

StorageWorks by Compaq

Advanced Performance Monitor User Guide

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This document contains information on the following topics: an advanced performance monitoring overview, installing the Advanced Performance Monitor using telnet commands, configuring and using the Advanced Performance Monitor with telnet commands.

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About this Guide

This User Guide provides information to help you:

- Install the Advanced Performance Monitor.
- Configure the performance monitor software using telnet commands.
- Use the advanced performance monitoring software with telnet commands.
- Contact technical support for additional assistance.

Intended Audience

This book is intended for use by System Administrators who are experienced with the following:

- *StorageWorks*™ Fibre Channel SAN Switches by Compaq.
- Fabric Operating System V3.0 or later

Related Documentation

In addition to this guide, Compaq provides corresponding information:

- Fabric Operating System Reference Guide—AA-RQ6FA-TE
- MIB Reference Guide—AA-RQ6HA-TE
- Zoning User Guide—AA-RQ6YA-TE
- Fabric Operating System Procedures User Guide—AA-RQ6EA-TE
- ISL Trunking User Guide—AA-RR82A-TE
- Web Tools User Guide—AA-RQ6GA-TE
- Quickloop User Guide—AA-RR7LA-TE
- Extended Fabric User Guide—AA-RR7QA-TE
- Fabric Watch User Guide—RR7YA-TE

Prerequisites

Before you install and/or configure the Advanced Performance Monitor software, make sure you consider the items in the Document Conventions section that follows.

Document Conventions

The conventions included in Table 1 apply in most cases.

Table 1: Document Conventions

Element	Convention
Key names, menu items, buttons, and dialog box titles	Bold
File names and application names	<i>Italics</i>
User input, command names, system responses (output and messages)	Monospace font COMMAND NAMES are uppercase unless they are case sensitive
Variables	<i>Monospace, italic font</i>
Website addresses	Sans serif font (http://www.compaq.com)

Symbols in Text

These symbols may be found in the text of this guide. They have the following meanings.



WARNING: Text set off in this manner indicates that failure to follow directions in the warning could result in bodily harm or loss of life.



CAUTION: Text set off in this manner indicates that failure to follow directions could result in damage to equipment or data.

IMPORTANT: Text set off in this manner presents clarifying information or specific instructions.

NOTE: Text set off in this manner presents commentary, sidelights, or interesting points of information.

Symbols on Equipment



Any enclosed surface or area of the equipment marked with these symbols indicates the presence of electrical shock hazards. Enclosed area contains no operator serviceable parts.

WARNING: To reduce the risk of injury from electrical shock hazards, do not open this enclosure.



Any RJ-45 receptacle marked with these symbols indicates a network interface connection.

WARNING: To reduce the risk of electrical shock, fire, or damage to the equipment, do not plug telephone or telecommunications connectors into this receptacle.



Any surface or area of the equipment marked with these symbols indicates the presence of a hot surface or hot component. Contact with this surface could result in injury.

WARNING: To reduce the risk of injury from a hot component, allow the surface to cool before touching.



Power supplies or systems marked with these symbols indicate the presence of multiple sources of power.

WARNING: To reduce the risk of injury from electrical shock, remove all power cords to completely disconnect power from the power supplies and systems.



Any product or assembly marked with these symbols indicates that the component exceeds the recommended weight for one individual to handle safely.

WARNING: To reduce the risk of personal injury or damage to the equipment, observe local occupational health and safety requirements and guidelines for manually handling material.

Rack Stability



WARNING: To reduce the risk of personal injury or damage to the equipment, be sure that:

- The leveling jacks are extended to the floor.
 - The full weight of the rack rests on the leveling jacks.
 - In single rack installations, the stabilizing feet are attached to the rack.
 - In multiple rack installations, the racks are coupled.
 - Only one rack component is extended at any time. A rack may become unstable if more than one rack component is extended for any reason.
-

Getting Help

If you still have a question after reading this guide, contact service representatives or visit our website.

Compaq Technical Support

In North America, call Compaq technical support at 1-800-OK-COMPAQ, available 24 hours a day, 7 days a week.

NOTE: For continuous quality improvement, calls may be recorded or monitored.

Outside North America, call Compaq technical support at the nearest location. Telephone numbers for worldwide technical support are listed on the Compaq website: <http://www.compaq.com>.

Be sure to have the following information available before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

Compaq Website

The Compaq website has the latest information on this product, as well as the latest drivers. Access the Compaq website at: <http://www.compaq.com/storage>. From this website, select the appropriate product or solution.

Compaq Authorized Reseller

For the name of your nearest Compaq Authorized Reseller:

- In the United States, call 1-800-345-1518.
- In Canada, call 1-800-263-5868.
- Elsewhere, see the Compaq website for locations and telephone numbers.

Advanced Performance Monitor

This chapter of the Advanced Performance Monitor User Guide contains the following:

- Advanced Performance Monitoring Overview on page 1-1
- Performance Monitoring Using Telnet Commands on page 1-2
- Performance Monitoring Using Web Tools on page 1-3

Advanced Performance Monitoring Overview

Advanced performance monitoring provides SAN performance management through an end-to-end monitoring system that enables you to:

- Increase end-to-end visibility into the fabric
- Enable more accurate reporting for service level agreements and charged access applications
- Improve performance tuning and resource optimization
- Shorten troubleshooting time
- Promote better capacity planning
- Simplify administration and setup
- Increase productivity with preformatted and customizable screens and reports

Features

The Advanced Performance Monitor software:

- Measures the bandwidth consumed by individual routes (host-target pairs)
- Provides device performance measurements by port, AL_PA, and LUN
- Reports CRC error measurement statistics

- Measures Trunking performance
- Compares IP versus SCSI traffic on each port
- Includes a wide range of predefined reports
- Allows you to create customized user-defined reports

Administration

The Advanced Performance Monitor is an optional-licensed product that runs on Compaq StorageWorks Fibre Channel SAN switches.

If you have a fabric with both SAN Switch 8/16 and SAN Switch 8-EL/16-EL switches, you can take advantage of the end-to-end performance monitoring features by installing a SAN Switch 8-EL/16-EL anywhere in the route path between the Source ID and the Destination ID.

You can administer performance monitoring through either telnet commands or Web Tools. If you use Web Tools, a Web Tools license must also be installed on the switch.

Terminology Used in this Document

- **AL_PA**—Arbitrated Loop Physical Address. An 8-bit value used to uniquely identify an individual port within a loop. A loop may have one or multiple AL_PAs.
- **SID**—3-byte Source ID of the originator device, in the “0xDomainAreaALPA” (0xDDAAPP) format.
- **DID**—3-byte Destination ID of the destination device, in the “0xDomainAreaALPA” (0xDDAAPP) format.
- **CRC**—Cyclic redundancy check; an error detection method. The CRC is 32 bits in the frame, after the data field, and before the EOF (end of frame).

See the Glossary in this user guide for other terms.

Performance Monitoring Using Telnet Commands

Telnet commands provide three different types of performance monitoring:

- AL_PA monitoring
- End-to-end monitoring

- Filter-based monitoring

Refer to Chapter 3, *Using the Advanced Performance Monitor*, for detailed information on how to use the telnet commands to monitor performance.

AL_PA Monitoring

AL_PA monitoring provides information regarding the number of CRC errors occurring in Fibre Channel frames in a loop configuration. AL_PA monitoring collects CRC error counts for each AL_PA attached to a specific port.

End-to-end Monitoring

End-to-end monitoring provides information regarding transaction performance between the transaction source (SID) and destination (DID) on a fabric or a loop. Up to eight SID-DID pairs per port can be specified.

The following information is available for each of the SID-DID pairs:

- CRC error count on the frames
- Fibre Channel words that have been transmitted through the port
- Fibre Channel words that have been received by the port

Filter-based Monitoring

Filter-based monitoring provides information about a filter's hit count. Any pattern of values in the first 64 bytes of the Fibre Channel frame can be measured. The counter increases each time a frame is filtered through the corresponding port. Examples of port filter statistics that can be measured are:

- SCSI Read, Write, or Read/Write commands
- IP versus SCSI traffic comparison

Performance Monitoring Using Web Tools

You can monitor performance using Web Tools, if a Web Tools license is also installed. The enhanced Advanced Performance Monitor features in Web Tools provide:

- Pre-defined reports for AL_PA, end-to-end, and filter-based performance monitoring

- User-definable reports
- Performance canvas for application level or fabric level views
- Configuration editor (save, copy, edit, and remove multiple configurations)
- Persistent graphs across reboots (saves parameter data across reboots)
- Print capabilities

Predefined Performance Graphs

Predefined graphs are provided to simplify performance monitoring. A wide range of end-to-end fabric, LUN, device, and port metrics are included. Table 1–1 lists the predefined performance graphs available with both basic and advanced performance monitoring.

Table 1–1: Predefined Performance Graphs

Basic Monitoring	Advanced Monitoring ¹
Port Throughput	SID/DID Performance
Switch Aggregate Throughput	SCSI vs. IP Traffic
Switch Throughput Utilization	AL_PA Errors
Port Error	SCSI Commands by port and LUN (R, W, R/W)
Switch Percent Utilization	
Port Snapshot Error	

1. These graphs are available only when a Advanced Performance Monitor license is installed.

Figure 1–1 is the basic performance monitor screen showing the list of predefined advanced performance monitoring graphs available with Web Tools.

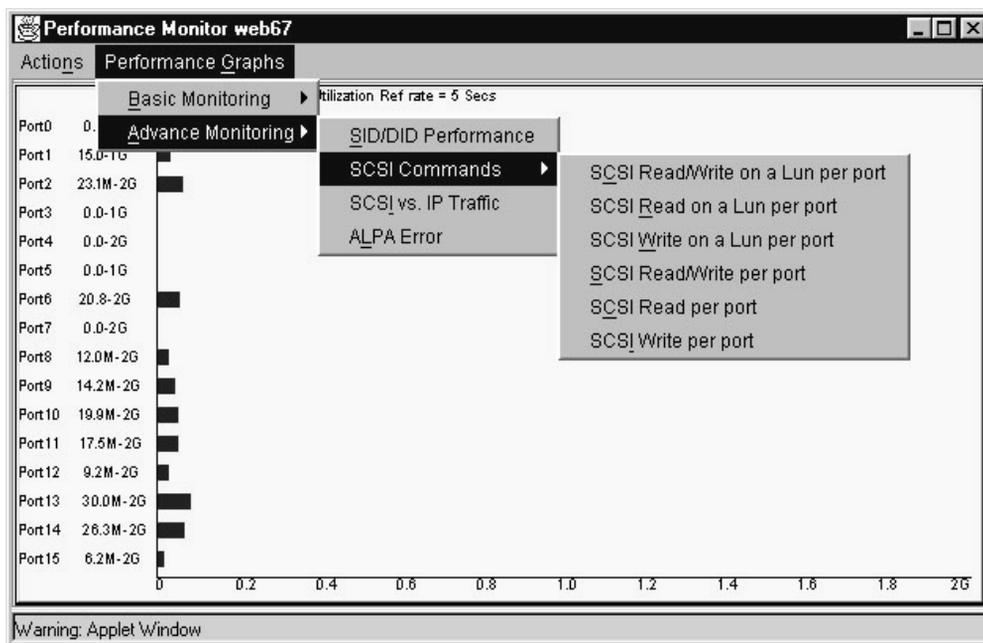


Figure 1–1: Accessing predefined performance graphs

User-defined Graphs

The predefined graphs can be modified based on parameter fields such as SID/DID, LUN, AL_PA, and port. These new user-defined graphs can be added and saved to canvas configurations. Figure 1–2 shows a list of user-defined graphs defined in a canvas.

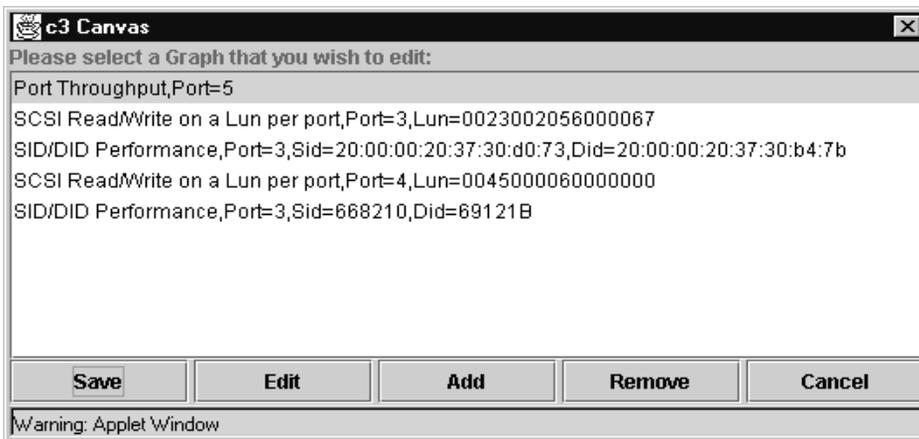


Figure 1–2: Canvas screen displaying user-defined graphs

Performance Graph Formats

Performance graphs can be displayed as vertical bar charts, horizontal bar charts, and line charts, as shown in Figure 1–3.

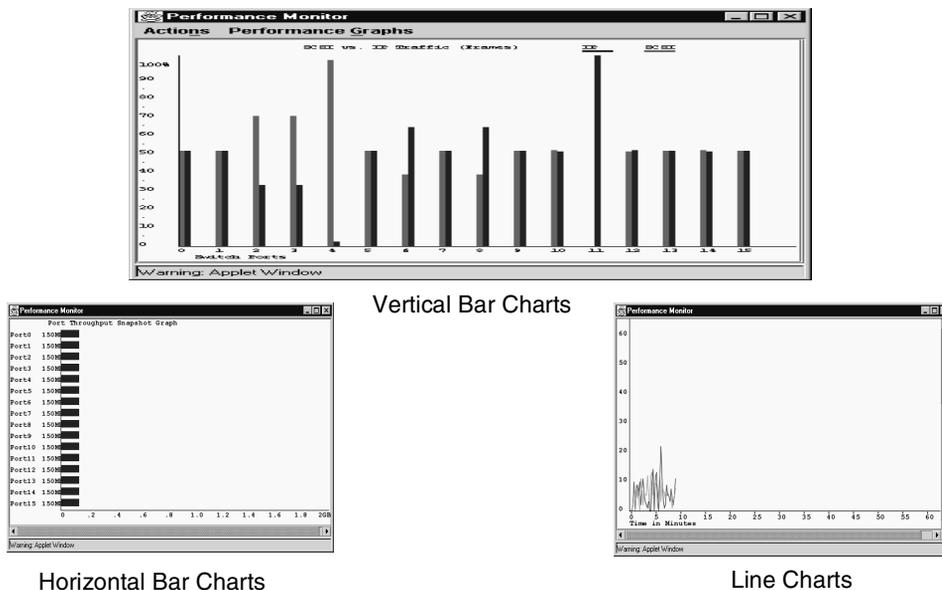


Figure 1–3: Types of performance graphs

In addition to the graphs shown in Figure 1–3, the Advanced Performance Monitoring Resource Usage Display (Figure 1–4) shows which filter slots have been used for each port, and which are available. The color-coded interface makes troubleshooting easier.

PORT	EE0	EE1	EE2	EE3	EE4	EE5
Port0	Free	Free	Free	Free	Free	Free
Port1	Free	Free	Free	Free	Free	Free
Port2	Free	Free	Free	Free	Free	Free
Port3	TELN: InUse	Free	Free	TELN: InUse	Free	Free
Port4	TELN: InUse	Free	Free	TELN: InUse	Free	Free
Port5	TELN: InUse	Free	Free	TELN: InUse	Free	Free
Port6	TELN: InUse	Free	Free	TELN: InUse	Free	Free
Port7	Free	Free	Free	Free	Free	Free
Port8	Free	Free	Free	Free	Free	Free
Port9	Free	Free	Free	Free	Free	Free
Port10	Free	Free	Free	Free	Free	Free
Port11	Free	Free	Free	Free	Free	Free
Port12	Free	Free	Free	Free	Free	Free
Port13	Free	Free	Free	Free	Free	Free
Port14	Free	Free	Free	Free	Free	Free
Port15	Free	Free	Free	Free	Free	Free

Warning: Applet Window

Figure 1–4: Advanced performance monitoring resource usage display

Performance Graph Canvas

The enhanced performance monitoring in Web Tools enables you to set up a canvas of performance graphs. The canvas can hold up to eight graphs per window, as shown in Figure 1–5.

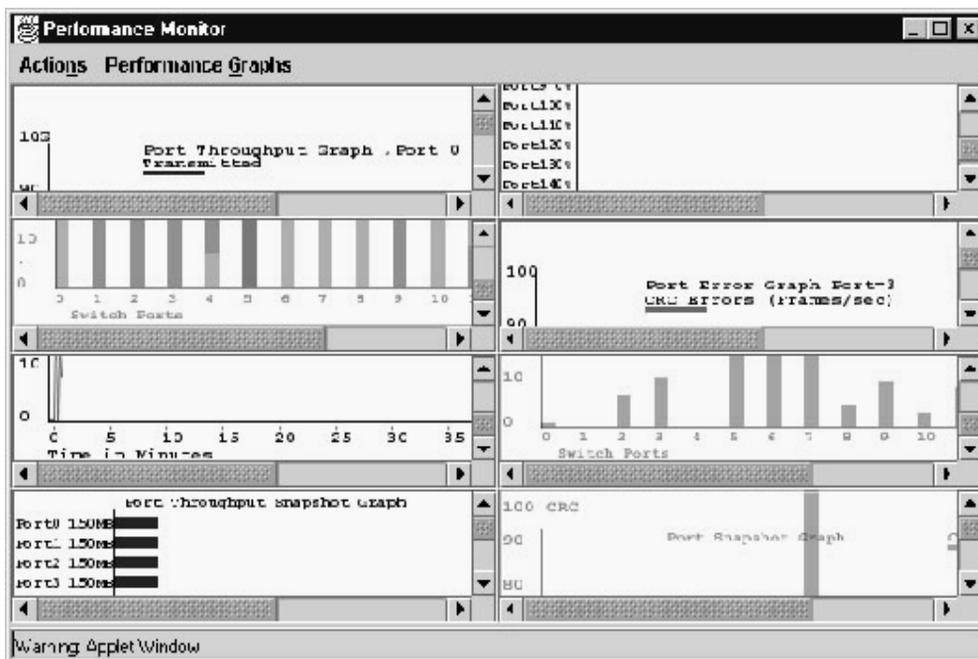


Figure 1–5: Canvas of eight performance monitoring graphs

Multiple canvasses can be created for different users or different scenarios. You can then save the multiple configurations of graphs, edit them, and recall them. Figure 1–6 shows a list of different canvas configurations from which you can choose to display.

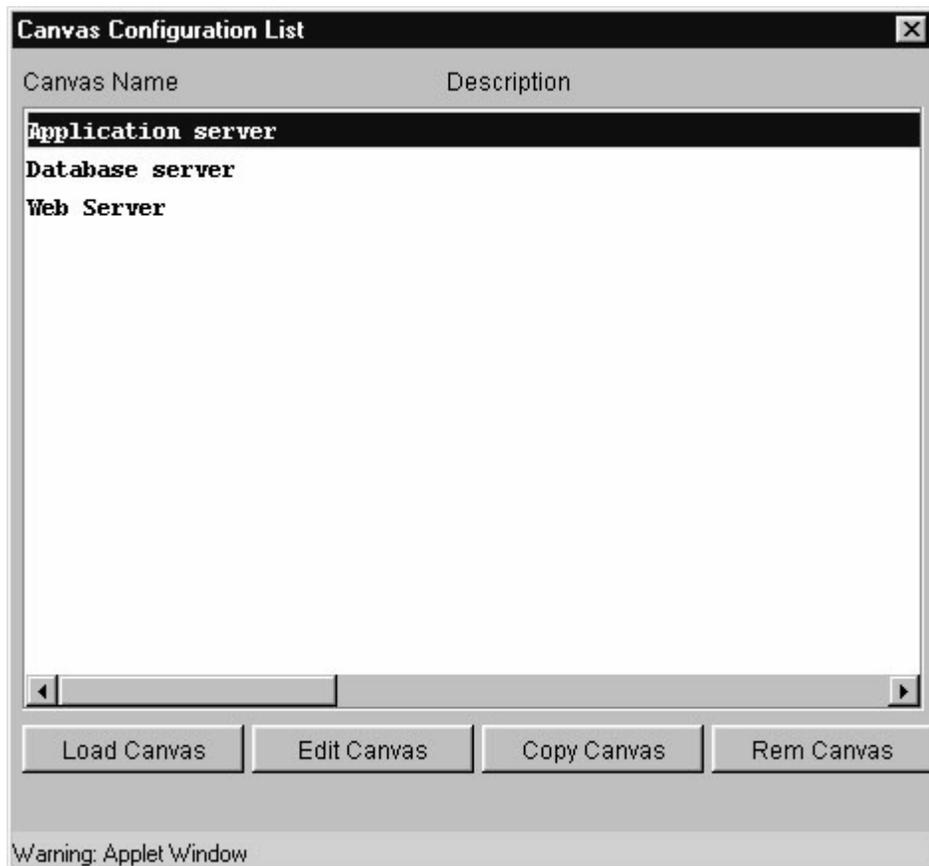


Figure 1–6: Example canvas configuration list

Installing the Advanced Performance Monitor

This chapter provides the following information on the installation of the Advanced Performance Monitor:

- Installation Overview on page 2-1
- Installing the Monitor Using Telnet Commands on page 2-1
- Installing the Monitor Using Web Tools on page 2-2

Installation Overview

To enable the Advanced Performance Monitor, you must install a license on each switch that will use this feature. Contact your switch supplier to obtain a license.

NOTE: A license may have already been installed on the switch at the factory.

You can install an Advanced Performance Monitor license using telnet commands or Web Tools (provided a Web Tools license is installed).

NOTE: Version 3.0 of the Advanced Performance Monitor requires a Compaq StorageWorks Fibre Channel SAN Switch with Fabric Operating System 3.0 (or later) installed.

Installing the Monitor Using Telnet Commands

1. Log onto the switch using telnet commands (see the *Fabric Operating System Procedures User Guide* for details), under an account that has administrative privileges.
2. Type `licenseShow` on the telnet command line to determine whether a Advanced Performance Monitor license is already installed on the switch.

A list of all the licenses currently installed on the switch displays. For example:

```
admin> licenseShow
1A1AaAaaaAAA1a:
Release v3.0
Zoning license
QuickLoop license
```

If the Advanced Performance Monitor license is not included in the list, continue with step 3.

3. Enter the following on the command line:

```
licenseAdd "key"
```

where “*key*” is the license key exactly as provided by your switch supplier, surrounded by double quotes. The license key is case-sensitive and must be entered exactly as given.

4. Verify the license was successfully added by entering `licenseShow` on the command line:

```
admin> licenseShow
1A1AaAaaaAAA1a:
Release v3.0
Zoning license
QuickLoop license
1A1AaAaaaAAA2a:
Performance Monitor license
```

The Advanced Performance Monitor features are available as soon as the license is added. Go to Using the Advanced Performance Monitor on page 3-1.

Installing the Monitor Using Web Tools

You can install a license using the Web Tools if a Web Tools license is already installed.

1. Launch a web browser, enter the switch name or IP address in the **Location/Address** field of the browser, and press **Enter**.

Web Tools launches, displaying the Fabric View (Figure 2–1).

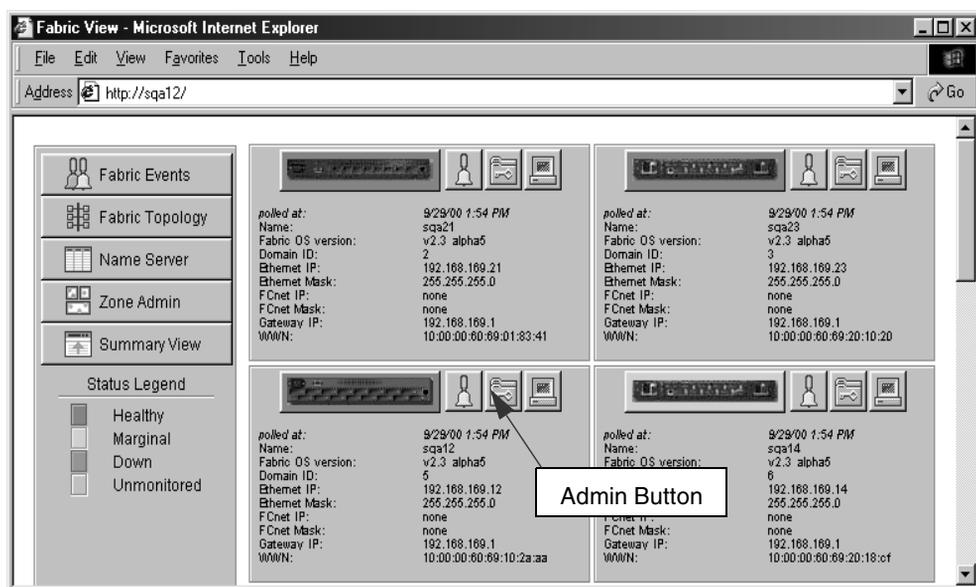


Figure 2–1: Fabric View

2. Click the **Admin** button on the relevant switch panel.

The logon window displays.

3. Enter a logon name and password with administrative privileges and press **Enter**. The administrator account name and default password is “admin” and “password.”

The Administration View displays.

4. Select the **License Admin** tab.
5. Enter the license key in the **License Key** field exactly as provided by your switch supplier, and click **Add** (Figure 2–2).

The Advanced Performance Monitor features are available as soon as the license is added.

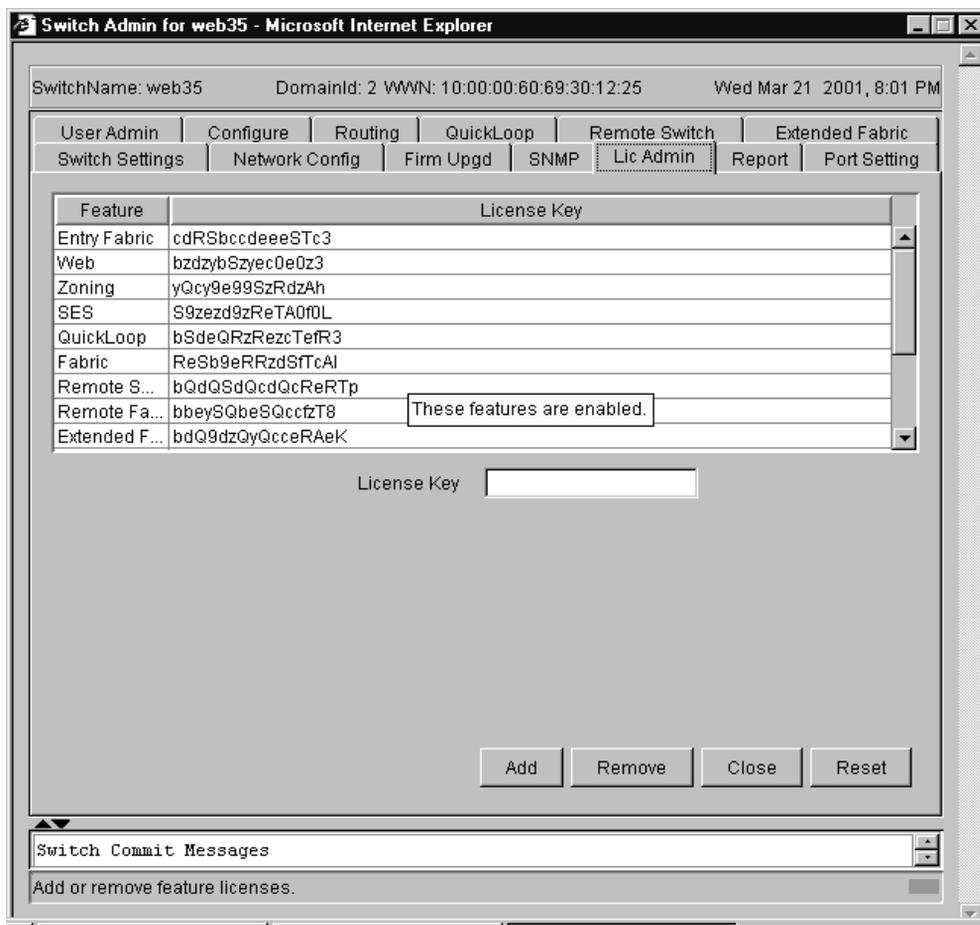


Figure 2-2: License Admin tab

For more information about using Web Tools, refer to the *Web Tools User Guide*.

Using the Advanced Performance Monitor

This chapter provides the following information about the use of the Advanced Performance Monitor software:

- Overview on page 3-1
- AL_PA Performance Monitoring on page 3-2
- End-to-end Performance Monitoring on page 3-3
- Filter-based Performance Monitoring on page 3-11
- Saving and Restoring Monitor Configuration on page 3-17

Overview

You can administer the advanced performance monitoring tools using telnet commands or Web Tools (an optional-licensed product). This chapter describes performance monitoring using telnet commands. A full description of each of the telnet commands is in the *Fabric Operating System Reference Guide*.

Web Tools

Switch performance can be monitored in the Performance View of the Web Tools. To access Performance View, click **Perf** in Switch View.

For information about performance monitoring with Web Tools, refer to the *Web Tools User Guide*.

Telnet Commands

The telnet commands for the Advanced Performance Monitor become available through the shell “admin” account when the Advanced Performance Monitor license key is installed. To use a telnet command, log into the relevant switch with administrative privileges, enter the command along with any required arguments, and press **Enter**.

Using telnet commands, you can track the following:

- Number of CRC errors for AL_PA devices
- Number of words in Fibre Channel frames with a defined SID/DID pair
- Number of times a particular command or frame type is received by a port

AL_PA Performance Monitoring

AL_PA performance monitoring allows you to track and display the number of CRC errors that have occurred on frames sent to each AL_PA on a specific port. No monitor configuration is necessary for AL_PA performance monitoring.

Displaying the CRC Error Count

Use the `perfShowAlpaCrc` command to display the CRC error count for all AL_PA devices or a single AL_PA on a specific port. The port must be an active L_Port.

Example 1. The command shown in Figure 3–1 displays the CRC error count for all AL_PA devices on port 3.

```
sw1:admin> perfShowAlpaCrc 3
AL_PA      CRC count
-----
0x01       2
0x02       0
0x04       1
```

Figure 3–1: Displaying the CRC error count for all AL_PA devices

Example 2. The command shown in displays the CRC error count for AL_PA 0x01 on port 3.

```
sw1:admin> perfShowAlpaCrc 3, 0x01
The CRC count at ALPA 0x1 on port 3 is 0x000000002.
```

Figure 3–2: Displaying the CRC error count for AL_PA 0x01

Clearing the CRC Error Count

Use the `perfClrAlpaCrc` command to clear the CRC error count for AL_PA devices on a specific port. You can clear the error counts for all the AL_PA devices on a port or for a specific AL_PA.

Example 1. The command shown in Figure 3–3 clears the CRC error count for all AL_PA devices on port 3.

```
sw1:admin> perfClrAlpaCrc 3
This will clear all ALPA CRC counts on port 3.
Do you want to continue? [y|n]y
Please wait ...
All alpa CRC counts are cleared on port 3.
```

Figure 3–3: Clearing the CRC error count

Example 2. The command shown in Figure 3–4 clears the CRC error count for AL_PA 1 on port 3.

```
admin> perfClrAlpaCrc 3, 0x01
CRC error count at ALPA 0x1 on port 3 is cleared.
```

Figure 3–4: Clearing the CRC error count for AL_PA 1

End-to-end Performance Monitoring

End-to-end performance monitoring counts the number of words and CRC errors in Fibre Channel frames for a specified Source ID (SID) and Destination ID (DID) pair. An end-to-end performance monitor counts the number of:

- Words in frames received at the port (RX_COUNT)
- Words in frames transmitted from the port (TX_COUNT)
- CRC errors in frames received at the port (CRC_COUNT)

To enable end-to-end performance monitoring, you must configure an end-to-end monitor on a port, specifying the SID-DID pair. The monitor counts only those frames with matching SID and DID.

Each SID or DID has three fields, listed in this order:

- Domain ID (DD)
- Area ID (AA)
- AL_PA (PP)

For example, the SID `0x118a0f` has a Domain ID of `0x11`, Area ID of `0x8a`, and an AL_PA of `0x0f`. (The prefix “0x” denotes a hexadecimal number.)

Adding End-to-end Monitors

Use the `perfAddEEMonitor` command to add an end-to-end monitor to a port. With this command you specify the port, the SID, and the DID that you want to monitor. Depending on the application, you can select any port along the routing path for monitoring.

Figure 3–5 shows an example configuration of two devices: Host A, which is connected to port 2 on switch 1, and Dev B, which is connected to port 15 on switch 2.

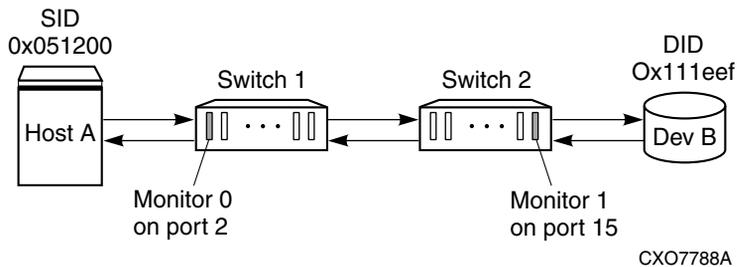


Figure 3–5: Setting end-to-end monitors on a port

To monitor the traffic from Host A to Dev B, add a monitor to port 2, specifying `0x051200` as the SID and `0x111eef` as the DID.

To monitor the traffic from Dev B to Host A, add a monitor to port 15, specifying `0x111eef` as the SID and `0x051200` as the DID. Use the following commands:

```
sw1:admin> perfAddEEMonitor 2, "0x051200", "0x111eef"  
End-to-End monitor number 0 added.  
  
-----  
  
sw2:admin> perfAddEEMonitor 15, "0x111eef", "0x051200"  
End-to-End monitor number 1 added.
```

Monitor 0 counts the frames that have an SID of 0x051200 and a DID of 0x111eef:

- RX_COUNT is the number of words from Host A to Dev B
- CRC_COUNT is the number of frames from Host A to Dev B with CRC errors
- TX_COUNT is the number of words from Dev B to Host A.

Monitor 1 counts the frames that have an SID of 0x111eef and a DID of 0x051200:

- RX_COUNT is the number of words from Dev B to Host A
- CRC_COUNT is the number of frames from Dev B to Host A with CRC errors
- TX_COUNT is the number of words from Host A to Dev B

NOTE: End-to-end performance monitoring monitors traffic on the receiving port respective to the SID only. In Figure 3–5, if you add a monitor to port 2 specifying Dev B as the SID and Host A as the DID, no counters are incremented.

Valid: `perfAddEEMonitor 2, "0x051200", "0x111eef"`

Not valid: `perfAddEEMonitor 2, "0x111eef", "0x051200"`

Figure 3–6 shows several switches and the proper ports on which to add performance monitors for a specified SID-DID pair.

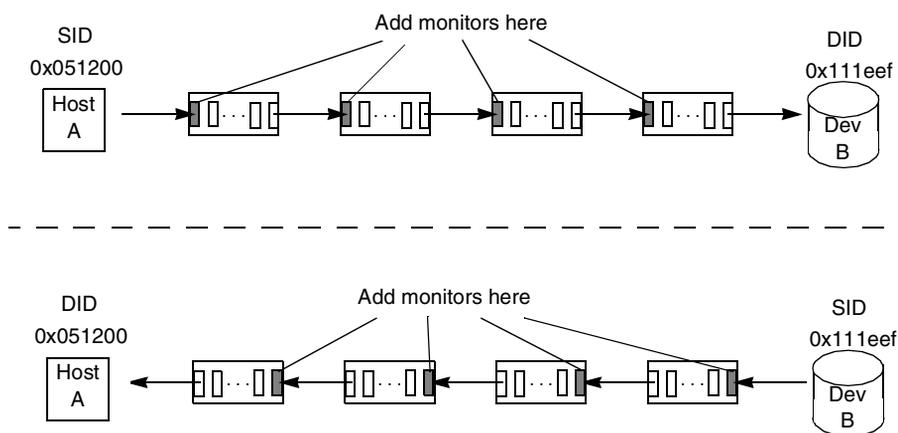


Figure 3–6: Proper placement of end-to-end performance monitors

Setting a Mask for End-to-End Monitors

End-to-end monitors count the number of words in Fibre Channel frames that match a specific SID/DID pair. If you want to match only part of the SID or DID, you can set a mask on the port to compare only certain parts of the SID or DID:

- No mask set—the frame must match the entire SID or DID to trigger the monitor counter.
- Mask set—you can choose to have the frame match only one or two of the three fields (Domain ID, Area ID, AL_PA) to trigger the monitor.

NOTE: You can set only one mask per port. The mask is applied to all of the end-to-end monitors on a port. If you subsequently create new monitors on the port, the mask is applied to these new monitors as well. The counters are reset when you set the mask.

The mask is specified in the form "*dd:aa:pp*"

where *dd* is the Domain ID mask, *aa* is the Area ID mask, and *pp* is the AL_PA mask.

The values for *dd*, *aa*, and *pp* are one of the following:

- *ff* (the field must match)
- *00* (the field is ignored).

Use the `perfSetPortEEMask` to set a mask for end-to-end monitors. The command sets the mask for all end-to-end monitors of a port, so that you can selectively choose the Fibre Channel frames in which the number of words are to be counted.

The `perfSetPortEEMask` command sets a mask for the Domain ID, Area ID, and AL_PA of the SIDs and DIDs for frames transmitted from and received by the port.

Figure 3–7 shows the mask positions in the command.

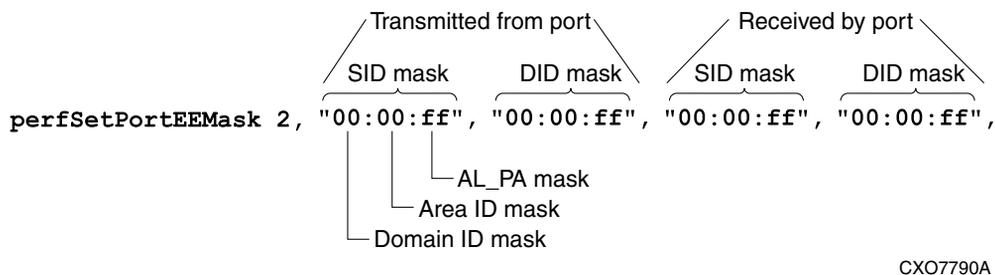


Figure 3–7: Mask positions for end-to-end monitors

In Figure 3–7, a mask (“ff”) is set on port 2 to compare the AL_PA fields on the SID and DID in all frames (transmitted and received) on port 2. The Domain ID mask and Area ID mask in all frames are ignored, as no mask is set on these fields.

For example, if you set the following monitor on a port:

```
perfAddEEMonitor 2, "0x051200", "0x111eef"
```

then the frame SID must be “0x051200” and the frame DID must be “0x111eef” to trigger the monitor.

If you set the mask shown in Figure 3–7, then the frame SID and DID must match only the AL_PA portion of the specified SID-DID pair. That is, frames with SID of “0xnnnn00” and DID of “0xnnnnef” trigger the monitor, where *nnnn* represents any number.

Each port can have only one EE mask. The mask is applied to all end-to-end monitors on the port. You cannot specify individual masks for each monitor on the port. If you define a new end-to-end monitor on a port after you have created a mask for that port, the mask is automatically applied to the new monitor.

The default EE mask value upon power-on is “ff:ff:ff” for everything—SID and DID on all transmitted and received frames.

Example. The commands shown in Figure 3–8 add an end-to-end monitor to port 2, and then set a mask on the SID and DID Domain ID of frames transmitted from port 2.

After the mask is set, monitor 0 counts the number of words in incoming Fibre Channel frames that have an SID of 0x05nnnn and DID of 0x11nnnn, where *nnnn* represents any number.

```
sw1:admin> perfAddEEMonitor 2, "0x051200", "0x111eef"  
End-to-End monitor number 0 added.  
  
sw1:admin> perfSetPortEEMask 2, "00:00:00", "00:00:00", "ff:00:00",  
"ff:00:00"  
The EE mask on port 2 is set and EE counters are reset.
```

Figure 3–8: Adding an end-to-end monitor to port 2

Displaying the End-to-end Mask of a Port

Use the `perfShowPortEEMask` command to display the current end-to-end mask of a port.

The end-to-end mask has 12 fields, with each field having a value of **on** or **off**.

Example. The commands shown in Figure 3–9 set an end-to-end mask on port 11 and display the mask.

```
sw1:admin> perfSetPortEEMask 11, "00:00:ff", "00:00:ff", "00:00:ff",  
"00:00:ff"  
The EE mask on port 11 is set and EE counters are reset.  
  
sw1:admin> perfShowPortEEMask 11  
The EE mask on port 11 is set by application TELNET  
  
TxSID Domain: off  
TxSID Area: off  
TxSID ALPA: on  
TxDID Domain: off  
TxDID Area: off  
TxDID ALPA: on  
RxSID Domain: off  
RxSID Area: off  
RxSID ALPA: on  
RxDID Domain: off  
RxDID Area: off  
RxDID ALPA: on
```

Figure 3–9: Setting an end-to-end mask on port 11

Displaying End-to-end Monitors

Use the `perfShowEEMonitor` command to display all the end-to-end monitors defined on a port. You can display cumulative counters or a rolling table of counters at specified intervals. This command displays the following information on all end-to-end monitors:

- Monitor number (KEY)
- SID
- DID
- CRC error count (CRC_COUNT)
- Number of Fibre Channel words transmitted (TX_COUNT)
- Number of Fibre Channel words received (RX_COUNT)
- Creator application (OWNER_APP)
- IP address of the creator, if known (OWNER_IP_ADDR)

If you specify an interval number in the `perfShowEEMonitor` command, the command displays a rolling table of CRC error, Tx, and Rx counters on a per-interval basis for all the valid monitors on the port. The counter values are the number of bytes, in decimal format.

If you omit the interval number, the command displays the cumulative transmit counter (TX_COUNT), receive counter (RX_COUNT), and CRC error counter. These cumulative counters are 64-bit values in hexadecimal format.

Example 1. The command shown in Figure 3–10 displays all of the end-to-end monitors on port 3 at an interval of once a second (in this example, there are three monitors on port 3, numbered 0, 1, and 2).

```
sw1:admin> perfShowEEMonitor 3, 1
perfShowEEMonitor 3, 1: Tx/Rx are # of bytes and crc is # of crc errors
```

0			1			2		
-----	-----	-----	-----	-----	-----	-----	-----	-----
crc	Tx	Rx	crc	Tx	Rx	crc	Tx	Rx
=====	=====	=====	=====	=====	=====	=====	=====	=====
0	0	0	0	0	0	0	0	0
0	53m	4.9m	0	53m	4.9m	0	53m	4.9m
0	53m	4.4m	0	53m	4.4m	0	53m	4.4m
0	53m	4.8m	0	53m	4.8m	0	53m	4.8m
0	53m	4.6m	0	53m	4.6m	0	53m	4.6m
0	53m	5.0m	0	53m	5.0m	0	53m	5.0m
0	52m	4.6m	0	52m	4.6m	0	52m	4.6m

Figure 3–10: Displaying all end-to-end monitors on port 3

Example 2. The command shown in Figure 3–11 displays the cumulative counters on all end-to-end monitors defined on port 3. The KEY column contains the monitor number.

```
Sswitch:admin> perfShowEEMonitor 3

There are 3 end-to-end monitor(s) defined on port 3.

KEY SID      DID      OWNER_APP  OWNER_IP_ADDR  TX_COUNT      RX_COUNT      CRC_COUNT
-----
0  0xb1300  0xb23ef  COMPAQ      N/A           0x00000004d0ba9915  0x0000000067229e65  0x0000000000000000
1  0xb1200  0xb22ef  COMPAQ      N/A           0x00000004d0baa754  0x0000000067229e87  0x0000000000000000
2  0x58e0f  0x1182ef  WEB_TOOLS  192.168.169.40 0x00000004d0bade54  0x0000000067229e87  0x0000000000000000
```

Figure 3–11: Displaying the cumulative counters on end-to-end monitors on port 3

Deleting End-to-End Monitors

Use the `perfDeleEEMonitor` command to delete an end-to-end monitor on a port. Indicate which monitor to delete by specifying the monitor number that was returned by a previous `perfAddeEEMonitor` command.

NOTE: If you do not specify a monitor number, then all end-to-end monitors on the port are deleted.

Example 1. The command shown in Figure 3–12 deletes the end-to-end monitor number 0 on port 2.

```
sw1:admin> perfDeleEEMonitor 2, 0
End-to-End monitor number 0 deleted
```

Figure 3–12: Deleting end-to-end monitor 0 on port 2

Example 2. The command shown in Figure 3–13 deletes all of the end-to-end monitors on port 2.

```
sw1:admin> perfDeleEEMonitor 2
This will remove ALL EE monitors on port 2, continue? [y|n]y
```

Figure 3–13: Deleting all end-to-end monitors on port 2

Clearing End-to-End Monitor Counters

To clear all of the end-to-end monitor counters on a port, use the `perfSetPortEEMask` command to reset all of the end-to-end monitor counters on that port.

NOTE: The `perfSetPortEEMask` command also sets the end-to-end mask, so if you do not want to change the mask, you must re-specify the current mask settings. You can view the current mask settings using the `perfShowPortEEMask` command.

To clear the counters for a single end-to-end monitor, delete the monitor using the `perfDeleteMonitor` command, and then add the monitor again, using the `perfAddEEMonitor` command.

Filter-based Performance Monitoring

Filter-based monitoring counts the number of times a particular command or frame type is received by a port. Filter-based monitoring is achieved by configuring a filter for a particular purpose. The filter can be a standard filter (for example, a read command filter that counts the number of read commands that have been received by the port) or a user-defined filter that you customize for your particular use.

The maximum number of filters is eight per port, in any combination of standard filters and user-defined filters.

Adding Standard Filter-Based Monitors

This section describes how to add standard filter-based monitors to a port. Use the telnet commands listed in Table 3–1 to define filter-based monitors on a port.

Table 3–1: Telnet Commands to Add Filter-based Monitors

Telnet command	Description
<code>perfAddReadMonitor</code>	Count the number of SCSI Read commands
<code>perfAddWriteMonitor</code>	Count the number of SCSI Write commands
<code>perfAddRWMonitor</code>	Count the number of SCSI Read and Write commands
<code>perfAddSCSIMonitor</code>	Count the number of SCSI traffic frames
<code>perfAddIPMonitor</code>	Count the number of IP traffic frames

Example. The commands shown in Figure 3–14 add several filter-based monitors to port 2 and display the results.

```
sw1:admin> perfAddReadMonitor 2
SCSI Read filter monitor #0 added

sw1:admin> perfAddWriteMonitor 2
SCSI Write monitor #1 added

sw1:admin> perfAddRWMonitor 2
SCSI Read/Write monitor #2 is added

sw1:admin> perfAddSCSIMonitor 2
SCSI traffic frame monitor #3 added

sw1:admin> perfAddIPMonitor 2,
IP traffic frame monitor #4 added

sw1:admin> perfShowFilterMonitor 2
There are 5 filter-based monitors defined on port 2.
```

KEY	ALIAS	OWNER_APP	OWNER_IP_ADDR	FRAME_COUNT
0	SCSI_RD	COMPAQ	N/A	0x0000000000000000
1	SCSI_WR	COMPAQ	N/A	0x0000000000000000
2	SCSI_RW	COMPAQ	N/A	0x0000000000000000
3	SCSI_Frame	COMPAQ	N/A	0x0000000000000000
4	IP_Frame	COMPAQ	N/A	0x0000000000000000

Figure 3–14: Adding filter-based monitors to port 2

Adding User-Defined Filter-Based Monitors

In addition to the standard filters (read, write, read/write, and frame count), you can create custom filters to qualify frames for gathering statistics to fit your own special needs.

To define a custom filter, use the `perfAddUserMonitor` telnet command. With this command, you must specify a series of *offsets*, *masks*, and *values*. The following actions are performed. For all incoming frames, the switch:

- Locates the byte found in the frame at the specified *offset*
- Applies the *mask* to the byte found in the frame
- Compares the value with the given *values* in the `perfAddUserMonitor` command
- Increments the filter counter if a match is found

You can specify up to six different offsets for each port, and up to four values to compare against each offset.

If more than one offset is required to properly define a filter, the bytes found at each offset must match one of the given values for the filter to increment its counter. If one or more of the given offsets does not match any of the given values, the counter does not increment.

The value of the offset must be 0 or must be between 4–63, in decimal format. Byte 0 indicates the first byte of the Start of Frame (SOF), byte 4 is the first byte of the frame header, and byte 28 is the first byte of the payload. Thus only the SOF, frame header, and first 36 bytes of payload may be selected as part of a filter definition.

Offset 0 is a special case, which can be used to monitor the first 4 bytes of the frame (SOF). When the *offset* is 0, the *values* are from 0–7, indicating the following:

- 0 SOF
- 1 SOFc1
- 2 SOFi1
- 3 SOFn1
- 4 SOFi2
- 5 SOFn2
- 6 SOFi3
- 7 SOFn3

The hardware can manage only a limited number of unique offsets and values. If the switch does not have enough resources to create a given filter, then other filters may have to be deleted to free up resources.

Example 1. The command shown in Figure 3–15 adds a filter-based monitor to count all FCP and IP frames received from domain 0x02 for port 2.

```
sw1:admin>  
perfAddUserMonitor 2, "12, 0xff, 0x05, 0x08, 9, 0xff, 0x02", "FCP/IP"  
User monitor #5 added
```

Figure 3–15: Adding a filter-based monitor to count all FCP and IP frames

The FCP and IP protocols are selected by monitoring offset 12, mask 0xff, and matching values of 0x05 or 0x08. Domain 2 is selected by monitoring offset 9, mask 0xff, and matching a value of 0x02.

The monitor counter is incremented for all incoming frames where byte 9 is 0x02 and byte 12 is 0x05 or 0x08.

Example 2. The command shown in Figure 3–16 adds a special case filter-based monitor for SOFi3 on port.

```
sw1:admin> perfAddUserMonitor 2, "0, 0xff, 6"  
User Monitor #6 added
```

Figure 3–16: Adding a special-case filter monitor

Displaying Filter-Based Monitors

Use the `perfShowFilterMonitor` command to display all the filter-based monitors of a port. You can display a cumulative count of the traffic detected by the monitors, or you can display a snapshot of the traffic at specified intervals.

This command displays all the filter-based monitors defined on the specified port. It displays all the valid monitor numbers and user-defined aliases on the specified port.

Example 1. The command shown in Figure 3–17 displays the filter monitor traffic on port 2 at an interval of once a second. In the command output, “#CMDs” refers to the read, write, and read-write counters, and “#Frames” refers to SCSI frame, IP frame, and user-defined counters.

```
sw1:admin> perfShowFilterMonitor 2, 1
```

0	1	2	3	4	5	6
#CMDs	#CMDs	#CMDs	#Frames	#Frames	#Frames	#Frames
0	0	0	0	0	0	0
26k	187	681	682	682	494	187
26k	177	711	710	710	534	176
26k	184	734	734	734	550	184
26k	182	649	649	649	467	182
26k	188	754	755	755	567	184

Figure 3–17: Displaying filter monitor traffic

Example 2. The command shown in Figure 3–18 displays the cumulative frame count of all filter-based monitors defined on port 2. The KEY column lists the monitor numbers.

```
sw1:admin> perfShowFilterMonitor 2
There are 7 filter-based monitors defined on port 2.
KEY   ALIAS      OWNER_APP      OWNER_IP_ADDR      FRAME_COUNT
-----
0   SCSI_RD    TELNET                N/A                0x0000000000002208
1   SCSI_WR    TELNET                N/A                0x000000000000464a
2   SCSI_RW    TELNET                N/A                0x000000000000fd8c
3   SCSI_Frame WEB_TOOLS          192.168.169.40    0x000000000002c2229
4   IP_Frame   WEB_TOOLS          192.168.169.40    0x0000000000000492
5   FCP/IP     WEB_TOOLS          192.168.169.40    0x0000000000000009
6   SCSI_RD    WEB_TOOLS          192.168.161.140  0x000000000000023a
```

Figure 3–18: Displaying the cumulative frame count of all filter-based monitors

Deleting Filter-Based Monitors

To delete a filter-based monitor, first list the valid monitor numbers using the `perfShowFilterMonitor` command, then use the `perfDelFilterMonitor` command to delete a specific monitor.

NOTE: If you do not specify a monitor number, then all filter monitors on the port are deleted.

Example. The commands shown in display the monitors on port 4 (the monitor numbers are listed in the KEY column), and then delete monitor number 1 on port 4.

```
sw1:admin> perfShowFilterMonitor 4
There are 4 filter-based monitors defined on port 4.
KEY   ALIAS      OWNER_APP      OWNER_IP_ADDR      FRAME_COUNT
-----
0   SCSI_RD    COMPAQ                N/A                0x0000000000002208
1   SCSI_WR    COMPAQ                N/A                0x000000000000464a
2   SCSI_RW    COMPAQ                N/A                0x000000000000fd8c
3   SCSI_Frame WEB_TOOLS          192.168.169.40    0x000000000002c2229

sw1:admin> perfDelFilterMonitor 4, 1
Monitor 1 is deleted
```

Figure 3–19: Displaying the monitor on port 4

Clearing Filter-Based Monitor Counters

To clear a filter-based monitor counter, delete the monitor using the `perfDelFilterMonitor` command, and then add the monitor again, using the appropriate command:

- `perfAddReadMonitor`
- `perfAddWriteMonitor`
- `perfAddRWMonitor`
- `perfAddSCSIMonitor`
- `perfAddIPMonitor`
- `perfAddUserMonitor`

Saving and Restoring Monitor Configuration

You can use the `perfCfgSave` command to save the current end-to-end and filter monitor configuration settings into flash memory. This enables the performance monitoring configuration to be saved over power cycles. You can use the `perfCfgRestore` command to restore the saved monitor configuration from flash memory, for example, after you power cycle the switch.

Example:

```
sw1:admin> perfCfgSave

This will overwrite previously saved Performance Monitoring
settings in FLASH ROM. Do you want to continue? [y|n]y
Please wait ...
Committing configuration...done.
Performance monitoring configuration saved in FLASH ROM.

sw1:admin> perfCfgRestore
This will overwrite current Performance Monitoring
settings in RAM. Do you want to continue? [y|n]y
Please wait ...
Performance monitoring configuration restored from FLASH ROM.
```

Use the `perfCfgClear` command to clear the previously saved performance monitoring configuration settings from flash memory.

Example:

```
sw1:admin> perfCfgClear
This will clear Performance Monitoring settings in FLASH ROM.
The RAM settings won't change. Do you want to continue? [y|n]y
Please wait ...
Committing configuration...done.
Performance Monitoring configuration cleared from FLASH.
```

Glossary

This glossary defines terms used in this guide or related to this product and is not a comprehensive glossary of computer terms.

8b/10b Encoding

An encoding scheme that converts each 8-bit byte into 10 bits. Used to balance ones and zeros in high-speed transports.

Address Identifier

A 24-bit or 8-bit value used to identify the source or destination of a frame.

AL_PA

Arbitrated Loop Physical Address; a unique 8-bit value assigned during loop initialization to a port in an arbitrated loop.

Alias Address Identifier

An address identifier recognized by a port in addition to its standard identifier. An alias address identifier may be shared by multiple ports.

Alias AL_PA

An AL_PA value recognized by an L_Port in addition to the AL_PA assigned to the port. See also *AL_PA*.

Alias Server

A fabric software facility that supports multicast group management.

API

Application Programming Interface; defined protocol that allows applications to interface with a set of services.

Arbitrated Loop

A shared 100 MBps Fibre Channel transport structured as a loop. Can support up to 126 devices and one fabric attachment. See also *Topology*.

ASIC

Application Specific Integrated Circuit.

ATM

Asynchronous Transfer Mode; a transport used for transmitting data over LANs or WANs that transmit fixed-length units of data. Provides any-to-any connectivity, and allows nodes to transmit simultaneously.

AW_TOV

Arbitration Wait Time-out Value; the minimum time an arbitrating L_Port waits for a response before beginning loop initialization.

Bandwidth

The total transmission capacity of a cable, link, or system. Usually measured in bps (bits per second). May also refer to the range of transmission frequencies available to a network. See also *Throughput*.

BB_Credit

Buffer-to-buffer credit; the number of frames that can be transmitted to a directly connected recipient or within an arbitrated loop. Determined by the number of receive buffers available. See also *Buffer-to-buffer Flow Control*, *EE_Credit*.

Beginning Run Disparity

The disparity at the transmitter or receiver when the special character associated with an ordered set is encoded or decoded. See also *Disparity*.

BER

Bit Error Rate; the rate at which bits are expected to be received in error. Expressed as the ratio of error bits to total bits transmitted. See also *Error*.

Block

As applies to Fibre Channel, upper-level application data that is transferred in a single sequence.

Bridge

Hardware that connects incompatible networks by providing translation for both hardware and software. For example, an ATM gateway can connect a Fibre Channel link to an ATM connection.

Broadcast

The transmission of data from a single source to all devices in the fabric, regardless of zoning. See also *Multicast*, *Unicast*.

Buffer-to-buffer Flow Control

Management of the frame transmission rate in either a point-to-point topology or in an arbitrated loop. See also *BB_Credit*.

Cascade

Two or more interconnected Fibre Channel switches. The recommended number of interswitch links is seven. See also *Fabric*, *ISL*.

Chassis

The metal frame in which the switch and switch components are mounted.

Circuit

An established communication path between two ports. Consists of two virtual circuits capable of transmitting in opposite directions. See also *Link*.

Class 1

Service that provides a dedicated connection between two ports (also called connection-oriented service), with notification of delivery or nondelivery.

Class 2

Service that provides multiplex and connection-less frame switching service between two ports, with notification of delivery or nondelivery.

Class 3

Service that provides a connection-less frame switching service between two ports, without notification of delivery or nondelivery of data. Can also be used to provide a multicast connection between the originator and recipients, with notification of delivery or nondelivery.

Class 4

Connection-oriented service that provides a virtual circuit between two ports, with notification of delivery or nondelivery. Allows fractional parts of the bandwidth to be used in a virtual circuit.

Class 6

Connection-oriented service that provides a multicast connection between the multicast originator and recipients, with notification of delivery or nondelivery.

Class F

Connection-less service for control traffic between switches, with notification of delivery or nondelivery of data between the E_Ports.

Class of Service

A specified set of delivery characteristics and attributes for frame delivery.

CLS

Close Primitive Signal. The protocol used by a port in an arbitrated loop to close a circuit.

Code Balance

The ratio of one bit to the total number of transmitted bits.

Comma

A unique pattern (either 1100000 or 0011111) used in 8B/10B encoding to specify character alignment within a data stream. See also *K28.5*.

Command Line

Interface that depends entirely on the use of commands, such as through telnet or SNMP, and does not involve a GUI.

Community (SNMP)

A relationship between a group of SNMP managers and an SNMP agent, in which authentication, access control, and proxy characteristics are defined. See also *SNMP*.

Connection Initiator

A port that has originated a Class 1 dedicated connection and received a response from the recipient.

Connection Recipient

A port that has received a Class 1 dedicated connection request and transmitted a response to the originator.

CRC

Cyclic Redundancy Check; a check for transmission errors included in every data frame.

Credit

As applies to Fibre Channel, the number of receive buffers available for transmission of frames between ports. See also *BB_Credit*, *EE_Credit*.

CT_HDR

Common Transport Header. A header that conforms to the Fibre Channel Common Transport (FC_CT) protocol.

CT_IU

Common Transport Information Unit. An information unit that conforms to the Fibre Channel Common Transport (FC_CT) protocol.

Current Fill Word

The fill word currently selected by the LPSM (loop port state machine). See also *Fill Word*.

Cut-through

A switching technique that allows the route for a frame to be selected as soon as the destination address is received. See also *Route*.

Data Word

Type of transmission word that occurs within frames. The frame header, data field, and CRC all consist of data words. See also *Frame*, *Ordered set*, *Transmission Word*.

Defined Zone Configuration

The set of all zone objects defined in the fabric. May include multiple zone configurations. See also *Enabled Configuration*, *Zone Configuration*.

Disparity

The relationship of ones and zeros in an encoded character. “Neutral disparity” means an equal number of each, “positive disparity” means a majority of ones, and “negative disparity” means a majority of zeros.

DLS

Dynamic Load Sharing; dynamic distribution of traffic over available paths. Allows for recomputing of routes when an Fx_Port or E_Port changes status.

Domain ID

As applies to SAN switches, a unique number between 1 and 239 that identifies the switch to the fabric and is used in routing frames. Usually automatically assigned by the switch, but can be manually assigned.

E_D_TOV

Error Detect Time-out Value; the minimum amount of time a target waits for a sequence to complete before initiating recovery. Can also be defined as the maximum time allowed for a round-trip transmission before an error condition is declared. See also *R_A_TOV*, *RR_TOV*.

E_Port

Expansion Port; a type of switch port that can be connected to an E_Port on another switch to create an ISL. See also *ISL*.

EE_Credit

End-to-end Credit; the number of receive buffers allocated by a recipient port to an originating port. Used by Class 1 and 2 services to manage the exchange of frames across the fabric between source and destination. See also *End-to-end Flow Control*, *BB_Credit*.

EIA Rack

A storage rack that meets the standards set by the Electronics Industry Association.

Enabled Zone Configuration

The currently enabled configuration of zones. Only one configuration can be enabled at a time. See also *Defined Configuration*, *Zone Configuration*.

End-to-end Flow Control

Governs flow of class 1 and 2 frames between N_Ports. See also *EE_Credit*.

Error

As applies to Fibre Channel, a missing or corrupted frame, time-out, loss of synchronization, or loss of signal (link errors). See also *Loop Failure*.

Exchange

The highest level Fibre Channel mechanism used for communication between N_Ports. Composed of one or more related sequences, and can work in either one or both directions.

F_Port

Fabric Port; a port that is able to transmit under fabric protocol and interface over links. Can be used to connect an N_Port to a switch. See also *FL_Port*, *Fx_Port*.

Fabric Name

The unique identifier assigned to a fabric and communicated during login and port discovery.

Fabric

A Fibre Channel network containing two or more switches in addition to hosts and devices. May also be referred to as a switched fabric. See also *Topology*, *SAN*, *Cascade*.

FC-AL-3

The Fibre Channel Arbitrated Loop standard defined by ANSI. Defined on top of the FC-PH standards.

FC-FLA

The Fibre Channel Fabric Loop Attach standard defined by ANSI.

FCIA

Fibre Channel Industry Association. An international organization of Fibre Channel industry professionals. Among other things, provides oversight of ANSI and industry developed standards

FCP

Fibre Channel Protocol; mapping of protocols onto the Fibre Channel standard protocols. For example, SCSI FCP maps SCSI-3 onto Fibre Channel.

FC-PH-1, 2, 3

The Fibre Channel Physical and Signalling Interface standards defined by ANSI.

FC-PI

The Fibre Channel Physical Interface standard defined by ANSI.

FC-PLDA

The Fibre Channel Private Loop Direct Attach standard defined by ANSI. Applies to the operation of peripheral devices on a private loop.

FC-SW-2

The second generation of the Fibre Channel Switch Fabric standard defined by ANSI. Specifies tools and algorithms for the interconnection and initialization of Fibre Channel switches in order to create a multi-switch Fibre Channel fabric.

Fibre Channel Transport

A protocol service that supports communication between Fibre Channel service providers. See also *FSP*.

Fill Word

An IDLE or ARB ordered set that is transmitted during breaks between data frames to keep the Fibre Channel link active.

FL_Port

Fabric Loop Port; a port that is able to transmit under fabric protocol and also has arbitrated loop capabilities. Can be used to connect an NL_Port to a switch. See also *F_Port*, *Fx_Port*.

FLOGI

Fabric Login; the process by which an N_Port determines whether a fabric is present, and if so, exchanges service parameters with it. See also *PLOGI*.

Frame

The Fibre Channel structure used to transmit data between ports. Consists of a start-of-frame delimiter, header, any optional headers, the data payload, a cyclic redundancy check (CRC), and an end-of-frame delimiter. There are two types of frames: Link control frames (transmission acknowledgements, etc.) and data frames.

FS_ACC

Fibre Channel Services Accept. The information unit used to indicate acceptance of a request for a Fibre Channel service.

FS_IU

Fibre Channel Services Information Unit. An information unit that has been defined by a specific Fibre Channel service.

FS_REQ

Fibre Channel Services Request. A request for a Fibre Channel services function, or notification of a fabric condition or event.

FS_RJT

Fibre Channel Services Reject. An indication that a request for Fibre Channel services could not be processed.

FS

Fibre Channel Service; a service that is defined by Fibre Channel standards and exists at a well-known address. For example, the Simple Name Server is a Fibre Channel service. See also *FSP*.

FSP

Fibre Channel Service Protocol; the common protocol for all fabric services, transparent to the fabric type or topology. See also *FS*.

FSPF

Fabric Shortest Path First; the routing protocol for Fibre Channel switches.

Full Fabric

The licensing that allows multiple E_Ports on a switch, making it possible to create multiple ISL links.

Full-duplex

A mode of communication that allows the same port to simultaneously transmit and receive frames. See also *Half-duplex*.

Fx_Port

A fabric port that can operate as either an F_Port or FL_Port. See also *F_Port*, *FL_Port*.

G_Port

Generic Port; a port that can operate as either an E_Port or F_Port. A port is defined as a G_Port when it is not yet connected or has not yet assumed a specific function in the fabric.

Gateway

A device such as a switch that connects different subnets together. A switch can be used as a gateway from the Ethernet to the Fibre Channel. Set the gateway address on one switch to the Fibre Channel IP address of another switch to enable the other switch to forward IP traffic to the ethernet port on the second switch.

GBIC

Gigabit Interface Converter; a removable serial transceiver module that allows gigabaud physical-level transport for Fibre Channel and gigabit ethernet. Also known as Optical Transceiver.

Gbps

Gigabits per second (1,062,500,000 bits/second).

GBps

GigaBytes per second (1,062,500,000 bytes/second).

Half-duplex

A mode of communication that allows a port to either transmit or receive frames at any time, but not simultaneously (with the exception of link control frames, which can be transmitted at any time). See also *Full-duplex*.

Hard Address

The AL_PA that an NL_Port attempts to acquire during loop initialization.

Hardware Translative Mode

A method for achieving address translation. The following two hardware translative modes are available to a QuickLoop enabled switch:

- Standard Translative Mode: Allows public devices to communicate with private devices that are directly connected to the fabric.
- QuickLoop Mode: Allows initiator devices to communicate with private or public devices that are not in the same loop.

HBA

Host Bus Adapter; the interface card between a server or workstation bus and the Fibre Channel network.

Hub

A Fibre Channel wiring concentrator that collapses a loop topology into a physical star topology. Nodes are automatically added to the loop when active and removed when inactive.

Idle

Continuous transmission of an ordered set over a Fibre Channel link when no data is being transmitted, to keep the link active and maintain bit, byte, and word synchronization.

IN_ID

Initial Identifier. The field in the CT_HDR where the port ID of the client originator of a Fibre Channel Services request.

Initiator

A server or workstation on a Fibre Channel network that initiates communications with storage devices. See also *Target*.

Integrated Fabric

The fabric created by a Compaq StorageWorks Fibre Channel SAN Switch IS/32 or IS/64, or SAN Switches 16-EL/8-EL switches cabled together and configured to handle traffic as a seamless group.

IOD

In-order Delivery; a parameter that, when set, guarantees that frames are either delivered in order or dropped.

IPA

Initial Process Associator. An identifier associated with a process at an N_Port.

ISL

Interswitch Link; a Fibre Channel link from the E_Port of one switch to the E_Port of another. See also *E_Port*, *Cascade*.

Isolated E_Port

An E_Port that is online but not operational due to overlapping domain IDs or nonidentical parameters (such as E_D_TOVs). See also *E_Port*.

IU

Information Unit; a set of information as defined by either upper-level process protocol definition or upper-level protocol mapping.

K28.5

A special 10-bit character used to indicate the beginning of a transmission word that performs Fibre Channel control and signaling functions. The first seven bits of the character are the comma pattern. See also *Comma*.

L_Port

Loop Port; a node port (NL_Port) or fabric port (FL_Port) that has arbitrated loop capabilities. An L_Port can be in one of two modes:

- *Fabric mode* Connected to a port that is not loop capable, and using fabric protocol.
- *Loop mode* In an arbitrated loop and using loop protocol. An L_Port in loop mode can also be in participating mode or non-participating mode.

See also *Non-participating Mode*, *Participating Mode*.

Latency

The period of time required to transmit a frame, from the time it is sent until it arrives.

Link Services

A protocol for link-related actions.

Link

As applies to Fibre Channel, a physical connection between two ports, consisting of both transmit and receive fibres. See also *Circuit*.

LIP

Loop Initialization Primitive; the signal used to begin initialization in a loop. Indicates either loop failure or resetting of a node.

LIS_HOLD_TIME

Loop Initialization Sequence Hold Time. The maximum period of time for a node to forward a loop initialization sequence.

LM_TOV

Loop Master Time-out Value; the minimum time that the loop master waits for a loop initialization sequence to return.

Login BB_Credit

The number of receive buffers a receiving L_Port has available when a circuit is first established. Communicated through PLOGI, PDISC link services, or FLOGI.

Loop Circuit

A temporary bidirectional communication path established between L_Ports.

Loop Failure

Loss of signal within a loop for any period of time, or loss of synchronization for longer than the time-out value.

Loop Initialization

The logical procedure used by an L_Port to discover its environment. Can be used to assign AL_PA addresses, detect loop failure, or reset a node.

Loop_ID

A hex value representing one of the 127 possible AL_PA values in an arbitrated loop.

Looplet

A set of devices connected in a loop to a port that is a member of another loop.

LPSM

Loop Port State Machine; the logical entity that performs arbitrated loop protocols and defines the behavior of L_Ports when they require access to an arbitrated loop.

LWL

Long Wavelength; a type of fiber optic cabling that is based on 1300-nm lasers and supports link speeds of 1.0625 Gbps. May also refer to the type of GBIC or SFP. See also *SWL*.

Master Port

As relates to trunking, the port that determines the routing paths for all traffic flowing through the trunking group. One of the ports in the first ISL in the trunking group is designated as the master port for that group. See also *ISL Trunking*.

MIB

Management Information Base; an SNMP structure to help with device management, providing configuration and device information.

Monitoring State

The state in which a port is monitoring the flow of information for data relevant to the port.

Multicast

The transmission of data from a single source to multiple specified N_Ports (as opposed to all the ports on the network). See also *Broadcast*, *Unicast*.

Multimode

A fiber optic cabling specification that allows up to 500 meters between devices.

N_Port

Node Port; a port on a node that can connect to a Fibre Channel port or to another N_Port in a point-to-point connection. See also *NL_Port*, *Nx_Port*.

NAA

Network Address Authority. An identifier that indicates the format of a network address.

Name Server

Frequently used to indicate Simple Name Server. See also *SNS*.

NL_Port

Node Loop Port; a node port that has arbitrated loop capabilities. Used to connect an equipment port to the fabric in a loop configuration through an FL_Port. See also *N_Port*, *Nx_Port*.

Node Name

The unique identifier for a node, communicated during login and port discovery.

Node

A Fibre Channel device that contains an N_Port or NL_Port.

Non-participating Mode

A mode in which an L_Port in a loop is inactive and cannot arbitrate or send frames, but can retransmit any received transmissions. This mode is entered if there are more than 127 devices in a loop and an AL_PA cannot be acquired. See also *L_Port*, *Participating Mode*.

Nx_Port

A node port that can operate as either an N_Port or NL_Port.

Open Originator

The L_Port that wins arbitration in an arbitrated loop and sends an OPN ordered set to the destination port, then enters the Open state.

Open Recipient

The L_Port that receives the OPN ordered set from the open originator, and then enters the Open state.

Open State

The state in which a port can establish a circuit with another port. A port must be in the Open state before it can arbitrate.

OPN

Open Primitive Signal. The protocol used by a port that has won arbitration in an arbitrated loop to establish a circuit.

Ordered Set

A transmission word that uses 8B/10B mapping and begins with the K28.5 character. Ordered sets occur outside of frames, and include the following items:

- *Frame delimiters* Mark frame boundaries and describe frame contents.
- *Primitive signals* Indicate events.
- *Primitive sequences* Indicate or initiate port states.

Ordered sets are used to differentiate Fibre Channel control information from data frames and to manage the transport of frames.

Packet

A set of information transmitted across a network. See also *Frame*.

Participating Mode

A mode in which an L_Port in a loop has a valid AL_PA and can arbitrate, send frames, and retransmit received transmissions. See also *L_Port, Non-participating Mode*.

Path Selection

The selection of a transmission path through the fabric. The Compaq switches use the FSPF protocol.

Phantom Address

An AL_PA value that is assigned to an device that is not physically in the loop. Also known as phantom AL_PA.

A twenty-bit public address created for an 8-bit loop device to allow public devices to access it.

Phantom Device

A device that is not physically in an arbitrated loop, but is logically included through the use of a phantom address.

PLOGI

Port Login; the port-to-port login process by which initiators establish sessions with targets. See also *FLOGI*.

Point-to-point

A Fibre Channel topology that employs direct links between each pair of communicating entities. See also *Topology*.

Port Cage

The metal casing extending out of the optical port on the switch, and in which the SFP can be inserted.

Port_Name

The unique identifier assigned to a Fibre Channel port. Communicated during login and port discovery.

POST

Power On Self-Test; a series of tests run by a switch after it is turned on.

Private Device

A device that supports arbitrated loop protocol and can interpret 8-bit addresses, but cannot log into the fabric.

Private Loop

An arbitrated loop that does not include a participating FL_Port.

Private NL_Port

An NL_Port that communicates only with other private NL_Ports in the same loop and does not log into the fabric.

Protocol

A defined method and a set of standards for communication.

Public NL_Port

An NL_Port that logs into the fabric, can function within either a public or a private loop, and can communicate with either private or public NL_Ports.

Public Device

A device that can log into the fabric and support 20-bit addresses (or has 20-bit phantom addresses created for it by the switch). See also *Phantom Addresses*

Public Loop

An arbitrated loop that includes a participating FL_Port, and may contain both public and private NL_Ports.

QuickLoop

A feature that makes it possible to allow private devices within loops to communicate with public and private devices across the fabric through the creation of a larger loop.

May also refer to the arbitrated loop created using this software. A QuickLoop can contain a number of devices or looplets; all devices in the same QuickLoop share a single AL_PA space.

R_A_TOV

Resource Allocation Time-out Value; the maximum time a frame can be delayed in the fabric and still be delivered. See also *E_D_TOV*, *RR_TOV*.

Route

As applies to a fabric, the communication path between two switches. May also apply to the specific path taken by an individual frame, from source to destination. See also *FSPF*.

Routing

The assignment of frames to specific switch ports, according to frame destination.

RR_TOV

Resource Recovery Time-out Value; the minimum time a target device in a loop waits after a LIP before logging out a SCSI initiator. See also *E_D_TOV*, *R_A_TOV*.

RSCN

Registered State Change Notification; a switch function that allows notification of fabric changes to be sent from the switch to specified nodes.

RX_ID

Responder Exchange Identifier. A 2-byte field in the frame header used by the responder of the Exchange to identify frames as being part of a particular exchange.

SAN

Storage Area Network; a network of systems and storage devices that communicate using Fibre Channel protocols. See also *Fabric*.

Sequence

A group of related frames transmitted in the same direction between two N_Ports.

Service Rate

The rate at which an entity can service requests. See also *Request Rate*.

Single Mode

The fiber optic cabling standard that corresponds to distances of up to 10 km between devices.

SI

Sequence Initiative.

SNMP

Simple Network Management Protocol. An internet management protocol that uses either IP for network-level functions and UDP for transport-level functions, or TCP/IP for both. Can be made available over other protocols, such as UDP/IP, because it does not rely on the underlying communication protocols. See also *Community (SNMP)*.

SNMPv1

The original _SNMP protocol, now labeled v1.

SNS

Simple Name Server; a switch service that stores names, addresses, and attributes for up to 15 minutes, and provides them as required to other devices in the fabric. SNS is defined by Fibre Channel standards and exists at a well-known address. May also be referred to as directory service. See also *FS*.

Switch Name

The arbitrary name assigned to a switch.

Switch Port

A port on a switch. Switch ports can be E_Ports, F_Ports, or FL_Ports.

Switch

Hardware that routes frames according to Fibre Channel protocol and is controlled by software.

SWL

Short Wavelength; a type of fiber optic cabling that is based on 850-nm lasers and supports 1.0625-Gbps link speeds. May also refer to the type of GBIC or SFP. See also *LWL*.

Target

A storage device on a Fibre Channel network. See also *Initiator*.

Tenancy

The time from when a port wins arbitration in a loop until the same port returns to the monitoring state. Also referred to as loop tenancy.

Throughput

The rate of data flow achieved within a cable, link, or system. Usually measured in bps (bits per second). See also *Bandwidth*.

Topology

As applies to Fibre Channel, the configuration of the Fibre Channel network and the resulting communication paths allowed. There are three possible topologies:

- Point to point - A direct link between two communication ports.
- Switched fabric - Multiple N_Ports linked to a switch by F_Ports.
- Arbitrated loop - Multiple NL_Ports connected in a loop.

Transfer State

The state in which a port can establish circuits with multiple ports without reentering the arbitration cycle for each circuit. This state can only be accessed by an L_Port in the Open state.

Translative Mode

A mode in which private devices can communicate with public devices across the fabric.

Transmission Character

A 10-bit character encoded according to the rules of the 8B/10B algorithm.

Transmission Word

A group of four transmission characters.

Trap (SNMP)

The message sent by an SNMP agent to inform the SNMP management station of a critical error. See also *SNMP*.

Tunneling

A technique for enabling two networks to communicate when the source and destination hosts are both on the same type of network, but are connected by a different type of network.

U_Port

Universal Port; a switch port that can operate as a G_Port, E_Port, F_Port, or FL_Port. A port is defined as a U_Port when it is not connected or has not yet assumed a specific function in the fabric.

UDP

User Datagram Protocol; a protocol that runs on top of IP and provides port multiplexing for upper-level protocols.

ULP_TOV

Upper-level Time-out Value; the minimum time that a SCSI ULP process waits for SCSI status before initiating ULP recovery.

ULP

Upper-level Protocol; the protocol that runs on top of Fibre Channel. Typical upper-level protocols are SCSI, IP, HIPPI, and IPI.

Unicast

The transmission of data from a single source to a single destination. See also *Broadcast*, *Multicast*.

Well-known Address

As pertaining to Fibre Channel, a logical address defined by the Fibre Channel standards as assigned to a specific function, and stored on the switch.

Workstation

A computer used to access and manage the fabric. May also be referred to as a management station or host.

WWN

Worldwide Name; an identifier that is unique worldwide. Each entity in a fabric has a separate WWN.

Xmitted Close State

The state in which an L_Port cannot send messages, but can retransmit messages within the loop. A port in the XMITTED CLOSE state cannot attempt to arbitrate.

Zone Configuration

A specified set of zones. Enabling a configuration enables all zones in that configuration. See also *Defined Configuration*, *Enabled Configuration*.

Zone

A set of devices and hosts attached to the same fabric and configured as being in the same zone. Devices and hosts within the same zone have access permission to others in the zone, but are not visible to any outside the zone. See also *Zoning*.

Zoning

A feature that runs on Fabric OS and allows partitioning of the fabric into logical groupings of devices. Devices in a zone can only access and be accessed by devices in the same zone. See also *Zone*.

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