards Organization (ISO) - a voluntary, non treaty organization founded in 1946 that is responsible for creating international standards in many areas, including computers and communications.

International Telephone and Telegraph Consultative Committee (CCITT) - the international standards body for telecommunications.

Internet - (note the capital "I") the largest internet in the world including large national backbone nets and many regional and local networks worldwide. The Internet uses the TCP/IP suite. Networks with only e-mail connectivity are not considered on the Internet.

internet - while an internet is a network, the term "internet" is usually used to refer to a collection of networks interconnected with routers.

Internet Addresses - the numbers used to identify hosts on an internet network. Internet host numbers are divided into two parts; the first is the network number and the second, or local, part is a host number on that particular network. There are also three classes of networks in the Internet, based on the number of hosts on a given network. Large networks are classified as Class A, having addresses in the range 1-126 and having a maximum of 16,387,064 hosts. Medium networks are classified as Class B, with addresses in the range 128-191 and with a maximum of 64,516 hosts. Small networks are classified as Class C, having 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.

In a Class B network, the first two numbers are the network, the last two are the local host address.

In a Class C network, the first three numbers are the network address, the last number is the local host address.

The following table summarizes the classes and sizes:

Class	First #	Max# Hosts
A	1-126	16,387,064
B	129-191	64,516
C	192-223	254

Network mask values are used to identify the network portion and the host portion of the address. Default network masks are as follows:

Class A - 255.0.0.0

Class B - 255.255.0.0

Class C - 255.255.255.0

Subnet masking is used when a portion of the host ID is used to identify a subnetwork. For example, if a portion of a Class B network address is used for a subnetwork, the mask could be set as 255.255.255.0. This would allow the third byte to be used as a subnetwork address. All hosts on the network would still use the IP address to get on the Internet.

Internet Control Message Protocol (ICMP) - the protocol that handles errors and control messages at the IP layer. ICMP is actually a part of the IP protocol layer. It can generate error messages, test packets, and informational messages related to IP.

Internet Engineering Task Force (IETF) - a large, open, international community of network designers, operators, vendors and researchers whose purpose is to coordinate the operation, management and evolution of the Internet to resolve short- and mid-range protocol and architectural issues.

Internet Protocol (IP) - a connectionless, best-effort packet switching protocol that offers a common layer over dissimilar networks.

Internetwork Packet Exchange (IPX) Protocol - a NetWare protocol similar to the Xerox Network Systems (XNS) protocol that provides datagram delivery of messages.

Interoperability - The ability of software and hardware on multiple machines, from multiple vendors, to communicate.

Interworking Function (IWF) - provides a means for two different technologies to interoperate.

IP Address - a unique 32-bit integer used to identify a device in an IP network. You will most commonly see IP addresses written in "dot" notation (e.g., 192.228.32.14).

IP Netmask - a 32-bit pattern 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. Netmasks are useful for sub-dividing IP networks. IP netmasks are written in "dot" notation (e.g., 255.255.0.0).

ISA Bus - a bus standard developed by IBM for expansion cards in the first IBM PC. The original bus supported a data path only 8 bits wide. IBM subsequently developed a 16-bit version for its AT class computers. The 16-bit AT ISA bus supports both 8- and 16-bit cards. The 8-bit bus is commonly called the PC/XT bus, and the 16-bit bus is called the AT bus.

Isochronous - signals carrying embedded timing information or signals that are dependent on uniform timing; usually associated with voice and/or video transmission.

International Telecommunications Union Telecommunications (ITU-T) - an international body of member countries whose task is to define recommendations and standards relating to the international telecommunications industry. The fundamental standards for ATM have been defined and published by the ITU-T (Previously CCITT).

J2 - Wide-area digital transmission scheme used predominantly in Japan that carries data at a rate of 6.312 Mbps.

Jitter - analog communication line distortion caused by variations of a signal from its reference timing position.

Joint Photographic Experts Group (JPEG) - An ISO Standards group that defines how to compress still pictures.

Jumper - a patch cable or wire used to establish a circuit, often temporarily, for testing or diagnostics; also, the devices, shorting blocks, used to connect adjacent exposed pins on a printed circuit board that control the functionality of the card.

Kbps - kilobits per second (thousand)

LAN Access Concentrator - a LAN access device that allows a shared transmission medium to accommodate more data sources than there are channels currently available within the transmission medium.

LAN Emulation Address Resolution Protocol (LE_ARP) - A message issued by a LE client to solicit the ATM address of another function.

LAN Emulation Client (LEC) - the component in an end system that performs data forwarding, address resolution, and other control functions when communicating with other components within an ELAN.

LAN Emulation Configuration Server (LECS) - the LECS is responsible for the initial configuration of LECs. It provides information about available ELANs that a LEC may join, together with the addresses of the LES and BUS associated with each ELAN.

LAN Emulation Server (LES) - the LES implements the control coordination function for an ELAN by registering and resolving MAC addresses to ATM addresses.

LAN Emulation (LANE) - technology that allows an ATM network to function as a LAN backbone. The ATM network must provide multicast and broadcast support, address mapping (MAC-to-ATM), SVC management, and a usable packet format. LANE also defines Ethernet and Token Ring ELANs.

lane - a program that provides control over the execution of the LAN Emulation Server (LES), Broadcast / Unknown Server (BUS), and LAN Emulation Configuration Server (LECS) on the local host.

Latency - The time interval between a network station seeking access to a transmission channel and that access being granted or received.

Layer Entity - an active layer within an element.

Layer Function - a part of the activity of the layer entities.

Layer Service - a capability of a layer and the layers beneath it that is provided to the upper layer entities at the boundary between that layer and the next higher layer.

Layer User Data - the information transferred between corresponding entities on behalf of the upper layer or layer management entities for which they are providing services.

le - a FORE program that implements both the LAN Emulation Server (LES) and the Broadcast / Unknown Server (BUS).

Leaky Bucket - informal cell policing term for the Generic Cell Rate Algorithm which in effect receives cells into a bucket and leaks them out at the specified or contracted rate (i.e., PCR).

Least Significant Bit (LSB) - lowest order bit in the binary representation of a numerical value.

lecs - a FORE program that implements the assignment of individual LECs to different emulated LANs.

leq - a FORE program that provides information about an ELAN. This information is obtained from the LES, and includes MAC addresses registered on the ELAN together with their corresponding ATM addresses.

Line Build Out (LBO) - Because T1 circuits require the last span to lose 15-22.5 dB, a selectable output attenuation is generally required of DTE equipment (typical selections include 0.0, 7.5 and 15 dB of loss at 772 KHz).

Line Code Violations (LCV) - Error Event. A Line Coding Violation (LCV) is the occurrence of either a Bipolar Violation (BPV) or Excessive Zeroes (EXZ) Error Event.

Link - An entity that defines a topological relationship (including available transport capacity) between two nodes in different subnetworks. Multiple links may exist between a pair of subnetworks. Synonymous with logical link.

Link Access Procedure, Balanced (LAPB) - Data link protocol in the X.25 protocol stack. LAPB is a bit-oriented protocol derived from HDLC. See also HDLC and X.25.

Link Down Trap - an SNMP trap, sent when an interface changes from a normal state to an error state, or is disconnected.

Link Layer - layer in the OSI model regarding transmission of data between network nodes.

Link Up Trap - an SNMP trap, sent when an interface changes from an error condition to a normal state.

Load Sharing - Two or more computers in a system that share the load during peak hours. During periods of non peak hours, one computer can manage the entire load with the other acting as a backup.

Local Access and Transport Area (LATA) - Geographic boundaries of the local telephone network, specified by the FCC, in which a single LEC may perform its operations. Communications outside or between LATAs are provided by IXCs.

Local Area Network (LAN) - a data network intended to serve an area of only a few square kilometers or less. Because the network is known to cover only a small area, optimizations can be made in the network signal protocols that permit higher data rates.

Logical Link Control (LLC) - protocol developed by the IEEE 802 committee for data-link-layer transmission control; the upper sublayer of the IEEE Layer 2 (OSI) protocol that complements the MAC protocol; IEEE standard 802.2; includes end-system addressing and error checking.

Loopback - a troubleshooting technique that returns a transmitted signal to its source so that the signal can be analyzed for errors. Typically, a loopback is set at various points in a line until the section of the line that is causing the problem is discovered.

looptest - program that tests an interface for basic cell reception and transmission functionality, usually used for diagnostic purposes to determine if an interface is functioning properly.

Loss Of Frame (LOF) - a type of transmission error that may occur in wide-area carrier lines.

Loss Of Pointer (LOP) - a type of transmission error that may occur in wide-area carrier lines.

Loss Of Signal (LOS) - a type of transmission error that may occur in wide-area carrier lines, or a condition declared when the DTE senses a loss of a DS1 signal from the CPE for more the 150 milliseconds (the DTE generally responds with an all ones “Blue or AIS” signal).

Management Information Base (MIB) - the set of parameters that an SNMP management station can query or set in the SNMP agent of a networked device (e.g., router).

Maximum Burst Size (MBS) - the Burst Tolerance (BT) is conveyed through the MBS which is coded as a number of cells. The BT together with the SCR and the GCRA determine the MBS that may be transmitted at the peak rate and still be in conformance with the GCRA.

Maximum Burst Tolerance - the largest burst of data that a network device is guaranteed to handle without discarding cells or packets. Bursts of data larger than the maximum burst size may be subject to discard.

Maximum Cell Delay Variance (MCDV) - This is the maximum two-point CDV objective across a link or node for the specified service category.

Maximum Cell Loss Ratio (MCLR) - This is the maximum ratio of the number of cells that do not make it across the link or node to the total number of cells arriving at the link or node.

Maximum Cell Transfer Delay (MCTD) - This is the sum of the fixed delay component across the link or node and MCDV.

Maximum Transmission Unit (MTU) - the largest unit of data that can be sent over a type of physical medium.

Mbps - megabits per second (million)

Media Access Control (MAC) - a media-specific access control protocol within IEEE 802 specifications; currently includes variations for Token Ring, token bus, and CSMA/CD; the lower sublayer of the IEEE’s link layer (OSI), which complements the Logical Link Control (LLC).

Media Attachment Unit (MAU) - device used in Ethernet and IEEE 802.3 networks that provides the interface between the AUI port of a station and the common medium of the Ethernet. The MAU, which can be built into a station or can be a separate device, performs physical layer functions including conversion of the digital data from the Ethernet interface, collision detection, and injection of bits onto the network.

Media Interface Connector (MIC) - fiber optic connector that joins fiber to the FDDI controller.

Message Identifier (MID) - message identifier used to associate ATM cells that carry segments from the same higher layer packet.

Metasignalling - an ATM Layer Management (LM) process that manages different types of signalling and possibly semipermanent virtual channels (VCs), including the assignment, removal, and checking of VCs.

Metasignalling VCs - the standardized VCs that convey metasignalling information across a User-to-Network Interface (UNI).

Metropolitan Area Network (MAN) - network designed to carry data over an area larger than a campus such as an entire city and its outlying area.

MicroChannel - a proprietary 16- or 32-bit bus developed by IBM for its PS/2 computers' internal expansion cards; also offered by others.

Minimum Cell Rate (MCR) - parameter defined by the ATM Forum for ATM traffic management, defined only for ABR transmissions and specifying the minimum value for the ACR.

Most Significant Bit (MSB) - highest order bit in the binary representation of a numerical value.

Motion Picture Experts Group (MPEG) - ISO group dealing with video and audio compression techniques and mechanisms for multiplexing and synchronizing various media streams.

MPOA Client - A device which implements the client side of one or more of the MPOA protocols, (i.e., is a SCP client and/or an RDP client. An MPOA Client is either an Edge Device Functional Group (EDFG) or a Host Behavior Functional Group (HBFG).

MPOA Server - An MPOA Server is any one of an ICFG or RSFG.

MPOA Service Area - The collection of server functions and their clients. A collection of physical devices consisting of an MPOA server plus the set of clients served by that server.

MPOA Target - A set of protocol address, path attributes, (e.g., internetwork layer QoS, other information derivable from received packet) describing the intended destination and its path attributes that MPOA devices may use as lookup keys.

Mu-Law - The PCM coding and companding standard used in Japan and North America.

Multicasting - The ability to broadcast messages to one node or a select group of nodes.

Multi-homed - a device having both an ATM and another network connection, like Ethernet.

Multimode Fiber Optic Cable (MMF) - fiber optic cable in which the signal or light propagates in multiple modes or paths. Since these paths may have varying lengths, a transmitted pulse of light may be received at different times and smeared to the point that pulses may interfere with surrounding pulses. This may cause the signal to be difficult or impossible to receive. This pulse dispersion sometimes limits the distance over which a MMF link can operate.

Multiplexing - a function within a layer that interleaves the information from multiple connections into one connection (see demultiplexing).

Multipoint Access - user access in which more than one terminal equipment (TE) is supported by a single network termination.

Multipoint-to-Multipoint Connection - a collection of associated ATM VC or VP links, and their associated endpoint nodes, with the following properties:

1. All N nodes in the connection, called Endpoints, serve as a Root Node in a Point-to-Multipoint connection to all of the (N-1) remaining endpoints.

2. Each of the endpoints can send information directly to any other endpoint, but the receiving endpoint cannot distinguish which of the endpoints is sending information without additional (e.g., higher layer) information.

Multipoint-to-Point Connection - a Point-to-Multipoint Connection may have zero bandwidth from the Root Node to the Leaf Nodes, and non-zero return bandwidth from the Leaf Nodes to the Root Node. Such a connection is also known as a Multipoint-to-Point Connection.

Multiprotocol over ATM (MPOA) - An effort taking place in the ATM Forum to standardize protocols for the purpose of running multiple network layer protocols over ATM.

Narrowband Channel - sub-voicegrade channel with a speed range of 100 to 200 bps.

National TV Standards Committee (NTSC) - Started in the US in 1953 from a specification laid down by the National Television Standards Committee. It takes the B-Y and R-Y color difference signals, attenuates them to I and Q, then modulates them using double-sideband suppressed subcarrier at 3.58MHz. The carrier reference is sent to the receiver as a burst during the back porch. An industry group that defines how television signals are encoded and transmitted in the US. (See also PAL, SECAM for non-U.S. countries).

Near-End - in a relationship between two devices in a circuit, the near-end device is the one that is local.

Network Layer - Layer three In the OSI model, the layer that is responsible for routing data across the network.

Network Management Entity (NM) - body of software in a switching system that provides the ability to manage the PNNI protocol. NM interacts with the PNNI protocol through the MIB.

Network Management Layer (NML) - an abstraction of the functions provided by systems which manage network elements on a collective basis, providing end-to-end network monitoring.

Network Management Station (NMS) - system responsible for managing a network or portion of a network by talking to network management agents, which reside in the managed nodes.

Network Module - ATM port interface cards which may be individually added to or removed from any *ForeRunner* ATM switch to provide a diverse choice of connection alternatives.

Network Parameter Control (NPC) - Defined as the set of actions taken by the network to monitor and control traffic from the NNI. Its main purpose is to protect network resources from malicious as well as unintentional misbehavior which can affect the QoS of other already established connections by detecting violations of negotiated parameters and taking appropriate actions. Refer to UPC.

Network Redundancy - Duplicated network equipment and/or data which can provide a backup in case of network failures.

Network Service Access Point (NSAP) - OSI generic standard for a network address consisting of 20 octets. ATM has specified E.164 for public network addressing and the NSAP address structure for private network addresses.

Network-to-Network Interface or Network Node Interface (NNI) - the interface between two public network pieces of equipment.

Node - A computer or other device when considered as part of a network.

Non Return to Zero (NRZ) - a binary encoding scheme in which ones and zeroes are represented by opposite and alternating high and low voltages and where there is no return to a zero (reference) voltage between encoded bits.

Non Return to Zero Inverted (NRZI) - A binary encoding scheme that inverts the signal on a "1" and leaves the signal unchanged for a "0". (Also called transition encoding.)

Nonvolatile Storage - Memory storage that does not lose its contents when power is turned off.

NuBus - a high-speed bus used in Macintosh computers, structured so users can put a card into any slot on the board without creating conflict over the priority between those cards.

nx64K - This refers to a circuit bandwidth or speed provided by the aggregation of nx64 kbps channels (where n= integer > 1). The 64K or DS0 channel is the basic rate provided by the T Carrier systems.

Nyquist Theorem - In communications theory, a formula stating that two samples per cycle is sufficient to characterize a bandwidth limited analog signal; in other words, the sampling rate must be twice the highest frequency component of the signal (i.e., sample 4 KHz analog voice channels 8000 times per second).

Object Identifier (OID) - the address of a MIB variable.

Octet - a grouping of 8 bits; similar, but not identical to, a byte.

One's Density - The requirement for digital transmission lines in the public switched telephone network that eight consecutive "0"s cannot be in a digital data stream; exists because repeaters and clocking devices within the network will lose timing after receiving eight "0"s in a row; a number of techniques are used to insert a "1" after every seventh-consecutive "0" (see Bit Stuffing).

Open Shortest Path First (OSPF) Protocol - a routing algorithm for IP that incorporates least-cost, equal-cost, and load balancing.

Open Systems Interconnection (OSI) - the 7-layer suite of protocols designed by ISO committees to be the international standard computer network architecture.

OpenView - Hewlett-Packard's network management software.

Operation and Maintenance (OAM) Cell - a cell that contains ATM LM information. It does not form part of the upper layer information transfer.

Optical Carrier level-n (OC-n) - The optical counterpart of STS-n (the basic rate of 51.84 Mbps on which SONET is based is referred to as OC-1 or STS-1).

Organizationally Unique Identifier (OUI) - Part of RFC 1483. A three-octet field in the SubNetwork Attachment Point (SNAP) header, identifying an organization which administers the meaning of the following two octet Protocol Identifier (PID) field in the SNAP header. Together they identify a distinct routed or bridged protocol.

Out-of-Band Management - refers to switch configuration via the serial port or over Ethernet, not ATM.

Out-of-Frame (OOF) - a signal condition and alarm in which some or all framing bits are lost.

Packet - An arbitrary collection of data grouped and transmitted with its user identification over a shared facility.

Packet Assembler Disassembler (PAD) - interface device that buffers data sent to/from character mode devices, and assembles and disassembles the packets needed for X.25 operation.

Packet Internet Groper (ping) - a program used to test reachability of destinations by sending them an ICMP echo request and waiting for a reply.

Packet Level Protocol (PLP) - Network layer protocol in the X.25 protocol stack. Sometimes called X.25 Level 3 or X.25 Protocol.

Packet Switched Network (PSN) - a network designed to carry data in the form of packets. The packet and its format is internal to that network.

Packet Switching - a communications paradigm in which packets (messages) are individually routed between hosts with no previously established communications path.

Payload Scrambling - a technique that eliminates certain bit patterns that may occur within an ATM cell payload that could be misinterpreted by certain sensitive transmission equipment as an alarm condition.

Payload Type (PT) - bits 2...4 in the fourth byte of an ATM cell header. The PT indicates the type of information carried by the cell. At this time, values 0...3 are used to identify various types of user data, values 4 and 5 indicate management information, and values 6 and 7 are reserved for future use.

Peak Cell Rate - at the PHY Layer SAP of a point-to-point VCC, the Peak Cell Rate is the inverse of the minimum inter-arrival time T0 of the request to send an ATM-SDU.

Peak Cell Rate (PCR) - parameter defined by the ATM Forum for ATM traffic management. In CBR transmissions, PCR determines how often data samples are sent. In ABR transmissions, PCR determines the maximum value of the ACR.

Peer Entities - entities within the same layer.

Peripheral Component Interconnect (PCI) - a local-bus standard created by Intel.

Permanent Virtual Channel Connection (PVCC) - A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell. A Permanent VCC is one which is provisioned through some network management function and left up indefinitely.

Permanent Virtual Circuit (or Channel) (PVC) - a circuit or channel through an ATM network provisioned by a carrier between two endpoints; used for dedicated long-term information transport between locations.

Permanent Virtual Path Connection (PVPC) - A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell. A PVPC is one which is provisioned through some network management function and left up indefinitely.

Phase Alternate Line (PAL) - Largely a German/British development in the late 60s, used in the UK and much of Europe. The B-Y and R-Y signals are weighted to U and V, then modulated onto a double-sideband suppressed subcarrier at 4.43MHz. The V (R-Y) signal's phase is turned through 180 degrees on each alternate line. This gets rid of NTSC's hue changes with phase errors at the expense of de-saturation. The carrier reference is sent as a burst in the back porch. The phase of the burst is alternated every line to convey the phase switching of the V signal. The burst's average phase is -V. (see NTSC for U.S.).

Physical Layer (PHY) - the actual cards, wires, and/or fiber-optic cabling used to connect computers, routers, and switches.

Physical Layer Connection - an association established by the PHY between two or more ATM-entities. A PHY connection consists of the concatenation of PHY links in order to provide an end-to-end transfer capability to PHY SAPs.

Physical Layer Convergence Protocol (PLCP) - a framing protocol that runs on top of the T1 or E1 framing protocol.

Physical Medium (PM) - Refers to the actual physical interfaces. Several interfaces are defined including STS-1, STS-3c, STS-12c, STM-1, STM-4, DS1, E1, DS2, E3, DS3, E4, FDDI-based, Fiber Channel-based, and STP. These range in speeds from 1.544Mbps through 622.08 Mbps.

Physical Medium Dependent (PMD) - a sublayer concerned with the bit transfer between two network nodes. It deals with wave shapes, timing recovery, line coding, and electro-optic conversions for fiber based links.

Plesiochronous - two signals are plesiochronous if their corresponding significant instants occur at nominally the same rate, with variations in rate constrained to specified limits.

Point of Demarcation - the dividing line between a carrier and the customer premise that is governed by strict standards that define the characteristics of the equipment on each side of the demarcation. Equipment on one side of the point of demarcation is the responsibility of the customer. Equipment on the other side of the point of demarcation is the responsibility of the carrier.

Point-to-Multipoint Connection - a collection of associated ATM VC or VP links, with associated endpoint nodes, with the following properties:

1. One ATM link, called the Root Link, serves as the root in a simple tree topology. When the Root node sends information, all of the remaining nodes on the connection, called Leaf nodes, receive copies of the information.

2. Each of the Leaf Nodes on the connection can send information directly to the Root Node. The Root Node cannot distinguish which Leaf is sending information without additional (higher layer) information. (See the following note for Phase 1.)

3. The Leaf Nodes cannot communicate directly to each other with this connection type.

Note: Phase 1 signalling does not support traffic sent from a Leaf to the Root.

Point-to-Point Connection - a connection with only two endpoints.

Point-to-Point Protocol (PPP) - Provides a method for transmitting packets over serial point-to-point links.

Policing - the function that ensures that a network device does not accept traffic that exceeds the configured bandwidth of a connection.

Port Identifier - The identifier assigned by a logical node to represent the point of attachment of a link to that node.

Presentation Layer - Sixth layer of the OSI model, providing services to the application layer.

Primary Reference Source (PRS) - Equipment that provides a timing signal whose long-term accuracy is maintained at 1 x 10 -11 or better with verification to universal coordinated time (UTC) and whose timing signal is used as the basis of reference for the control of other clocks within a network.

Primitive - an abstract, implementation-independent interaction between a layer service user and a layer service provider.

Priority - the parameter of ATM connections that determines the order in which they are reduced from the peak cell rate to the sustained cell rate in times of congestion. Connections with lower priority (4 is low, 1 is high) are reduced first.

Private Branch Exchange (PBX) - a private phone system (switch) that connects to the public telephone network and offers in-house connectivity. To reach an outside line, the user must dial a digit like 8 or 9.

Private Network Node Interface or Private Network-to-Network Interface (PNNI) - a protocol that defines the interaction of private ATM switches or groups of private ATM switches

Programmable Read-Only Memory (PROM) - a chip-based information storage area that can be recorded by an operator but erased only through a physical process.

Protocol - a set of rules and formats (semantic and syntactic) that determines the communication behavior of layer entities in the performance of the layer functions.

Protocol Control Information - the information exchanged between corresponding entities using a lower layer connection to coordinate their joint operation.

Protocol Data Unit (PDU) - a unit of data specified in a layer protocol and consisting of protocol control information and layer user data.

Proxy - the process in which one system acts for another system to answer protocol requests.

Proxy Agent - an agent that queries on behalf of the manager, used to monitor objects that are not directly manageable.

Public Data Network (PDN) - a network designed primarily for data transmission and intended for sharing by many users from many organizations.

Pulse Code Modulation (PCM) - a modulation scheme that samples the information signals and transmits a series of coded pulses to represent the data.

Q.2931 - Derived from Q.93B, the narrowband ISDN signalling protocol, an ITU standard describing the signalling protocol to be used by switched virtual circuits on ATM LANs.

Quality of Service (QoS) - Quality of Service is defined on an end-to-end basis in terms of the following attributes of the end-to-end ATM connection:

Cell Loss Ratio
Cell Transfer Delay
Cell Delay Variation

Queuing Delay (QD) - refers to the delay imposed on a cell by its having to be buffered because of unavailability of resources to pass the cell onto the next network function or element. This buffering could be a result of oversubscription of a physical link, or due to a connection of higher priority or tighter service constraints getting the resource of the physical link.

Radio Frequency Interference (RFI) - the unintentional transmission of radio signals. Computer equipment and wiring can both generate and receive RFI.

Real-Time Clock - a clock that maintains the time of day, in contrast to a clock that is used to time the electrical pulses on a circuit.

Red Alarm - In T1, a red alarm is generated for a locally detected failure such as when a condition like OOF exists for 2.5 seconds, causing a CGA, (Carrier Group Alarm).

Reduced Instruction Set Computer (RISC) - a generic name for CPUs that use a simpler instruction set than more traditional designs.

Redundancy - In a data transmission, the fragments of characters and bits that can be eliminated with no loss of information.

Registration - The address registration function is the mechanism by which Clients provide address information to the LAN Emulation Server.

Relaying - a function of a layer by means of which a layer entity receives data from a corresponding entity and transmits it to another corresponding entity.

Request To Send (RTS) - an RS-232 modem interface signal (sent from the DTE to the modem on pin 4) which indicates that the DTE has data to transmit.

Requests For Comment (RFCs) - IETF documents suggesting protocols and policies of the Internet, inviting comments as to the quality and validity of those policies. These comments are collected and analyzed by the IETF in order to finalize Internet standards.

RFC1483 - Multiprotocol Encapsulation over ATM Adaptation Layer 5.
RFC1490 - Multiprotocol Interconnect over Frame Relay.
RFC1577 - Classical IP and ARP over ATM.
RFC1755 - ATM Signaling Support for IP over ATM.

Robbed-Bit Signaling - In T1, refers to the use of the least significant bit of every word of frames 6 and 12 (D4), or 6, 12, 18, and 24 (ESF) for signaling purposes.

Route Server - A physical device that runs one or more network layer routing protocols, and which uses a route query protocol in order to provide network layer routing forwarding descriptions to clients.

Router - a device that forwards traffic between networks or subnetworks based on network layer information.

Routing Domain (RD) - A group of topologically contiguous systems which are running one instance of routing.

Routing Information Protocol (RIP) - a distance vector-based protocol that provides a measure of distance, or hops, from a transmitting workstation to a receiving workstation.

Routing Protocol - A general term indicating a protocol run between routers and/or route servers in order to exchange information used to allow computation of routes. The result of the routing computation will be one or more forwarding descriptions.

SBus - hardware interface for add-in boards in later-version Sun 3 workstations.

Scalable Processor Architecture Reduced instruction set Computer (SPARC) - a powerful workstation similar to a reduced-instruction-set-computing (RISC) workstation.

Segment - a single ATM link or group of interconnected ATM links of an ATM connection.

Segmentation And Reassembly (SAR) - the SAR accepts PDUs from the CS and divides them into very small segments (44 bytes long). If the CS-PDU is less than 44 bytes, it is padded to 44 with zeroes. A two-byte header and trailer are added to this basic segment. The header identifies the message type (beginning, end, continuation, or single) and contains sequence numbering and message identification. The trailer gives the SAR-PDU payload length, exclusive of pad, and contains a CRC check to ensure the SAR-PDU integrity. The result is a 48-byte PDU that fits into the payload field of an ATM cell.

Selector (SEL) - A subfield carried in SETUP message part of ATM endpoint address Domain specific Part (DSP) defined by ISO 10589, not used for ATM network routing, used by ATM end systems only.

Semipermanent Connection - a connection established via a service order or via network management.

Serial Line IP (SLIP) - A protocol used to run IP over serial lines, such as telephone circuits or RS-232 cables, interconnecting two systems.

Service Access Point (SAP) - the point at which an entity of a layer provides services to its LM entity or to an entity of the next higher layer.

Service Data Unit (SDU) - a unit of interface information whose identity is preserved from one end of a layer connection to the other.

Service Specific Connection Oriented Protocol (SSCOP) - an adaptation layer protocol defined in ITU-T Specification: Q.2110.

Service Specific Convergence Sublayer (SSCS) - The portion of the convergence sublayer that is dependent upon the type of traffic that is being converted.

Session Layer - Layer 5 in the OSI model that is responsible for establishing and managing sessions between the application programs running in different nodes.

Severely Errored Seconds (SES) - a second during which more event errors have occurred than the SES threshold (normally 10-3).

Shaping Descriptor - *n* ordered pairs of GCRA parameters (I,L) used to define the negotiated traffic shape of an APP connection. The traffic shape refers to the load-balancing of a network, where load-balancing means configuring data flows to maximize network efficiency.

Shielded Pair - Two insulated wires in a cable wrapped with metallic braid or foil to prevent interference and provide noise free transmission.

Shielded Twisted Pair (STP) - two or more insulated wires, twisted together and then wrapped in a cable with metallic braid or foil to prevent interference and offer noise-free transmissions.

Signaling System No. 7 (SS7) - The SS7 protocol has been specified by ITU-T and is a protocol for interexchange signaling.

Simple and Efficient Adaptation Layer (SEAL) - also called AAL 5, this ATM adaptation layer assumes that higher layer processes will provide error recovery, thereby simplifying the SAR portion of the adaptation layer. Using this AAL type packs all 48 bytes of an ATM cell information field with data. It also assumes that only one message is crossing the UNI at a time. That is, multiple end-users at one location cannot interleave messages on the same VC, but must queue them for sequential transmission.

Simple Gateway Management Protocol (SGMP) - the predecessor to SNMP.

Simple Mail Transfer Protocol (SMTP) - the Internet electronic mail protocol used to transfer electronic mail between hosts.

Simple Network Management Protocol (SNMP) - the Internet standard protocol for managing nodes on an IP network.

Simple Protocol for ATM Network Signalling (SPANS) - FORE Systems' proprietary signalling protocol used for establishing SVCs between FORE Systems equipment.

Single Mode Fiber (SMF) - Fiber optic cable in which the signal or light propagates in a single mode or path. Since all light follows the same path or travels the same distance, a transmitted pulse is not dispersed and does not interfere with adjacent pulses. SMF fibers can support longer distances and are limited mainly by the amount of attenuation. Refer to MMF.

Small Computer Systems Interface (SCSI) - a standard for a controller bus that connects hardware devices to their controllers on a computer bus, typically used in small systems.

Smart PVC (SPVC) - a generic term for any communications medium which is permanently provisioned at the end points, but switched in the middle. In ATM, there are two kinds of SPVCs: smart permanent virtual path connections (SPVPCs) and smart permanent virtual channel connections (SPVCCs).

snmpd - an SMNP agent for a given adapter card.

Source - Part of communications system which transmits information.

Source Address (SA) - The address from which the message or data originated.

Source MAC Address (SA) - A six octet value uniquely identifying an end point and which is sent in an IEEE LAN frame header to indicate source of frame.

Source Traffic Descriptor - a set of traffic parameters belonging to the ATM Traffic Descriptor used during the connection set-up to capture the intrinsic traffic characteristics of the connection requested by the source.

Spanning Tree Protocol - provides loop-free topology in a network environment where there are redundant paths.

Static Route - a route that is entered manually into the routing table.

Statistical Multiplexing - a technique for allowing multiple channels and paths to share the same link, typified by the ability to give the bandwidth of a temporarily idle channel to another channel.

Stick and Click (SC) - Designation for an Optical Connector featuring a 2.5 mm physically contacting ferrule with a push-pull mating design. Commonly referred to as Structured Cabling, Structured Connectors or Stick and Click

Stick and Turn (ST) - A fiber-optic connector designed by AT&T which uses the bayonet style coupling rather than screw-on as the SMA uses. The ST is generally considered the eventual replacement for the SMA type connector.

Store-and-Forward - the technique of receiving a message, storing it until the proper outgoing line is available, then retransmitting it, with no direct connection between incoming and outgoing lines.

Straight Tip (ST) - see *Stick and Turn*.

Structured Cabling (SC) - see *Stick and Click.*

Structured Connectors (SC) - see *Stick and Click*.

Sublayer - a logical subdivision of a layer.

SubNetwork Access Protocol (SNAP) - a specially reserved variant of IEEE 802.2 encoding SNAP indicates to look further into the packet where it will fine a Type field.

Subscriber Network Interface (SNI) - the interface between an SMDS end user's CPE and the network directly serving the end user, supported by either a DS1 or DS3 access arrangement.

Super Frame (SF) - a term used to describe the repeating 12 D4 frame format that composes a standard (non-ESF) T1 service.

Super User - a login ID that allows unlimited access to the full range of a device's functionality, including especially the ability to reconfigure the device and set passwords.

Sustainable Cell Rate (SCR) - ATM Forum parameter defined for traffic management. For VBR connections, SCR determines the long-term average cell rate that can be transmitted.

Sustained Information Rate (SIR) - In ATM this refers to the long-term average data transmission rate across the User-to-Network Interface. In SMDS this refers to the committed information rate (similar to CIR for Frame Relay Service).

Switch - Equipment used to interconnect lines and trunks.

Switched Connection - A connection established via signaling.

Switched Multimegabit Data Service (SMDS) - a high-speed, datagram-based, public data network service expected to be widely used by telephone companies in their data networks.

Switched Virtual Channel Connection (SVCC) - A Switched VCC is one which is established and taken down dynamically through control signaling. A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell.

Switched Virtual Circuit (or Channel) (SVC) - a channel established on demand by network signalling, used for information transport between two locations and lasting only for the duration of the transfer; the datacom equivalent of a dialed telephone call.

Switched Virtual Path Connection (SVPC) - a connection which is established and taken down dynamically through control signaling. A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell.

Switching System - A set of one or more systems that act together and appear as a single switch for the purposes of PNNI routing.

Symmetric Connection - a connection with the same bandwidth specified for both directions.

Synchronous - signals that are sourced from the same timing reference and hence are identical in frequency.

Synchronous Data Link Control (SDLC) - IBM's data link protocol used in SNA networks.

Synchronous Optical Network (SONET) - a body of standards that defines all aspects of transporting and managing digital traffic over optical facilities in the public network.

Synchronous Payload Envelope (SPE) - the payload field plus a little overhead of a basic SONET signal.

Synchronous Transfer Mode (STM) - a transport and switching method that depends on information occurring in regular, fixed patterns with respect to a reference such as a frame pattern.

Synchronous Transport Signal (STS) - a SONET electrical signal rate.

Systeme En Coleur Avec Memoire (SECAM) - Sequential and Memory Color Television - Started in France in the late 60s, and used by other countries with a political affiliation. This is. The B-Y and R-Y signals are transmitted on alternate lines modulated on an FM subcarrier. The memory is a one line delay line in the receiver to make both color difference signals available at the same time on all lines. Due to FM, the signal is robust in difficult terrain.

Systems Network Architecture (SNA) - a proprietary networking architecture used by IBM and IBM-compatible mainframe computers.

T1 - a specification for a transmission line. The specification details the input and output characteristics and the bandwidth. T1 lines run at 1.544 Mbps and provide for 24 data channels. In common usage, the term "T1" is used interchangeably with "DS1."

T1 Link - A wideband digital carrier facility used for transmission of digitized voice, digital data, and digitized image traffic. This link is composed of two twisted-wire pairs that can carry 24 digital channels, each operating at 64K bps at the aggregate rate of 1.544M bps, full duplex. Also referred to as DS-1.

T3 - a specification for a transmission line, the equivalent of 28 T1 lines. T3 lines run at 44.736 Mbps. In common usage, the term "T3" is used interchangeably with "DS3."

Tachometer - in *ForeView*, the tachometer shows the level of activity on a given port. The number in the tachometer shows the value of a chosen parameter in percentage, with a colored bar providing a semi-logarithmic representation of that percentage.

Tagged Cell Rate (TCR) - An ABR service parameter, TCR limits the rate at which a source may send out-of-rate forward RM-cells. TCR is a constant fixed at 10 cells / second.

Telephony - The conversion of voices and other sounds into electrical signals which are then transmitted by telecommunications media.

Telnet - a TCP / IP protocol that defines a client / server mechanism for emulating directly-connected terminal connections.

Terminal Equipment (TE) - Terminal equipment represents the endpoint of ATM connection(s) and termination of the various protocols within the connection(s).

Throughput - Measurement of the total useful information processed or communicated by a computer during a specified time period, i.e. packets per second.

Time Division Multiplexing (TDM) - a method of traditional digital multiplexing in which a signal occupies a fixed, repetitive time slot within a higher-rate signal.

Token Ring - a network access method in which the stations circulate a token. Stations with data to send must have the token to transmit their data.

topology - a program that displays the topology of a FORE Systems ATM network. An updated topology can be periodically re-displayed by use of the interval command option.

Traffic - the calls being sent and received over a communications network. Also, the packets that are sent on a data network.

Traffic Management (TM) - The traffic control and congestion control procedures for ATM. ATM layer traffic control refers to the set of actions taken by the network to avoid congestion conditions. ATM layer congestion control refers to the set of actions taken by the network to minimize the intensity, spread and duration of congestion. The following functions form a framework for managing and controlling traffic and congestion in ATM networks and may be used in appropriate combinations:

Connection Admission Control
Feedback Control
Usage Parameter Control
Priority Control
Traffic Shaping
Network Resource Management
Frame Discard
ABR Flow Control

Traffic Parameter - A parameter for specifying a particular traffic aspect of a connection.

Trailer - the protocol control information located at the end of a PDU.

Transit Delay - the time difference between the instant at which the first bit of a PDU crosses one designated boundary, and the instant at which the last bit of the same PDU crosses a second designated boundary.

Transmission Control Protocol (TCP) - a specification for software that bundles and unbundles sent and received data into packets, manages the transmission of packets on a network, and checks for errors.

Transmission Control Protocol/Internet Protocol (TCP/IP) - a set of communications protocols that has evolved since the late 1970s, when it was first developed by the Department of Defense. Because programs supporting these protocols are available on so many different computer systems, they have become an excellent way to connect different types of computers over networks.

Transmission Convergence (TC) - generates and receives transmission frames and is responsible for all overhead associated with the transmission frame. The TC sublayer packages cells into the transmission frame.

Transmission Convergence Sublayer (TCS) - This is part of the ATM physical layer that defines how cells will be transmitted by the actual physical layer.

Transparent Asynchronous Transmitter/Receiver Interface (TAXI) - Encoding scheme used for FDDI LANs as well as for ATM; supports speed typical of 100 Mbps over multimode fiber.

Transport Layer - Layer Four of the OSI reference model that is responsible for maintaining reliable end-to-end communications across the network.

trap - a program interrupt mechanism that automatically updates the state of the network to remote network management hosts. The SNMP agent on the switch supports these SNMP traps.

Trivial File Transfer Protocol (TFTP) - Part of IP, a simplified version of FTP that allows files to be transferred from one computer to another over a network.

Twisted Pair - Insulated wire in which pairs are twisted together. Commonly used for telephone connections, and LANs because it is inexpensive.

Unassigned Cells - a generated cell identified by a standardized virtual path identifier (VPI) and virtual channel identifier (VCI) value, which does not carry information from an application using the ATM Layer service.

Unavailable Seconds (UAS) - a measurement of signal quality. Unavailable seconds start accruing when ten consecutive severely errored seconds occur.

UNI 3.0/3.1 - the User-to-Network Interface standard set forth by the ATM Forum that defines how private customer premise equipment interacts with private ATM switches.

Unicasting - The transmit operation of a single PDU by a source interface where the PDU reaches a single destination.

Universal Test & Operations Interface for ATM (UTOPIA) - Refers to an electrical interface between the TC and PMD sublayers of the PHY layer.

Unshielded Twisted Pair (UTP) - a cable that consists of two or more insulated conductors in which each pair of conductors are twisted around each other. There is no external protection and noise resistance comes solely from the twists.

Unspecified Bit Rate (UBR) - a type of traffic that is not considered time-critical (e.g., ARP messages, pure data), allocated whatever bandwidth is available at any given time. UBR traffic is given a “best effort” priority in an ATM network with no guarantee of successful transmission.

Uplink - Represents the connectivity from a border node to an upnode.

Usage Parameter Control (UPC) - mechanism that ensures that traffic on a given connection does not exceed the contracted bandwidth of the connection, responsible for policing or enforcement. UPC is sometimes confused with congestion management (see *congestion management*).

User Datagram Protocol (UDP) - the TCP/IP transaction protocol used for applications such as remote network management and name-service access; this lets users assign a name, such as “RVAX*2,S,” to a physical or numbered address.

User-to-Network Interface (UNI) - the physical and electrical demarcation point between the user and the public network service provider.

V.35 - ITU-T standard describing a synchronous, physical layer protocol used for communications between a network access device and a packet network. V.35 is most commonly used in the United States and Europe, and is recommended for speeds up to 48 Kbps.

Variable Bit Rate (VBR) - a type of traffic that, when sent over a network, is tolerant of delays and changes in the amount of bandwidth it is allocated (e.g., data applications).

Virtual Channel (or Circuit) (VC) - a communications path between two nodes identified by label rather than fixed physical path.

Virtual Channel Connection (VCC) - a unidirectional concatenation of VCLs that extends between the points where the ATM service users access the ATM Layer. The points at which the ATM cell payload is passed to, or received from, the users of the ATM Layer (i.e., a higher layer or ATMM-entity) for processing signify the endpoints of a VCC.

Virtual Channel Identifier (VCI) - the address or label of a VC; a value stored in a field in the ATM cell header that identifies an individual virtual channel to which the cell belongs. VCI values may be different for each data link hop of an ATM virtual connection.

Virtual Channel Link (VCL) - a means of unidirectional transport of ATM cells between the point where a VCI value is assigned and the point where that value is translated or removed.

Virtual Channel Switch - a network element that connects VCLs. It terminates VPCs and translates VCI values. The Virtual Channel Switch is directed by Control Plane functions and relays the cells of a VC.

Virtual Connection - an endpoint-to-endpoint connection in an ATM network. A virtual connection can be either a virtual path or a virtual channel.

Virtual Local Area Network (VLAN) - Work stations connected to an intelligent device which provides the capabilities to define LAN membership.

Virtual Network Software (VINES) - Banyan's network operating system based on UNIX and its protocols.

Virtual Path (VP) - a unidirectional logical association or bundle of VCs.

Virtual Path Connection (VPC) - a concatenation of VPLs between virtual path terminators (VPTs). VPCs are unidirectional.

Virtual Path Identifier (VPI) - the address or label of a particular VP; a value stored in a field in the ATM cell header that identifies an individual virtual path to which the cell belongs. A virtual path may comprise multiple virtual channels.

Virtual Path Link (VPL) - a means of unidirectional transport of ATM cells between the point where a VPI value is assigned and the point where that value is translated or removed.

Virtual Path Switch - a network element that connects VPLs, it translates VPI (not VCI) values and is directed by Control Plane functions. The Virtual Path Switch relays the cells of a Virtual Path.

Virtual Path Terminator (VPT) - a system that unbundles the VCs of a VP for independent processing of each VC.

Virtual Private Data Network (VPDN) - a private data communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

Virtual Private Network (VPN) - a private voice communications network built on public switching and transport facilities rather than dedicated leased facilities such as T1s.

Virtual Source/Virtual Destination (VS/VD) - An ABR connection may be divided into two or more separately controlled ABR segments. Each ABR control segment, except the first, is sourced by a virtual source. A virtual source implements the behavior of an ABR source endpoint. Backwards RM-cells received by a virtual source are removed from the connection. Each ABR control segment, except the last, is terminated by a virtual destination. A virtual destination assumes the behavior of an ABR destination endpoint. Forward RM-cells received by a virtual destination are turned around and not forwarded to the next segment of the connection.

Virtual Tributary (VT) - a structure used to carry payloads such as DS1s that run at significantly lower rates than STS-1s.

Warm Start Trap - an SNMP trap which indicates that SNMP alarm messages or agents have been enabled.

Wide-Area Network (WAN) - a network that covers a large geographic area.

Wideband Channel - Communications channel with more capacity (19.2K bps) than the standard capacity of a voice grade line.

X.21 - ITU-T standard for serial communications over synchronous digital lines. The X.21 protocol is used primarily in Europe and Japan.

X.25 - a well-established data switching and transport method that relies on a significant amount of processing to ensure reliable transport over metallic media.

Yellow Alarm - An alarm signal sent back toward the source of a failed signal due to the presence of an AIS (may be used by APS equipment to initiate switching).

Zero Byte Time Slot Interchange (ZBTSI) - A technique used with the T carrier extended superframe format (ESF) in which an area in the ESF frame carries information about the location of all-zero bytes (eight consecutive “0”s) within the data stream.

Zero Code Suppression - The insertion of a “1” bit to prevent the transmission of eight or more consecutive “0” bits. Used primarily with T1 and related digital telephone company facilities, which require a minimum “1’s density” in order to keep the individual subchannels of a multiplexed, high speed facility active.

Zero-Bit Insertion - A technique used to achieve transparency in bit-oriented protocols. A zero is inserted into sequences of one bits that cause false flag direction.

Index