



StorageWorks Fibre Channel Storage Switch User's Guide

AA-RHBYA-TE 135267-001

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Compaq Computer Corporation

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About This Guide

This guide is designed to be used as step-by-step instructions for installation and as a reference for operation, troubleshooting, and future upgrades.

Text Conventions

This document uses the following conventions to distinguish elements of text:

| | |
|-------------|--|
| Keys | Keys appear in boldface. A plus sign (+) between two keys indicates that they should be pressed simultaneously. |
| USER INPUT | User input appears in a different typeface and in uppercase. |
| Type | When you are instructed to <i>type</i> information, type the information without pressing the Enter key. |
| Enter | When you are instructed to <i>enter</i> information, type the information and then press the Enter key. |

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 loss of information.

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

These icons may be located on equipment in areas where hazardous conditions may exist.



Any 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. If this surface is contacted, the potential for injury exists.

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 equipment is supplied by multiple sources of power.

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

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.
 - The stabilizing feet are attached to the rack if it is a single rack installations.
 - The racks are coupled together in multiple rack installations.
 - A rack may become unstable if more than one component is extended for any reason. Extend only one component at a time.
-

Getting Help

If you have a problem and have exhausted the information in this guide, you can get further information and other help in the following locations.

Compaq Technical Support

You are entitled to free hardware technical telephone support for your product for as long you own the product. A technical support specialist will help you diagnose the problem or guide you to the next step in the warranty process.

In North America, call the Compaq Technical Phone Support Center at 1-800-OK-COMPAQ¹. This service is available 24 hours a day, 7 days a week.

¹ For continuous quality improvement, calls may be recorded or monitored.

Outside North America, call the nearest Compaq Technical Support Phone Center. Telephone numbers for world wide Technical Support Centers are listed on the Compaq website. Access the Compaq website by logging on to the Internet at <http://www.compaq.com>.

Be sure to have the following information available before you call Compaq:

- Technical support registration number (if applicable)
- Product serial number (s)
- Product model name(s) and numbers(s)
- Applicable error messages
- Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level
- Detailed, specific questions

Compaq Website

The Compaq website has information on this product as well as the latest drivers and Flash ROM images. You can access the Compaq website by logging on to the Internet at <http://www.compaq.com>.

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.

Chapter 1

Introduction

Option Kits

The StorageWorks Fibre Channel Storage Switch is a key component of the Enterprise Network Storage Area (ENSA) implementation. The Switch is used to connect network servers with storage devices, such as Compaq's RA8000/ESA12000 HSG80 RAID Array Storage Subsystems, to create a Storage Area Network (SAN). There are two Switch Option Kits (Models), an 8-port model and a 16-port model. The 8-port model contains four dual-port interface cards; the 16-port model has eight interfaced card installed on the motherboard.

NOTE: Note: Zoning, Cascading, FL_ports, SES, and Copper Media are not fully supported by Compaq as of April 1999. However, the software bundle that enables these features is included in the software package with this Switch and is provided at no additional cost so that customers may have the opportunity to become familiar with these advanced SAN functions. Compaq will support many of these and other SAN functions in the future. Contact your Compaq Authorized Reseller or Compaq Account Representative for specific information on these features.

**Table 1-1
Option Kits**

| Model | Part Number |
|---|---------------------------|
| 8-port Fibre Channel Switch, rack mount kit, software/doc. kit, no GBICs | DS-DSGGA-AA 380591-B21 |
| 16-port Fibre Channel Switch, rack mount kit, software/doc. kit, no GBICs | DS-DSGGA-AB 380578-B21 |

The Switch supports up to 16 fibre channel ports and consists of a motherboard, processor board, connectors for supporting up to 8 dual-port interface cards, and software for building and managing a Fibre Channel Fabric. The primary function of a Fabric is to receive frames from a source N_Port (host bus fibre channel adapter or fibre channel storage) and route the frames to the destination N_Port whose address identifier is specified in the frame.

Front Panel Features

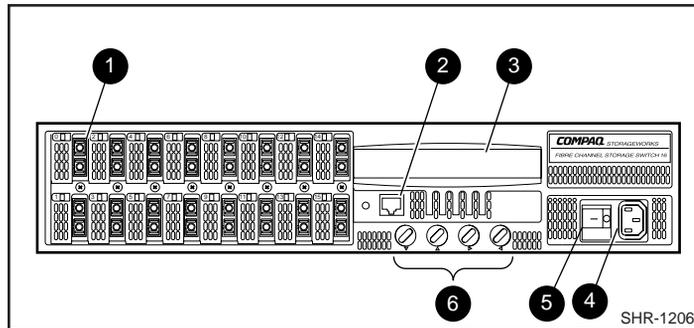


Figure 1-1. Storage Switch Front Panel

- ❶ Fibre Channel Port: Connects the Switch to the Fabric.
- ❷ RJ45 Ethernet Connector: Connects the Switch to the network for out-of-band management of the Switch.

- ③ Front Panel Display: Shows menu selections. Used to configure and manage the Switch using the front panel controls.
- ④ Power Connector: Connects the Switch to the power source.
- ⑤ ON/OFF Switch: Turns the Switch ON and Off.
- ⑥ Front Panel Controls: The front panel controls are used to navigate through the built-in menus and to make menu selections.

Chapter 2

Installing the Switch

Installation Summary

To install the Switch you have to perform the following steps:

- Unpack the shipping container
- Select an operating location
- Select a Switch mounting method
- Install the Gigabit Interface Converter (GBIC) modules (ordered separately)
- Connect cables to the Switch
- Turn on the power to the Switch
- Enter the IP address.

Package Contents

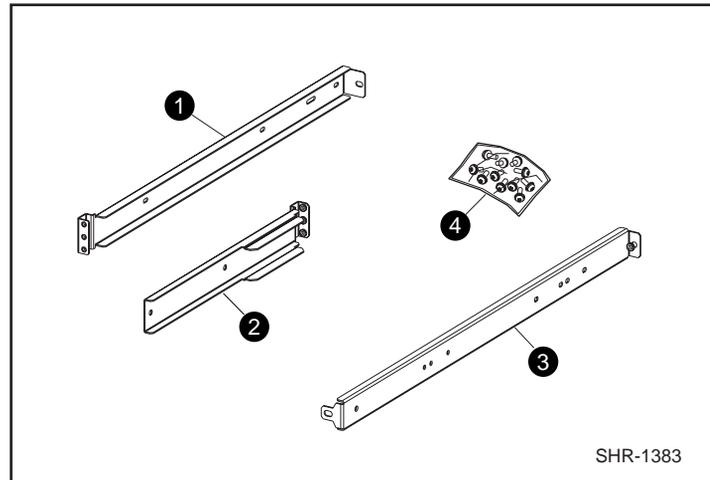
Make sure the following items are included in the shipment:

- A 16-port Fibre Channel Switch (380578-B21) or an 8-port Fibre Channel Switch (380591-B21)
- Two ac power cords: one for rack mounting the Switch; one for table top use
- Interface cards (already installed in the Switch)

- A software and documentation kit
- An Installation Kit that includes rubber mounting feet
- A Universal Mounting Kit for mounting the Switch in an equipment rack. Table 2-1 describes the kit contents, while Figure 2-1 illustrates the parts.

Table 2-1
Universal Mounting Kit Parts

| Part Description | Part Number | Quantity |
|-------------------------|-------------|----------|
| Slide bracket | 74-60352-01 | 2 |
| Mounting bracket | 74-60354-01 | 2 |
| Extender bracket | 74-60353-01 | 2 |
| Screw, SEMS, 10-32x9/32 | 12-21368-04 | 4 |
| Screw, SEMS, 10-32x5/8 | 12-21368-02 | 16 |
| Push mount cable tie | 90-11456-01 | 2 |
| Clip nut | 90-07786-00 | 4 |
| Alignment washer | 74-60363-01 | 8 |
| Installation Guide | EK-GGAAB-IG | 1 |
| Mounting template | EK-GGAAB-RT | 1 |



❶ Mounting bracket; ❷ Extender bracket; ❸ Slide bracket; ❹ Hardware bag
Figure 2-1. Universal Mounting Kit Parts

Selecting an Operating Location

The Switch should be located in a secure or limited-access place to control use of the Switch front panel controls, and to ensure that cable connections are not compromised. The operating location you select for the Switch must meet cooling air requirements and power requirements.

Cooling Air Requirements

Cooling air is drawn into the Switch chassis by the power supply fan and by two other fans mounted on the rear of the chassis; the air is expelled through vents in the front of the chassis. The combined air flow through the Switch is 75 cubic feet per minute (cfpm), and nominal bulk flow of 15 cfpm.



CAUTION: Do not block the front or rear air vents. The Switch must have free access to ambient air for cooling.

Power Requirements

You connect the ac power cord to a switched connector on the bottom right side of the Switch front panel. The ac power source must meet these requirements:

- A properly-wired, earth-grounded ac outlet
- Voltage capability of 90–134 Vac or 180–257 Vac, and IEC 801-5 surge voltage
- Input voltage frequency of 50–60 Hz
- Power capability of 219 watts, maximum.

The Switch has an autoranging power supply that automatically accepts voltages within its range. There is no provision for surge protection built into the Switch power supply so the ac source should include provisions to assure clean ac power.

Selecting a Switch Mounting Method

The Switch can be placed on a table top or other surface, or it can be mounted in an equipment rack.

Placing the Switch on a Surface (Table-top Mounting)

You can set the Switch on a surface, such as a table top, and operate it from that location. Although adhesive rubber feet are included in the Installation Kit, they are not necessary for proper or safe operation of the Switch. If you want to install the rubber feet, perform these steps:

- Use the alcohol wipes to clean the depression in each corner of the bottom of the chassis; allow the alcohol to dry.
- Remove the rubber feet from the sheet and insert one in each depression.
- Press the rubber feet in place firmly.

For table-top mounting continue the installation procedure with Installing the GBIC Modules.

NOTE: If you attach rubber feet, you have to remove them before you can install the Switch in a 19-inch equipment rack.

Mounting the Switch in an Equipment Rack

You can install the Switch in a RETMA 41U or 42U rack, in a Compaq rack, or in a metric SW600 rack. Observe the following guidelines:

- When you install the Switch in a closed or multi-rack assembly, be sure the air temperature measured at the Switch front panel does not exceed 40° C (104° F).
- Make sure the air flow to the Switch is at least 300 cfpm.
- Verify that when the Switch is installed it does not unbalance the rack or exceed the rack mechanical limits, both with the slide brackets secured and with the slide brackets fully extended.
- Verify that the supply circuit, the line fuse, and the wire size are appropriate for the service.
- Verify that all the other equipment installed in the rack has a reliable ground connection; do not rely on connection to a branch circuit, such as a power strip.
- Route and support the power cord to ensure that the Switch moves freely on the slide brackets without crimping or chafing the power cord, or interfering with other equipment and cables installed in the rack.

Before you install the Switch in the rack you must attach mounting brackets to the rack rails. Where you attach the mounting brackets vertically in the rack depends on your installation, i.e., what other equipment is mounted in the rack along with the Switch. The only tool you need is a Number 2 Phillips screwdriver. Perform the applicable procedure from the following subsections.

Attaching Mounting Brackets in a RETMA 41U Rack

You mount the Switch in this rack from the front of the rack only. Perform the following steps:

1. Position the mounting template against the front and rear vertical rails (Figure 2–2), first on one side of the cabinet and then on the other side; make sure the template is parallel from front-to-rear.

IMPORTANT: The template front should be positioned against the front rail, while the template rear should be positioned against the rear rail.

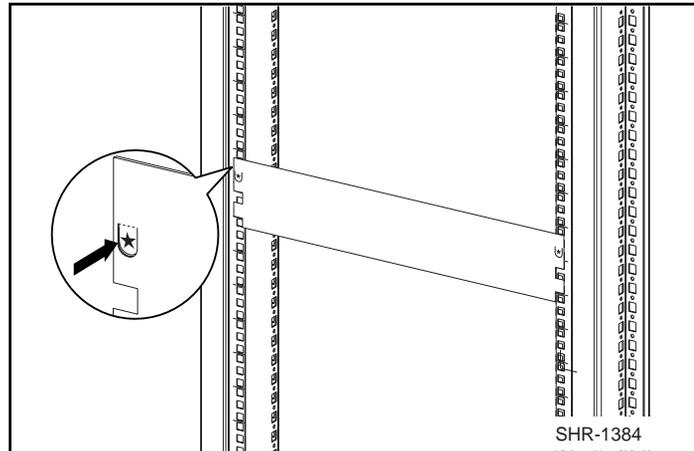
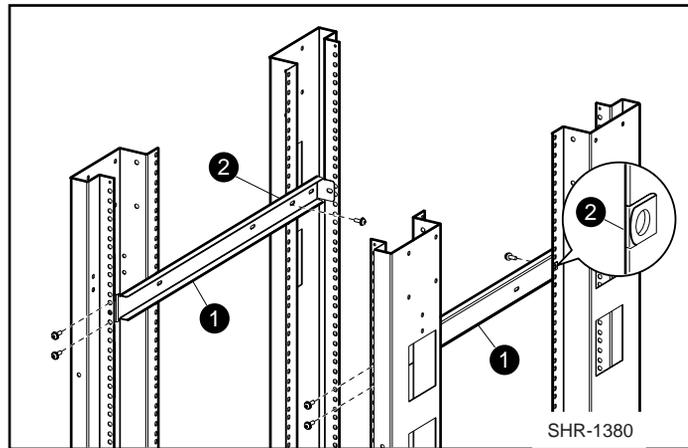


Figure 2-2. Positioning the Mounting Template

2. Pencil-mark the mounting bracket holes on each side of the rack with an *M*.
3. Slide a clip nut over the marked hole on each rear rail (Figure 2-3).
4. Attach a mounting bracket to the rails on each side of the rack and secure each bracket with three 10-32x5/8 SEMS screws; tighten the screws at the front before you tighten the one at the rear.
5. Go to the section entitled *Attaching the Slide Brackets to the Switch*.



❶ Mounting bracket; ❷ Clip nut

Figure 2-3. Installing the Mounting Brackets in a RETMA 41U Rack

Attaching Mounting Brackets in a RETMA 42U or Compaq Rack

You can mount the Switch in this rack from either the front or the rear of the rack. Perform the following steps:

1. Position the mounting template against the front and rear vertical rails (Figure 2-2), first on one side of the cabinet and then on the other side; make sure the template is parallel from front-to-rear.

IMPORTANT: In a rack-front installation the template front should be positioned against the front rail; in a rack-rear installation the template front should be positioned against the rear rail.

2. Pencil-mark the mounting bracket holes on each side of the rack with an *M*.
3. Connect an extender bracket to each mounting bracket using two SEMS 10-32x5/8 screws (Figure 2-4); just finger-tighten the screws.

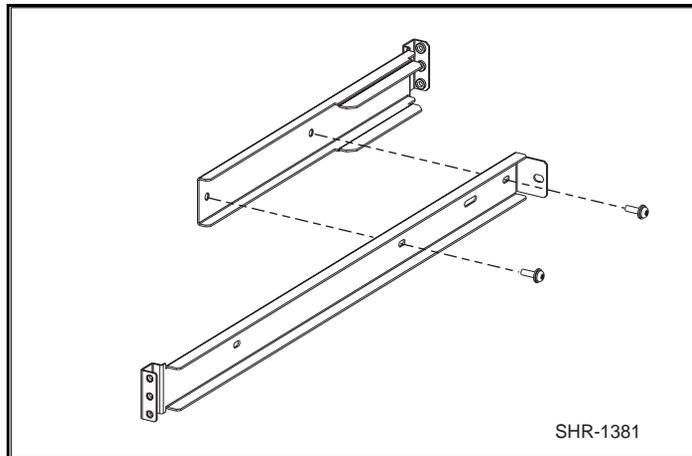


Figure 2-4. Connecting an Extender Bracket to a Mounting Bracket

4. Insert an alignment washer into each of the eight rail holes marked *M* (Figure 2-5).

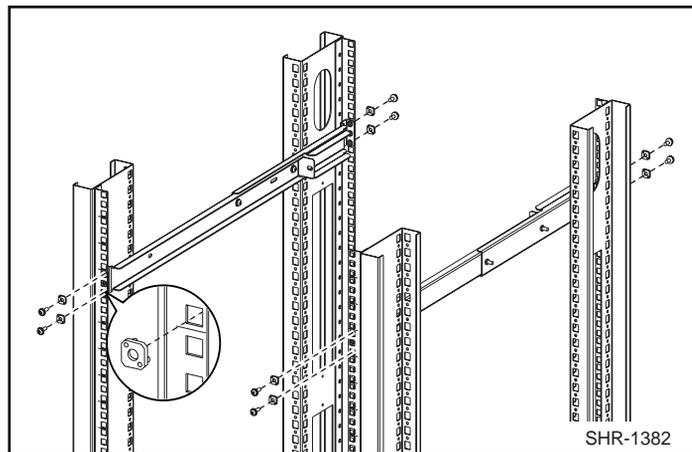


Figure 2-5. Installing the Mounting Brackets in a RETMA 42U or Compaq Classic Rack

5. Attach each mounting bracket to the rack rails by inserting SEMS 10-32x5/8 screws through the alignment washers into the bracket holes; tighten all the screws.
6. Tighten the four screws that connect the extender brackets to the mounting brackets.

IMPORTANT: These screws must be fully tightened to ensure to strength of the extended bracket.

7. Go to the subsection entitled *Attaching the Slide Brackets to the Switch*.

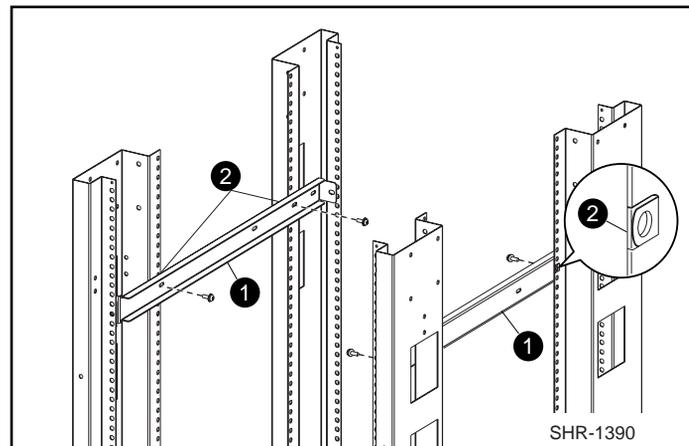
Attaching Mounting Brackets in a Metric Rack

You mount the Switch in this rack from the front of the rack only. Perform the following steps:

1. Position the mounting template against the front and rear vertical rails (Figure 2–2), first on one side of the cabinet and then on the other side; make sure the template is parallel from front-to-rear.

IMPORTANT: The template front should be positioned against the front rail, while the template rear should be positioned against the rear rail.

2. Pencil-mark the mounting bracket holes on each side of the rack with an *M*.
3. Slide a clip nut over each hole identified as a clip nut mounting hole (Figure 2–6).



❶ Mounting bracket; ❷ Clip nut

Figure 2-6. Installing the Mounting Brackets in a Metric Rack

4. Attach a mounting bracket to the rails on each side of the rack and secure each bracket with 10–32x5/8 SEMS screws.
5. Go to the subsection entitled *Attaching the Slide Brackets to the Switch*.

Attaching the Slide Brackets to the Switch

You attach the slide brackets to the Switch using different bracket mounting holes for a rack-front installation than for a rack-rear installation. Use Figure 2-7 or Figure 2-8 to guide you in installing the slide brackets on the Switch; attach each bracket with two SEMS 10-32 x 9/32 pan-head screws.



CAUTION: Make sure you use the right screws. If you use screws longer than 9/32", you can damage the Switch.

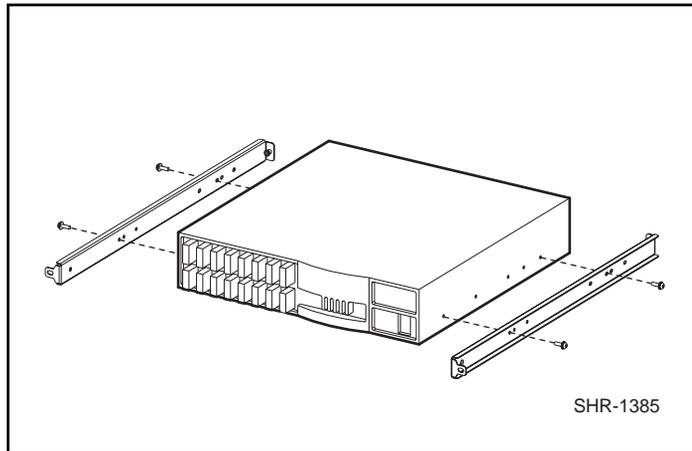


Figure 2-7. Attaching the Slide Brackets, Rack-Front Installation

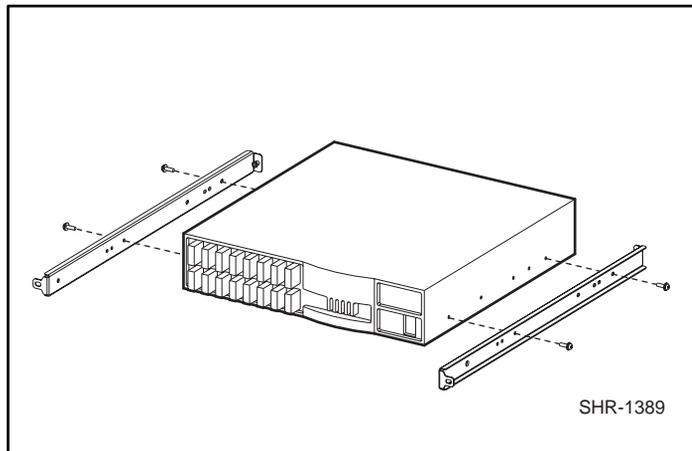


Figure 2-8. Attaching the Slide Brackets, Rack-Rear Installation

Installing the Switch in the Rack

To install the Switch in the rack you have to lift up the Switch and insert the slide brackets into the mounting brackets.



CAUTION: Make sure you keep the Switch parallel to the floor when you insert the slide brackets into the mounting brackets; you could damage the brackets if you tilt the Switch.

Slide the Switch all the way into the mounting brackets and secure the slide brackets in the mounting brackets with four SEMS 10–32 x 5/8 pan-head screws (Figures 2–9 and 2–10).

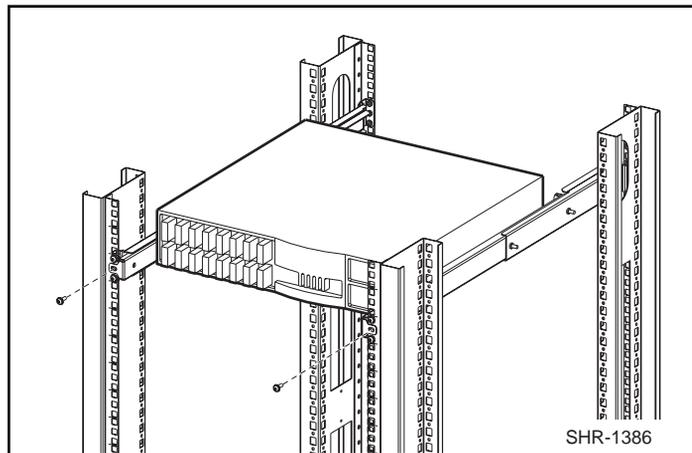


Figure 2-9. Securing the Brackets in the Front

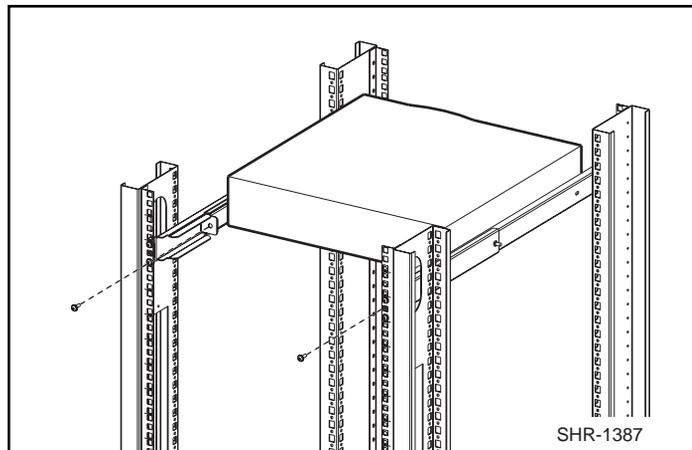


Figure 2-10. Securing the Brackets in the Rear

Installing GBIC Modules

Each interface card installed in the Switch has two G_Ports. A GBIC module must be installed in each G_Port in order to use that port. Perform the following steps to install a GBIC module.



CAUTION: The GBIC modules contain static sensitive components. Use ESD precautions when handling this card.



CAUTION: When you insert the GBIC module in the next step, do not force the module if you feel resistance.

1. Insert the GBIC module into the G_Port. The module is keyed and you can insert it only one way; if you feel resistance after you have inserted the module about an inch into the G_Port, you have oriented it incorrectly. When it is oriented correctly, be sure the locking bar on the front of the module is positioned to the right.
2. When the GBIC module is fully inserted lock it in place by moving the locking bar to the left.
3. Insert a rubber protective plug over the module fiber-optic connectors.
4. Repeat the procedure for each GBIC module to be installed.

Connecting Cables to the Switch

All cables connect at the front of the Switch. Install two push-mount cable ties so you can route the power and data cables along the rack rails (Figure 2-11).

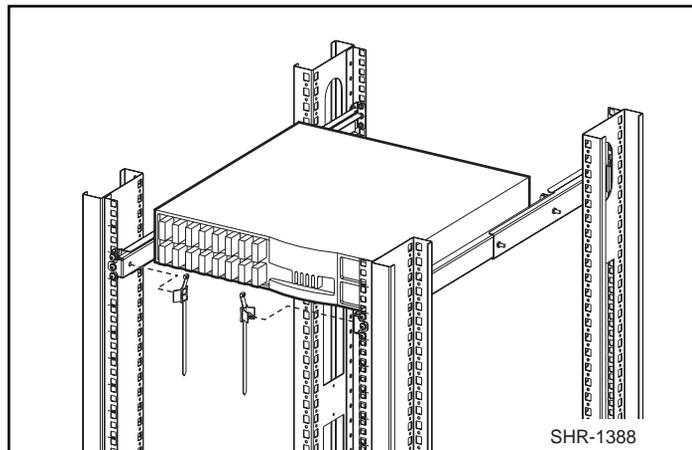


Figure 2-11. Attaching Cable Ties to the Rack Rails

Connecting the StorageWorks Subsystem and the Host to the Switch

The StorageWorks subsystem and the host connect to the Switch by fiber-optic cables that have the specifications shown in Table 2-2.

Table 2-2
Fiber-optic Cable Specifications

| Item | Specific ation |
|----------------------|--|
| Cable type | Multimode fiber, 50 μm or 62.5 μm core diameter; 125 μm cladding diameter |
| Connector type | Duplex SC plug connectors |
| Maximum cable length | 500 meters (1641 feet) 50 μm /125 μm 200 meters (656 feet) 62.5 μm 125 μm |
| GBIC module type | Shortwave (770–850) μm , without open-fiber control |

The SC connectors, ❶ and ❷ (Figure 2-12), are indexed and must be inserted into the GBIC module connectors properly. Remove the protective cover from the GBIC connector and make sure the fiber surface of all the connectors are clean and free of dust or debris before mating the connectors.

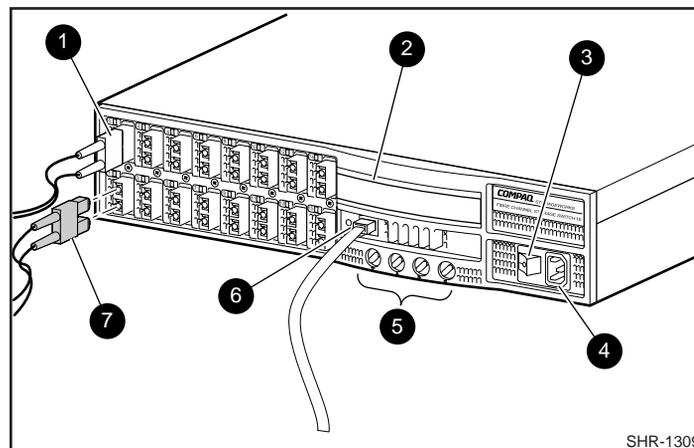


Figure 2-12. Switch Cable Connections

Connecting an Ethernet Network to the Switch

Connect an Ethernet 10BaseT network to the Switch by plugging in the Ethernet cable at the RJ-45 connector ⑥.

Connecting the Power Cable to the Switch

Connect the ac power cable to the Switch ac connector ④.

Turn on the Power to the Switch

Turn on the ac power switch ⑤. The Switch runs the power-on self test (POST). The front panel display ② shows the tests performed in serial fashion:

- Memory test
- Port register test
- Central memory test
- Port loop-back test.

When each test completes successfully, the message “Passed” appears on the display. When all the tests have been completed the display returns to the normal dark condition, and the Port LEDs show a steady green light. Refer to Table 2-2 for the meaning of the different LED states.

If the POST encounters errors, the last error discovered is retained on the front panel display after the POST is complete. If the POST is completed successfully, the Switch is ready to operate.

Table 2-3
Port LED Status Indicators

| Port's LED | Port's LED |
|------------------|---|
| No light showing | No light or signal carrier (no module, no cable) for media interface LEDs. |
| Steady yellow | Receiving light or signal carrier, but not yet online. |
| Slow yellow | Disabled (result of diagnostics or portDisable command). Flashes every 2 seconds. |

| | |
|------------------|--|
| Fast yellow | Error, fault with port. Flashes every 1/2 second. |
| Steady green | Online (connected with external device over cable) |
| Slow green | Online, but segmented (loopback cable or incompatible Switch) flashes every 2 seconds. |
| Fast green | Internal loopback (diagnostic). Flashes every 1/2 second. |
| Flickering green | Online and frames flowing through port. |

Enter the IP Address of Your Switch

To enter an IP address you use the front panel display and the four buttons under the display. (Refer to Chapter 3 for more information on managing the Switch using the front panel.) After the Switch successfully completes POST, proceed as follows:

1. Press the down-arrow button (far left button). The display shown Configuration Menu.
2. Press the left-arrow button, far right button. This button is the enter button. The display shows IP Address.
3. Press the enter button again. Use the right-arrow button to scroll through the IP address. After you have selected "IP Address", the up-arrow and down-arrow buttons allow you to increment and decrement each numeric entry.

Chapter 3

Managing the Switch

Switch Management Overview

This chapter contains general information and examples on managing and monitoring the Switch. This chapter discusses:

- Comparing Switch Management Methods
- Managing the Switch Using the Front Panel Controls
- Managing Via Telnet
- Managing with SNMP
- *syslog* Daemon
- Managing the Switch using StorageWorks Command Console (refer to Chapter 4 for an introduction to StorageWorks Command Console software).
- Managing the Switch Over the Web (Refer to Chapter 5)

Comparing Switch Management Access Methods

There are several access methods for managing a Switch. Table 3-1 summarizes the different management access methods.

| Method | Description | Local | In-Band (Fibre Channel) | Out-of-band (Ethernet) |
|-------------------------------|--|--------------|--|-----------------------------------|
| Front panel controls | Managed through control located on the Switch | Yes | No | No |
| Telnet commands | Managed remotely using Telnet commands | No | Yes | Yes |
| Managing with SNMP | Managed remotely using Simple Network Management Protocol (SNMP) | No | Yes | Yes |
| Web-based management | Managed remotely through web | No | Yes | Yes |
| Managing with Command Console | Managed remotely through Command Console | No | Yes | Yes |

NOTE: An advanced set of controls and displays are available using a Telnet connection for testing and debugging purposes. Before a Telnet connection can be established the Switch must have an IP address assigned to it, use the front panel buttons to assign an IP address.

To reset a Switch to factory default values, use the Reset to Default command described in Reset to Default. Before changing any factory default settings, become familiar with the operations described in this chapter including both the Switch's functions and interactive characteristics.

Figure 3-1 shows the various methods and communication paths for accessing Switch management information. (StorageWorks Comand Console GUI interface is not shown.)

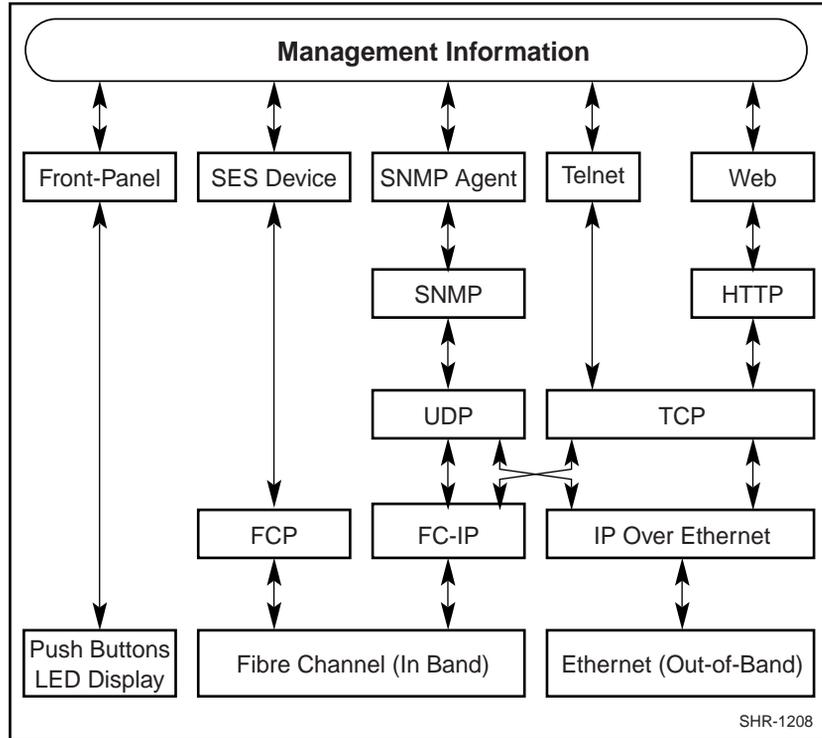


Figure 3-1. Methods for Managing Information

Fabric Management through a Single Ethernet Port

Multiple Compaq Storage Switches can be managed through a single IP connection to one of the Switches using Telnet services, Web Tools or SNMP commands, shown in Figure 3-2. Each Switch supports a 10bT Ethernet connection that has generally been the link for IP services. There is a second IP connection, the Fibre Channel IP or in-band support which is also available for use when managing a Switch.

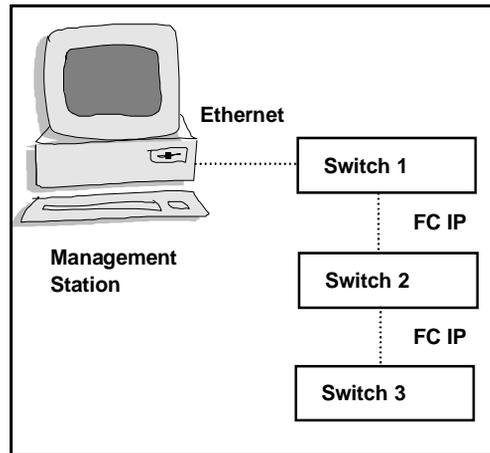


Figure 3-2. Single-port Management of Switches

At this point there are no Host Bus Adapters (HBAs) that can initiate in-band fibre channel IP connections. For that reason, it is necessary to have at least one Ethernet connection into the Fabric. From that one entry point, it is possible to manage the remaining Switches in the Fabric using in-band IP services.

The management workstation, which runs a browser, a Telnet session or SNMP, will need to be able to address the Switch that has an Ethernet connection. This means that the management workstation and the Ethernet IP address of the a Switch need to be in the same subnet. In addition, the management station must either have a static route to the FC IP subnet, or the Switch must be the default gateway for the management workstation. This will allow the management station to direct IP to or through the Switch.

The Switches not connected to the Ethernet must have their default gateways set to the Fibre Channel IP address of the Switch connected to the Ethernet. Also, these Switches must have their FC IP addresses in a different subnet from the Ethernet IP addresses of the management station. Lastly, the FC IP addresses of all Switches must be in the same subnet. Example settings follow:

| | Management Station | Switch 1 | Switch 2 | Switch 3 |
|---------------------|--------------------|---------------|---------------|---------------|
| Ethernet IP Address | 192.168.1.09 | 192.168.1.10 | 204.1.1.11 | 204.1.1.12 |
| FC IP Address | 192.168.65.09 | 192.168.65.10 | 192.168.65.11 | 192.168.65.12 |
| Default Gateway | 192.168.65.10 | (any) | 192.168.65.10 | 192.168.65.10 |

The effect of this special connectivity is that the route to all switches will be through the single Switch with the Ethernet connection. The route back to the workstation from the other Switches will also be through that initial Switch. The initial Switch, which has both Ethernet and FC IP capability, will act as a “bridge” in that it will route between Ethernet and FC IP to send the traffic to the right place with the right protocol.

Managing Using the Front Panel Buttons

Figure 3-1 shows the front panel buttons, they allow you to select the following menus:

- Configuration Menu
- Operation Menu
- Status Menu
- Test Menu.

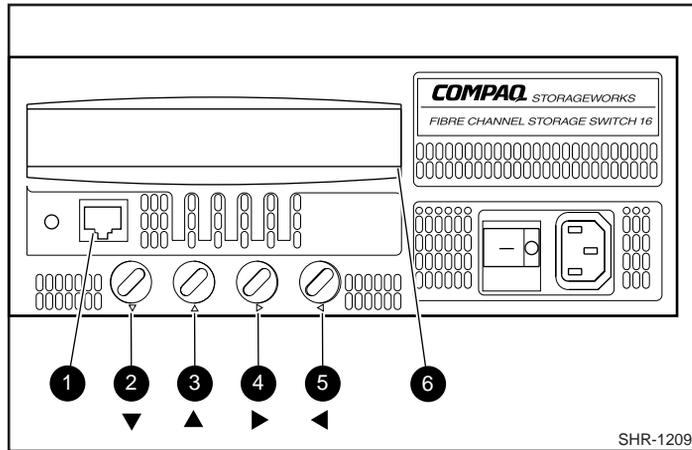


Figure 3-3. Front Panel Buttons

Table 3-2 lists the primary control button functions. Button function changes depending on the menu level. Buttons either control navigating through the menus or incrementing/decrementing numeric values.

Table 3-2
Front Panel Control Buttons

| Item Number | Control Button | Description |
|-------------|----------------|---|
| 2 | <Down> | <Down> scrolls down the command list, or if the user is changing a numeric display, it decrements the displayed value. |
| 3 | <Up> | <Up> scrolls up the command list, or if the user is changing a numeric display, pressing this button increments the numeric value. |
| 4 | <Tab/Esc> | <Tab/Esc> tabs through multiple options. When displaying a menu item, pressing the <Tab/Esc> button reverses through previous commands and, if pressed repeatedly, turns off the front panel display. |
| 5 | <Enter> | <Enter> accepts the input and executes the selected function. To abort an entry, pressing <Tab/Esc> navigates to the previous item. |

When entering a number, the <Up> and <Down> buttons start in the slow mode and change to, if either button is held down, the fast mode. Most numbers go to a maximum of 255; for a large number, it may be faster to use the <Down> button.

Activating Menu Display

The Switch's front panel display is normally not illuminated. Pressing any front panel buttons activates the display: If no command is issued, the display turns off after 30 seconds

Menus

The menus are controlled using front panel buttons. From the initial display, users can navigate to commands and configure the Switch. The following menus are discussed:

- Configuration Menu
- Operation Menu
- Status Menu
- Test Menu.

Table 3-3 shows the front panel commands and their equivalent Telnet command.

NOTE: For most applications default values should be used.

**Table 3-3
Front Panel and Telnet Commands**

| Menu | FRONT PANEL | TELNET COMMAND | DEFAULT |
|-----------------------|--------------------------|----------------|----------------------------|
| Configuration | Ethernet IP Address | ipAddrSet | 192.168.90.x |
| | Ethernet Subnetmask | ipAddrSet | none |
| | Fibre Channel IP Address | ipAddrSet | 192.168.91.1 |
| | Fibre Channel Subnetmask | ipAddrSet | |
| | Gateway Address | ipAddrSet | none |
| | Domain | flashSet | 1 |
| | BB_credit | flashSet | 16 (G_Port) 0 (FL_Port) |
| | R_A_TOV | flashSet | 10000 |
| | E_D_TOV | flashSet | 2000 |
| | Operating Mode | flashSet | 0 |
| | VC Link Ctl | flashSet | 0 |
| | VC Class 2 | flashSet | 2 |
| | VC Class 3 | flashSet | 3 |
| | VC Multicast | flashSet | 7 |
| | VC Priorities | flashSet | 0,1,2,2,2,2,3,3 |
| Alternate BB_credit | flashSet | 0 | |
| Open/Opened BB_credit | flashSet | 4 | |
| Frame Collection | flashSet | 4 | |
| Reset to Default | flashDefault | Piling | |

continued

Table 3-3
Front Panel and Telnet Commands *continued*

| Menu | FRONT PANEL | TELNET COMMAND | DEFAULT |
|-----------|----------------------|-------------------------|---------|
| | Switch Offline | SwitchDisable | N/A |
| Operation | Switch Online | SwitchEnable | N/A |
| | Port Disable | portDisable <portno> | N/A |
| | Port Enable | portEnable <portno> | N/A |
| | Close Telnet Session | exit | N/A |
| | Reboot | reboot | N/A |
| Status | Switch Name | switchShow | N/A |
| | Worldwide Name | switchShow | N/A |
| | Firmware Version | version | N/A |
| | Current Date | date | N/A |
| | Booted At | dateShow | N/A |
| | Firmware Date | dateShow | N/A |
| | Flash Date | dateShow | N/A |
| | Boot Prom Date | dateShow | N/A |
| | Port Type | switchShow | N/A |
| | Module Type | switchShow | N/A |
| | Port Throughput | portPerfShow | N/A |
| | Temperature | tempShow | N/A |
| | Error Log | errShow | N/A |
| | License | licenseShow | N/A |
| Test | Switch Offline | SwitchDisable | N/A |
| | Switch Online | SwitchEnable | N/A |
| | Memory Test | ramTest | N/A |

continued

Table 3-3
Front Panel and Telnet Commands *continued*

| Menu | FRONT PANEL | TELNET COMMAND | DEFAULT |
|------|---------------------|-------------------|---------|
| | Port Register Test | portRegTest | N/A |
| | Central Memory Test | centralMemoryTest | N/A |
| | RDRAM Test | rdramTest | N/A |
| | Port Loopback Test | portLoopbackTest | N/A |
| | Cross Port Test | crossPortTest | N/A |
| | Spin Silk Test | spinSilk | N/A |
| | Display Test | N/A | N/A |
| | Push Button Test | N/A | N/A |

Configuration Menu

You configure the Switch using the Configuration Menu. Pressing <Enter> while in the `Configuration` Menu selects the option to choose commands:

IMPORTANT: After changing any IP address from the following menus from the front panel or Telnet, you must reboot the Switch for the changes to take effect.

Ethernet IP Address

Pressing <Enter>, while `Ethernet IP address` is selected, displays the Switch's Ethernet IP address:

Ethernet IP Address

10. 00. 00. 10

The Switch's default IP address, as shown, is a temporary address derived from the Switch's WWN. Enter a valid IP address.

NOTE: The IP address must have been previously installed using the front panel controls. Consult with the your network system administrator for the Switch's assigned IP address. Only one Telnet session is allowed at a time.

To enter an IP address:

1. Use <Up> and <Down> to increment or decrement the displayed value. The underlined cursor indicates the numbers to modify.

When entering a number, <Up> and <Down> start in the slow mode and move to the fast mode if the button is held down. The numbers go to a maximum of 255 and wraps to zero; for a large number, it may be faster to use the <Down> button.

2. After entering a number, press <Tab/Esc> to move the cursor to modify the next field.
3. After setting the IP address, pressing <Enter> stores the value.

Ethernet Subnetmask

Pressing <Enter>, while Ethernet Subnetmask is selected, displays:

```
Ethernet Subnetmask
  none
```

The default subnet mask value is *none*. Refer to the network administrator for the appropriate subnet mask.

Enter the Switch's subnet address by using <Up> and <Down> to increment or decrement the displayed value. The numbers with the underline cursor is the group to modify.

Fibre Channel IP Address

Pressing <Enter>, while Fibre Channel IP address is selected, displays:

```
Fibre Channel IP Address
  0 . 0 . 0 . 0
```

The default Fibre Channel IP address is 0 . 0 . 0 . 0, as shown in the example. Entering a valid non-zero IP address allows the Switch to transfer IP over the Fibre Channel and the ability to manage all other switches connected to the Fabric. All Switches must have Ethernet IP addresses on a different subnet than their FC IP addresses. The FC IP addresses of all Switches must be on the same subnet.

To update the Fibre Channel's IP address:

4. Use <Up> and <Down> to increment or decrement the displayed value. The underlined cursor indicates the numbers to modify.
5. After entering a number, press <Tab/Esc> to move the cursor to modify the next field.
6. After setting the Fibre Channel's IP address, pressing <Enter> stores the value.

Fibre Channel Subnetmask

Pressing <Enter>, while Fibre Channel Subnetmask is selected, displays:

```
Fibre Channel Subnetmask
none
```

The default subnetmask value is *none*, as shown in the example. Consult your network administrator for the appropriate subnetmask.

Enter the Switch's Fiber Channel Subnetmask by using <Up> and <Down> to increment or decrement the displayed value.

Gateway Address

Pressing <Enter>, while Gateway address is selected, displays:

```
Gateway Address
0.0.0.0
```

The default gateway address is shown above. You must enter a valid gateway address, if required.

To enter the gateway address:

1. Use <Up> and <Down> to increment or decrement the displayed value. The underlined cursor indicates the numbers to modify.
2. After entering a number, press <Tab/Esc> to move the cursor to modify the next field.
3. After setting the gateway address, pressing <Enter> stores the value.

Domain

Pressing <Enter>, while Domain is selected, displays:

```
Domain
1
```

The domain number uniquely identifies the Switch in a Fabric. This Switch ID is normally automatically assigned by the Switch and may be any value between 0 and 31. You may also assign the initial domain number manually.

The Switch with the lowest initial domain will become the master Switch and control the configuration.

BB_credit

Pressing <Enter>, while BB_credit is selected, displays:

```
BB_credit
16
```

The number represents the number of buffers, from 1 to 16, available to the host. The default for G_Port cards is 16. The BB_credit for FL_Port cards is 0. For a complete description of buffer-to-buffer credit, refer to the industry specification *Fibre Channel Physical and Signalling Interface (FC-PH)*.

R_A_TOV

Pressing <Enter>, while R_A_TOV is selected, displays:

```
R_A_TOV
10000
```

Resource Allocation Time Out Value (R_A_TOV) is adjustable in 1-second increments using front panel controls, but its value is displayed in milliseconds. This variable works with the variable E_D_TOV to determine the Switch's actions when presented with an error condition. Allocated circuit resources with detected errors are not released until the time value has expired. If the condition is resolved prior to the timing out, the internal time out clock resets and waits for the next error condition. The range is 1 to 120 seconds.

NOTE: The set value must be larger than the set value for the Error Detect Time Out Value

E_D_TOV

Pressing <Enter>, while E_D_TOV is selected, displays:

```
E_D_TOV  
2000
```

E_D_TOV (Error Detect Time Out Value) is adjustable in 1-second increments using the front panel controls, but its value is displayed in milliseconds.

NOTE: Use the flashSet command during a Telnet session to set the E_D_TOV or R_A_TOV value (in milliseconds) for values other than whole seconds.

This timer is used to flag a potential error condition when an expected response is not received (an acknowledgment or reply in response to packet receipt, for example) within the set time limit. If the time for an expected response exceeds the set value, then an error condition is met. The range is 1 to 60 seconds.

NOTE: The set value must be less than the set value for the Resource Allocation Time Out Value.

Operating Mode

Pressing <Enter>, while Operating Mode is selected, displays:

```
Operating Mode:  
0
```

The operating modes are determined by the host adapter. The five operating modes for the Switch are described in Table 3-4.

Table 3-4
Operating Mode Definitions

| Mode | Description |
|------|---|
| 0 | Normal operating mode, none of the following modes are in effect |
| 1 | Tachyon operating mode. Set this mode when there is one or more Tachyon host adapters connected to the Fabric, and a protocol other than SCSI-FCP is being used over this host adapter. When this mode is set, multiple Sequences from different sources will be interleaved to Tachyon at Sequence boundaries rather than at frame boundaries, resulting in better performance from Tachyon. |
| 2 | Isolated operating mode. Set this mode only if the switch's E_Port discovery process (transmission of a Class F frame) causes some attached device to fail. When this mode is set, switches will not join to become a Fabric. |
| 4 | No_Probe operating mode. Set this mode only if the switch's N_Port discovery process (PLOGI, PRLI, INQUIRY) causes some attached device to fail. When this mode is set, devices that do not register themselves with the Name Server will not be present in the Name Server data base. |
| 8 | No_MCast operating mode. Set this mode only if buffer-to-buffer credit values greater than 16 are needed, and broadcast and multicast are not needed. When this mode is set, the normal range of buffer-to-buffer credit is changed from 1-16 to 1-62 and broadcast and multicast are disabled. |

NOTE: These modes are additive, for example to set a Switch in Tachyon mode and in No_MCast mode, the operating mode should be set to 9. Any combination of bit maps can be set up to 16, all values above 16 are ignored.

Virtual Channels

The Switch provides the ability to tune the Switch in a specific application.

The first two virtual channels are reserved for the Switch's internal functions and are not available.

NOTE: The default virtual channel settings are already optimized for Switch performance. Changing the default values, if properly selected, may improve Switch performance somewhat, but may also severely degrade performance. You should not change these settings without fully understanding the change's effects.

VC Link Ctl

Pressing <Enter>, while VC Link Ctl is selected, displays:

VC Link Ctl

0

The Virtual Channel Link Control changes the link control channel. There are two options: 0 and 1.

Option 0 forces data receipt acknowledgments on Class 2 channels to be sent back on the data channel. This traffic consumes a portion of the available data channel bandwidth.

Option 1 allows data receipt acknowledgment packets to use the VC-1 (internal Switch traffic channel) which frees additional bandwidth in the data channel, and transfers the data receipt traffic load to the Switch's internal traffic channel.

VC Class 2

Pressing <Enter>, while VC Class 2 is selected, displays:

VC Class 2

2

This example shows the default channel as 2, but you can also select virtual channel 3, 4, or 5.

VC Class 3

Pressing <Enter>, while VC Class 3 is selected, displays:

VC Class 3

3

This example shows the default channel as 3, but you can select virtual channel 2, 4, or 5.

VC Multicast

Pressing <Enter>, while `VC Multicast` is selected, displays:

```
VC Multicast
7
```

The virtual channel multicast is shown as channel 7 in the example. You may change the multicast transmission channel to either virtual channel 6 or 7. Verify that the multicast channel has the frame class priority set to the frame class of the expected traffic.

VC Priorities

Pressing <Enter>, while `VC Priorities` is selected, displays:

```
VC Priorities
0.1.2.2.2.3.3
```

The numbers displayed show the priorities assigned to each of the Switch's virtual channels. Positions 1 and 2, starting at the left of the display, are fixed and displays 0 or 1.

The first position, a '0', shows and indicates that this virtual channel, assigned to handle internal Switch traffic, has the highest priority. This priority value cannot be changed by the user.

The second position, indicated with a 1, shows the priority assigned by the virtual channel link control as described in the *VC Link Ctl* on page 4-22.

The third through eighth positions can have only a 2 or a 3 indicating that the channel gives priority to either Class 2 frame traffic or to Class 3 frame traffic.

Alternate BB_credit

Pressing <Enter>, while `Alternate BB_credit` is selected, displays:

```
Alternate BB_credit
0
```

The number is used in an ACC to an NL_Port's FLOGI. If this number is 0, an NL_Port must wait for an R_RDY before it can send a frame to the FL_Port in a loop. If this number is 1, an NL_Port can immediately send a frame to the FL_Port without waiting for an R_RDY. Thus reducing the loop turn around

time and increases performance. For a complete description of buffer-to-buffer credit, refer to the industry specification *Fibre Channel Physical and Signalling Interface (FC-PH)*.

Open/Opened BB_credit

Pressing <Enter>, while Open/Opened BB_credit is selected, displays:

```
Open/Opened BB_credit
```

```
4
```

The number is used to specifies the maximum number of R_RDY's an FL_Port can issue (provided buffers are available) at the beginning of each loop tenancy. Configuring a higher value allows NL_Ports to send out more frames to the Fabric in a loop, and can increase performance especially in bigger loops.

Frame Collection

Pressing <Enter>, while Frame Collection is selected, displays:

```
Frame Collection
```

```
Method? Bundle/Piling
```

This command specifies two frame collection methods, bundle and piling. Using bundling, frames are separated in different queues based on source/destination pairs. Piling accumulates frame based on destination AL_PA. Piling can minimize loop traffic by reducing overhead and increases the loop efficiency.

To set, press <Tab/Esc> for Bundle or <Enter> for Piling.

Reset to Default

Pressing <Enter>, while Reset to Default is selected, displays:

```
Reset to Default
```

```
Accept? Yes No
```

Selecting the Yes option then pressing <Enter> causes all values in the *Configuration Menu* to reset to default conditions. Once the Ethernet IP address and the switchname are changed, they are not reset to default values.

NOTE: Resetting the Switch to default causes all configuration settings, names, and passwords entered to be reset to default settings, except the IP address and switchname.

Operation Menu

You control the Switch's overall operational state using the Operation Menu. Pressing <Enter> while the Operation Menu is selected, allows you to select commands:

Switch Offline

The shutdown process is initiated from the front panel by pressing <Enter> while the Switch Offline message is displayed.

Operation Menu:

Switch Offline

NOTE: You can observe and verify this process by watching the front panel LEDs change color from green to slow flashing amber as each port goes inactive.

After all multicast and broadcast paths have been rerouted, the F_Ports and FL_Ports are taken offline. This is followed by making all routes through the Switch unavailable by increasing path cost to hex '00 00 00 00'. E_Ports are then taken offline individually as all routes through a given E_Port are eliminated.

Switch Online

Pressing <Enter>, while the Switch Online message is selected, brings the Switch online.

Operation Menu:

Switch Online

Port Disable

Pressing <Enter>, while the `Port Disable` message is selected, displays a submenu to select the port to disable.

Operation Menu:

Port Disable

Pressing <Enter>, while a selected port is displayed, disables the port. The LED associated with the port changes from green to amber indicating the selected port has been disabled.

Port Enable

Pressing <Enter> while the `Port Enable` message is displayed opens a submenu where you select the port.

Operation Menu:

Port Enable

Pressing <Enter>, while the selected port is displayed, enables the selected port. The LED associated with selected port changes from amber to green indicating the port has been enabled. When `FL_Ports` are enabled, the port initializes the loop attempting to be the master.

Close Telnet

Pressing <Enter> while the `Close Telnet Session` message is displayed opens a submenu where you select to close an open Telnet session.

Operation Menu:

Close Telnet Session

Pressing <Enter>, while the `Close Telnet Session` message is displayed closes the open Telnet session.

Close Telnet Session

Accept? Yes No

Reboot

Pressing <Enter> while the `Reboot` message is displayed causes the Switch to reboot immediately.

Operation Menu:

`Reboot`

Rebooting the Switch causes it to immediately exit all current processes and states, and start the POST process. Exercise caution using the reboot command on a Switch connected to the Fabric.

Pressing <Enter>, while the screen above is selected, displays:

`Reboot`

`Accept? Yes No`

Selecting `Yes` causes the Switch to immediately reboot. Selecting `No` or pressing <Tab/Esc> exits this function.

Status Menu

You can retrieve information on the Switch using the Status Menu. The menu is informational only; you cannot make changes to the Switch's status from this menu.

Press <Enter> while the Status Menu is selected to select commands.

Switch Name

Pressing <Enter>, while `Switch Name` is selected, displays:

Switch Name:

`Sw15`

Worldwide Name

Pressing <Enter>, while `Worldwide Name` is selected, displays:

Worldwide Name:

`10:0:0:60:69:0:0:0`

The Switch's WWN is a unique numeric identifier for each Switch and it is assigned by the manufacturer. A numbering scheme administrated globally assures that this WWN is unique.

Firmware Version

Pressing <Enter>, while `Firmware Version` is selected, displays:

Firmware Version:

V1.6

Current Date

Pressing <Enter>, while `Current Date` is selected, displays the Switch's current date:

Current Date:

Mon Oct 21 10:23:35 1997

Booted At

Pressing <Enter>, while `Booted At` is selected, displays the Switch's boot time:

Boot AT:

Mon Dec 14 18:34:20 1998

Firmware Date

The *date* always reflects the firmware assembly date. The *Firmware Date* reflects the date code of the current executing firmware on the CPU. *Flash Date* reflects the firmware date in flash memory. These dates may not match if the flash memory has been updated with new firmware but the Switch has not yet been rebooted. When the Switch is rebooted the flash code becomes the executing CPU code, both dates match.

Pressing <Enter>, while `Firmware Date` is selected, displays the date of the Switch's firmware:

Firmware Date:

Nov 16 18:15:29 PST 1998

Flash Date

Pressing <Enter>, while `Flash Date` is selected, displays:

Flash Date:

Nov 16 18:15:59 PST 1998

This display gives the date and time for the last flash firmware update. If you upgrade the firmware in flash memory with a different firmware version, the date the new firmware was entered is displayed. Use this date to quickly establish the date the firmware was updated.

Boot Prom Date

Pressing <Enter>, while `Boot Prom Date` is selected, displays:

Boot Prom Date

Jun 12 08:48:29 PST 1997

This display gives the date and time the Boot Prom was manufactured. Use this date to establish the Boot Prom version.

Port Type

`Port Type` displays E/F/G/L for each port and by GBIC Type which displays C/L/S for copper, longwave and shortwave GBICs. Pressing <Enter>, while `Port Type` is selected, displays:

Port Type: GEEF GEEF

GEFF GEFF

This display shows the status of each port on the Switch. The ports start with the first port on the Switch which is the port in the top left position when the ports are viewed from the Switch's front panel. The definitions assigned are:

**Table 3-5
Port Types**

| Type | Description |
|------|---|
| E | E_Port is an interSwitch expansion port, used to connect to an E_Port of another Switch to build a larger Switch Fabric. |
| F | F_Port, the Fabric access port is used to connect an N_Port and is used within the Switch Fabric for control and management.. |
| G | G_Port is a generic port that can operate either as an E_Port or an F_Port but has not yet assumed a specific function in the Fabric. |
| L | FL_Port is a Switch port connected to an arbitrated loop. |
| - | Indicates no port is installed. |

Module Type

Pressing <Enter>, while `Module Type` is selected, displays:

```
Module Type: SSSS SSSS
             SSSS SSSS
```

**Table 3-6
Module Types**

| Type | Description |
|------|----------------------------------|
| C | Copper GBIC installed. |
| L | Longwave length GBIC installed. |
| S | Shortwave length GBIC installed. |
| - | Indicates no GBIC is installed. |

Port Throughput

Pressing <Enter>, while `Port Throughput` is selected, displays:

```
Port Throughput:
Port 0 75MB/s
```

This display shows port throughput on the Switch. The throughput number represents the number of bytes received plus the number of bytes transmitted per second and is displayed as bytes/second (B/s), kilobytes/second (KB/s) or megabytes/second (MB/s). You can select different ports using <Up> and <Down>, from port 0 to port 15, and all ports, and is used to monitor a single or the aggregate of all port(s) performance.

Temperature

Pressing <Enter>, while Temperature is selected, displays:

Temperature:

36 34 37 36 35

NOTE: Using the <Up> or <Down> buttons, the user can toggle between Centigrade (default) and Fahrenheit temperature values.

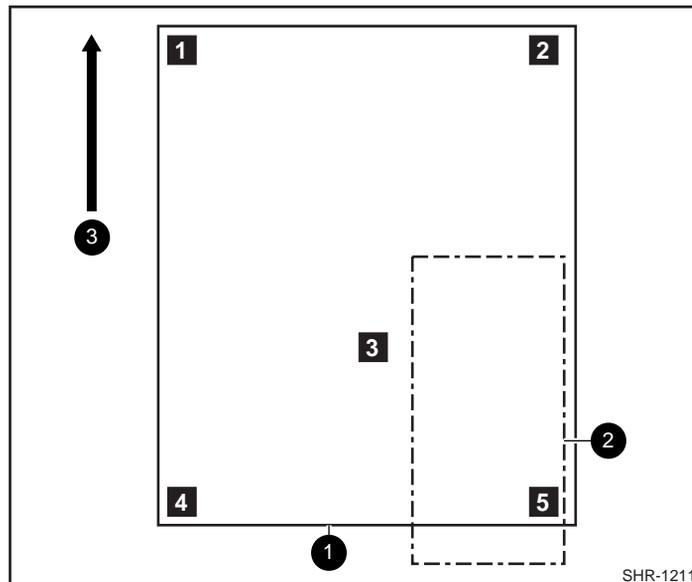


Figure 3-4. Temperature Sensor Locations on Motherboard

The numbered temperature sensor locations on the motherboard, shown in Figure 3-3, correspond to the temperature in the display. Sensor number 1 corresponds to the first temperature, 36, sensor number two corresponds to the second temperature, 34, and so forth.

The temperature readings are shown at a rate of one reading per second on the front panel. Readings obtained during a Telnet session are single reading made at command execution.

Error Log

Selecting `Error Log`, then pressing `<Enter>`, displays:

```
01 Feb 12 08:48:29 (23)
```

```
Err SENSOR-FAILED-3
```

The error log stores the last 30 error types sensed by the Switch. The front panel display shows:

- Error number (01-30)
- Date and time of the last occurrence each error type was sensed
- Total number of occurrences of each error type
- Error type
- Error level (0-4)

0–Panic (when this level is reached, the Switch automatically reboots and the display no longer shows the error)

1–Critical

2–Error

3–Warning

4–Debug

In the sample above, the first line shows that this is the first error (01) found on Feb 12 08:48:29 and had (23) occurrences. The second line shows that the error type is `SENSOR-FAILED` with a severity level of 3 (warning).

NOTE: The error occurrence count, shown in brackets at the end of the first line, does not appear until the error occurrence is higher than one.

Licenses

Selecting `Licenses`, then pressing `<Enter>`, displays:

```
Licenses
000
```

Features requiring a license are:

Table 3-7
Licenses

| Type | Description |
|------|---------------------|
| 000 | None |
| 001 | Web Tools installed |
| 002 | Zoning installed |
| 004 | SES installed |

Test Menu

The tests available from the Test Menu are part of the diagnostic and fault isolation capabilities. These tests, and their use, are discussed in the *Service Guide*.

Managing Via Telnet

To make a successful Telnet connection to a Switch, the user needs:

- Switch name or IP address
- Username
- Password.

NOTE: The IP address must have been previously installed using the front panel controls. Consult with the your network system administrator for the Switch's assigned IP address. Only one Telnet session is allowed at a time.

Default Usernames and Security Levels

Each Username has a security level associated to it. Username 3 is the least privileged and the security level goes up to Username 0 which is the most privileged.

Table 3-8
Default Username

| Default Username | Description |
|--------------------|--|
| other (username 3) | Gives users access to execute commands ending in Show, such as <code>dateShow</code> . |
| user (username 2) | Gives users access to all Show commands plus any commands in the help menu that do not change a Switch state, such as <code>version</code> . This level is the recommended level for monitoring Switch activity. |
| admin (username 1) | Gives users access to all Show commands, plus any commands in the help menu. Most Switch administration is performed at this level. |
| root (username 0) | Gives access to an extensive command set that can significantly alter system performance. Root commands are beyond the scope of this manual. Compaq recommends consulting customer service before using root commands. |

The system administrator may assign different Usernames than those listed, if desired. The User at a particular Security Level, however, has the same privileges regardless of the name assigned.



CAUTION: Access to root should be limited to those responsible for maintaining and modifying the Fabric. Commands available to root, if used inappropriately, can cause the Switch to stop functioning or to function abnormally. Root should only be used at the request of Compaq's customer service.

Changing Passwords

1. Log in as `admin`.
2. Issue the command `passwd`. Each username (`admin`, `user`, `other`) is displayed in sequence allowing the administrator to modify each password and name.
3. Enter a password or name while a user name is displayed to replace the existing password or name.

NOTE: If you lose the password, refer to Table 3-3 for commands.

Managing with SNMP

The resident SNMP agent allows remote Switch management via IP over Ethernet and Fibre Channel interfaces and provides access to most of the functions described in the front panel *Menu* section.

This section provides an overview of key concepts about Switch management based on Simple Network Management Protocol (SNMP). Additionally, refer to other references and text books on SNMP for more detailed discussions of the protocol and usage.

Within the SNMP model, a manageable network consists of one or more manager systems (or network management stations), and a collection of agent systems (or network elements):

- A manager system runs a management application (such as StorageWorks Command Console GUI) that monitors and controls the network elements
- An agent system is a network device such as a Fibre Channel Switch, a managed hub, or a bridge, that has an agent responsible for carrying out operations requested by the manager. Therefore, an agent is the interface to a managed device.

The manager communicates with an agent using the Simple Network Management Protocol (SNMP). The Switch agent supports both SNMP version 1 (SNMPv1) and Community-based SNMP version 2 (SNMPv2C).

A manager can retrieve management information, such as its identification, from an agent. There are three operations for this activity:

- SNMP-GET
- SNMP-NEXT

■ SNMP-BULKGET (SNMPv2C).

A manager can change management information on the agent. This operation is termed SNMP-SET.

An agent can send information to the manager without being explicitly polled for. This operation is termed a trap in SNMPv1 or a notification in SNMPv2C. Traps or notifications would alert the manager to events that occur on the agent system, such as reboot. For the rest of the document, the term *trap* is used.

The information on an agent is known as the Management Information Base (MIB). It is an abstraction of configuration and status information. A specific type or class of management information is known as a MIB object or variable. For example, the MIB variable, `sysDescr`, defines the description of an agent system. The existence of a particular value for a MIB object in the agent system is known as a MIB object instance, or simply instance. Some MIB objects have only a single instance for a given agent system. For example, the system description and the instance is denoted as `sysDescr . 0`. Other MIB objects have multiple instances. For example, the operational status of each Fibre Channel port on a Switch and a particular instance may be denoted as `swFCPortOperStatus . 5`.

MIB objects are conceptually organized in a hierarchical tree structure. Each branch in the tree has a unique name and numeric identifier (Figure 3-4). Intermediate branches of the tree serve as a way to group related MIB objects together. The *leaves* of the tree represent the actual MIB objects. Figure 3-4 illustrates the tree structure, with special attention to the Internet MIB tree and the Fibre Channel MIB tree.

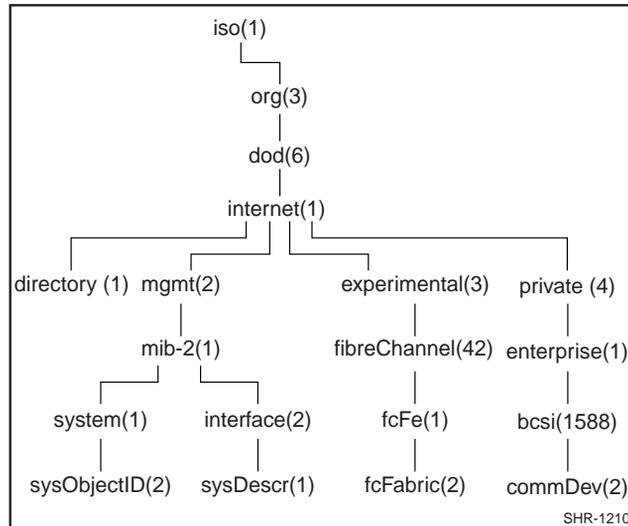


Figure 3-5. MIB Tree

A MIB object is therefore uniquely identified or named by its position in the tree. A full object identifier consists of the identifier of each branch along the path through the tree. For example, the object `sysObjectID` has the full identifier of `1.3.6.1.2.1.1.2`. For readability the notation `{system 1}` may be used.

The Switch's agent supports the following:

- SNMPv1 manager
- Command line utilities to provide access to and command the agent.
- MIB-II system group, interface group, and SNMP group
- Fabric Element MIB
- Vendor-Specific MIBs
- Standard Generic traps
- Enterprise Specific traps.

SNMPv1 Transports

The SNMP agent residing on the embedded processor supports UDP/IP over the Ethernet interface or any FC-IP interface. This transport provides an immediate “plug-and-play” support for the Switch, once the IP address has been assigned.

MIB-II Support

There are eleven groups of objects specified in MIB-II. The Switch's SNMP agent supports 3 of these groups. The three groups supported include:

- System group (object ID is {iso, org, dod, internet, mgmt, mib-2, 1})
- Interfaces group (object ID is {iso, org, dod, internet, mgmt, mib-2, 2})
- SNMP group (object ID is {iso, org, dod, internet, mgmt, mib-2, 11})

The following variables are modifiable via the SNMP set command, given an appropriate community with read-write access:

The Switch is shipped with the default identifiers.

`sysDescr` System description: the default value is set as "*Fibre Channel Switch*"

`sysObjectID` System object identifier vendor's authoritative identification (1.3.6.1.4.1.1588.2.1.1.1)

`sysUpTime` The time since the agent was last initialized

`sysContact` The identification and contact information for this system. By default, this is set as "*Field Support*".

`sysLocation` The node's physical location. The default setting is "*End User Premise*".

The interface group supports three interface drivers: software loopback, Ethernet, and Fibre Channel IP.

Fabric Element MIB Support

There are five object groups defined:

- Configuration group
- Operation group
- Error group
- Accounting group
- Capability group.

The agent supports all groups.

Specific MIBs

Five groups of MIBs are defined and supported:

- Switch System Group
- Fabric Group
- SNMP Agent Configuration Group
- Fibre Channel Port Group
- Name Server Group.

Generic Traps

Setting up the Switch's SNMP connection to an existing managed network allows the network system administrator to receive the following generic traps:

- coldStart – indicates the agent has reinitialized itself such that the agent's configuration can be altered.
- warmStart – indicates the agent has reinitialized itself, but no configuration has changed.
- linkDown – indicates an IP interface (Ethernet, loop back, or embedded N_Port) has gone down and is not available.
- linkUp – indicates an IP interface (Ethernet, loop back, or embedded N_Port) has become available.

NOTE: linkUp and linkDown traps are not associated with removing or adding a Ethernet cable. This is strictly a driver indication that the interface is configured, operational, and available and does not necessarily mean that the physical network cable is connected.

- authenticationFailure – indicates the agent has received a protocol message that is not properly authenticated. This trap, by default, is disabled but can be enabled via the command `agtcfGSet`.

Enterprise Specific Traps

Three Enterprise Specific Traps are supported. They are:

- swFault – indicates the diagnostics detect a fault with the Switch.
- swSensorScn – indicates an environment sensor changes its operational state. For example; a fan stops working. The VarBind in the Trap Data Unit contains the corresponding instance of the sensor status.

- `swFCPortScn` - a notification that a Fibre Channel Port changes its operational state. For instance, the Fibre Channel Port goes from on-line to offline. The `VarBind` in the Trap Data Unit contains the corresponding instance of the port's operational status.

NOTE: SNMP `swFCPortScn` traps are generated on GBIC insertion and removal even though the state remains offline.

Agent Configuration

NOTE: Changes to SNMP from either Telnet or SNMP are not displayed in SNMP until the Switch is rebooted running. This is due to SNMP running from cache while the active settings are running from the flash PROM.

The parameters that can be configured include:

- SNMPv1 communities (up to 6)
- trap recipients (1 per community)
- `sysName`
- `sysContact`
- `sysLocation`
- `authenticationFailure` – indicates the agent has received a protocol message that is not properly authenticated. This trap, by default, is disabled but can be enabled via the command `agtcfgSet`.

The `sysX` parameters can be configured via the `SNMPv1 SET` command with an appropriate community. These parameters can be configured via a Telnet connection, using the command `agtcfgSet`.

NOTE: A change in the first two configuration parameters takes effect only after rebooting the Switch.

Tools for Managing with SNMP

Compaq's StorageWorks Command Console (SWCC) software is the easiest tool to set up for managing the Storage Switch. The SNMP MIBs are integrated into the SWCC software. Refer to SWCC documentation included with the Storage Switch CD. Information is provided for Compaq CNMS and HP OpenView for those sites that want to control the Switch using tools other than SWCC.

Trap definitions may be setup with a number of tools including StorageWorks Command Console (SWCC), HP OpenView, and others.

Compaq CNMS SNMP Setup

Complete the following steps to incorporate the FC standard MIB and the Compaq specific MIB into an SNMP Management station:

1. Install Compaq-CNMS on your PC.
2. Login to your PC
3. Double-click on the Compaq-CNMS icon on the desktop
4. When the User settings Wizard will pops up:
 - Choose normal and click Next.
 - Choose default polling option, and click Next.
 - Change the default "write" Community string to "private", and click Next.
 - Leave the email choices at their default values, and click Next.
 - Leave the web choices at their default values, and click Next.
 - Leave the wizards choices at their default values, and click Next.
 - Choose YES for "manageable devices automatically discovered" and click Next.
 - Type in the gateway Router IP address (provided by your network manager).
 - Leave the "other community strings for read" at their default values, and click Next.
 - Leave the automatic layout settings at their default values, and click Next.
 - At the next window click on "begin discovery now." This completes the User settings wizard entries.

5. Go to the pull-down menu under tools and click on “Create Custom Device.” You will be prompted for a Device Type Name.
6. Enter a name such as “FC Switch”. Click on next. You will be prompted for an icon.
7. Click on “none selected”. Choose an icon. Click on next.
8. Skip the “batch file” prompt. You will be prompted for the type of MIB this device supports.
9. From the list select RFC1213-MIB and then click on next. If you do not have the RFC1213-MIB, it is available from Compaq.
10. The next window will ask you for the SysObject ID. This is the string of numbers that defines the object id for SNMP. Enter 1.3.6.1.4.1.1588.2.1.1.1 Click on next.
11. The next window prompts for a Physical Port. Enter a name for the Ethernet port, (i.e. “Ethernet Mgmt Port”). Click on add port. Choose Ethernet as the protocol.
12. At the next window click on Finish. A window will pop up saying you were successful in creating this custom device type. You must now exit the complete program and restart for the device type to take effect. Exit and restart Compaq CNMS.
13. When the program starts, you will be prompted with the User Settings Wizard. Click on cancel. You should now see the “FC Switch” icon in the networking devices. This is the custom device type you just created.
14. Drag the icon to the window labeled “Main” (click and hold on the Switch). A picture of the FC Switch will now be in the “Main” window.
15. A pop up window for the description of the Switch will appear. Enter a name and the IP address for your Switch. Click OK.
16. Place the cursor on the Switch and click on the right mouse button. From the pop up window, choose SNMP statistics, system information. A window will pop up with the information about the Switch as configured via the Telnet command agtCfgSet. The values that currently appear are the default settings. Change them if you wish. After you change the values, you can verify they are set on the Switch via Telnet and the agtcfgShow command as well as via SNMP.
17. Go back to the SNMP Statistics and choose protocols for a list of supported protocols.
18. Go back to statistics and choose MIB Browser. A window will pop up with three items in a tree. Choose “parse MIBS.”

19. Click OK on the next window, then choose “Browse MIB to parse” from the next window.
20. Choose the sw.mib. The MIB should compile successfully. Exit out of the Parse MIB Window. Exit out of the MIB Browser window.

HP OpenView SNMP Setup

The following example explains how to integrate a Switch Enterprise MIB to the SNMP database through HP OpenView in a Windows NT environment. For specific SNMP site requirements, refer to your system administrator.

To integrate the Enterprise MIB into the SNMP database:

1. Rename and place the copy of the femib.mib or swmib.mib definition under the appropriate subdirectory under HP OpenView. The default is C:\OV\MIBS.
2. Start the OpenView manager and click “control” on the menu bar followed by choosing the SNMP manager and Manage Database
3. Click on Select and pick the C:\OV\MIBS\femib.mib or c:\OV\MIBS\swmib.mib
4. Click Compile button. You are now ready to create a submap, queries, and perform SNMP operations on the Switch.

syslog Daemon

A UNIX style *syslog daemon (syslogd)* process has been added. *Syslogd* reads system events and forwards system messages to users and/or writes the events to log files according to your system configuration.

Introduction

Syslogd reads system events and forwards system messages to users and/or stores them in log files according to your system configuration. Events are categorized by facility and severity. Please refer to the manual pages on your UNIX system for a list of facilities and severity levels. The log process is used to log errors and system events on the local machine and are sent to a user or system administrator. The daemon is constantly running and ready to receive messages from system processes. The events are logged according to the statements in the configuration file. In addition, *syslogd* is enabled to receive messages from a remote machine. *Syslogd* listens to UDP port 514 for system events. A remote machine does not have to be running UNIX to forward messages to *syslogd*. But it must follow the basic syslog message format standard.

An example entry in a *syslogd* log file is:

```
Jul 18 12:48:00 sendmail[9558]: NOQUEUE: SYSERR(uucp):  
/etc/mail/sendmail.cf: line 0: cannot open: No such file  
or directory
```

The first two items are the event's date/time (as known by the machine where *syslogd* is running) and the machine name that issued the error. This would be the local machine, if the message is generated by a task running on the same machine as *syslogd*, or a remote machine, if the message was received on UDP port 514. The first two items are always present, all other entries are message specific.

NOTE: The log file may be located on a different machine and be remotely mounted. So a local error is an error that occurred where *syslogd* is running, not on the machine where the error log physically resides.

syslogd applications for NT and Win95 are available at no charge on several FTP servers on the Internet

syslogd Support

Switch firmware maintains an internal log of all error messages. The log is implemented as a circular buffer, with a storage capability of 30 errors. After 30 errors have been logged, the next error message overwrites the messages at the beginning of the buffer.

If configured, the Switch sends internal error messages to *syslogd* by sending UDP packet to port 514 on the *syslogd* machine. This allows the storage of Switch errors on a *syslogd* capable machine and avoids the limitations of the circular buffer.

syslogd provides system error support via a single log file and can notify a system administrator in real time of error events. Additionally, the daemon provides dial home capability.

Error Message Format

Each error message logged sends the following information:

- Error number (1 for the first error after boot, increments by one with each new error).
- The error message, exactly as it is stored in the error log (and printed via the command `errShow`).

The error number makes it easy to identify the error and also determine when a Switch rebooted. If there is a log of error number *N* from the Switch, followed by another log of error number 0 from the Switch, then the Switch rebooted between the two errors.

The error message includes the Switch that reported the error with the following event information:

- ID of the task that generated the error.
- Name of the task that generated the error.
- Date and time when the error occurred, as seen by the Switch. This may be different from the first item in the log file, which is the time as seen by the *syslogd* machine. These two time values are different if the clocks in the Switch and in the *syslogd* machine are not in sync.
- The error identifier consisting of a module name, a dash and an error name.
- The error severity.
- Optional informational part.
- Optional stack trace.

Example:

syslogd running on Switch sw9 is sending log events to the UNIX machine called *example*. The following is an example of a No memory error generated by the shell. This is a severity 1 (LOG_CRITICAL) error. *syslogd* is configured to store the errors in: */var/adm/silkworm* file.

```
example% egrep sw9 /var/adm/silkworm
Jul 11 16:48:25 sw9 1 0x103d8620 (tShell): Jul 11 16:48:19
    Jul 11 16:48:25 sw9Error SYS-NOMEM, 1, No memory
    Jul 11 16:48:25 sw9 Traceback:
    Jul 11 16:48:25 sw9 _t1+0x40 (0x103a2030)
    Jul 11 16:48:25 sw9 _yystart+0x95c (0x1017128c)
    Jul 11 16:48:25 sw9 _yyparse+0x694 (0x10172dc4)
    Jul 11 16:48:25 sw9 _execute+0xdc (0x1014c06c)
    Jul 11 16:48:25 sw9 _shellTask+0x964 (0x1003aea4)
    Jul 11 16:48:25 sw9 _shellTask+0x198 (0x1003a6d8)
    Jul 11 16:48:25 sw9 _vxTaskEntry+0x10 (0x10114d14)
    Jul 11 16:48:25 sw9
```

Message Classification

syslogd messages are classified according to facility and priority (severity code). Thus allowing a system administrator to take different actions depending on the error. The action taken, based on the message's facility and priority, is defined in the *syslog* configuration file. Example configurations are provided in a following section.

The Switch uses the facility *local7* for all error messages sent to the *syslogd*.

UNIX provides eight priorities, whereas the Switch provides four severity codes (code LOG_PANIC (0) causes a reboot and is not sent to the *syslogd*). The mapping between the Switch's severity codes and UNIX *syslogd* priorities is provided in Table 3-9.

Table 3-9
syslog Message Classification

| Switch | UNIX |
|------------------|---------|
| LOG_CRITICAL (1) | alert |
| LOG_ERROR (2) | err |
| LOG_WARNING (3) | warning |
| LOG_DEBUG (4) | debug |

Switch configuration

To start the *syslogd* type the following command:

```
syslogdIp <IP address of the syslogd machine>
```

The command with no parameter prints the IP address of the current target *syslogd* machine. An IP address of 0.0.0.0 disables the forwarding of error messages to *syslogd*. In this case, error messages are still logged internally to the Switch, but it is not forwarded to the *syslogd*.

Examples,

Enable and verify *syslogd* support:

```
=> syslogdIp "10.0.0.1"  
=> syslogdIp  
    syslog daemon's address: 10.0.0.1
```

Disable *syslogd* support:

```
=> syslogdIp "0.0.0.0"  
=> syslogdIp  
    syslog daemon's address: 0.0.0.0
```

syslogd configuration

The *syslog* configuration provides the *syslogd* with instructions on how to handle different messages. The following are example entries in a *syslog* configuration file (`/etc/syslog.conf`), on how to store Switch error messages stored in different files. Please refer to the *syslog* manual pages on your UNIX system for the full documentation of the *syslog* configuration file. The following entry in `/etc/syslog.conf` causes all messages from the Switch of UNIX priority warning or higher (Switch severity `LOG_WARNING` or higher) to be stored in the file `/var/adm/silkworm`.

```
local7.warning    /var/adm/silkworm
```

The following entries in `/etc/syslog.conf` causes the messages from the *silkworm* of UNIX priority alert (Switch severity `LOG_CRITICAL`) to be stored in the file `/var/adm/alert`, and all other messages from the Switch to be stored in the file `/var/adm/silkworm`.

```
local7.alert      /var/adm/alert  
local7.debug      /var/adm/silkworm
```

The `local7` prefix identifies the message from a Switch. Note that usually a file must exist and have the proper permission in order for the *syslogd* to write to it.

Chapter 4

StorageWorks Command Console Software

Introduction

The StorageWorks Command Console (SWCC) Fibre Channel Switch software allows you to manage the Switch, Fabric and your HSG80 Storage Subsystem from the same window. Once the software is installed, you can access, manage, and configure the Switch and Fabric by double-clicking on an icon, the *Fabric Window*, in Command Console's Navigation Window, shown in Figure 4-1.



Figure 4-1. Navigation Window for a Fibre Channel Network

If you choose to install and use the Fibre Channel Switch software, detailed instructions on how to install, configure and use SWCC are provided in:

- Getting Started with SWCC for the Fibre Channel Switch Guide, xx-AA-RHDAA-TE (included in the Fibre Channel Switch software kit)
- Command Console V2.1 (HSG80) for RAID Array 8000/ESA12000 User's Guide AA-RFR2C-TE, 387405-003 (included with your Storage Subsystem Platform Kit)
- RA8000/ESA12000 HSG Solution Software V8.4 Installation Reference Guide (included in your storage subsystem kit)
- The text files readme, ccclient and fcswitch located in the CD packaged with the Switch software kit.

StorageWorks Command Console Fibre Channel Switch Applet Requirements

- An Internet browser installed and operating on your computer.
- You need a TCP/IP compatible network to communicate between your Windows platform and the Switch. Two software components are required to communicate over the network: a Client and its companion Agent. The Client runs on a Windows NT, Windows 95 or a Windows 98 platforms, the Agent runs only on a Windows NT platform.

Installation Summary

1. Install Command Console Client, version 2.1 for the HSG80 Storage Subsystem, and install the Fibre Channel Switch Client. Installation instructions and the path to the Client's setup.exe file are provided in Chapter 4 of the Getting Started with SWCC Guide included with your Switch Software Kit.
2. Install the Fibre Channel Switch Agent. Refer to Chapter 6 of the Getting Started with SWCC Guide for instructions and the path to the setup.exe file.
3. Configure the Fibre Channel Switch Agent. Refer to Chapter 7 of the Getting Started with SWCC Guide.

Accessing the Command Console Fabric Window

To create the Fabric, add Fabric elements, and monitor and manage the Switch and Fabric, double-click on the Fabric Network icon in the Navigation Window to display the Fibre Channel Network Window, shown in Figure 4-2.

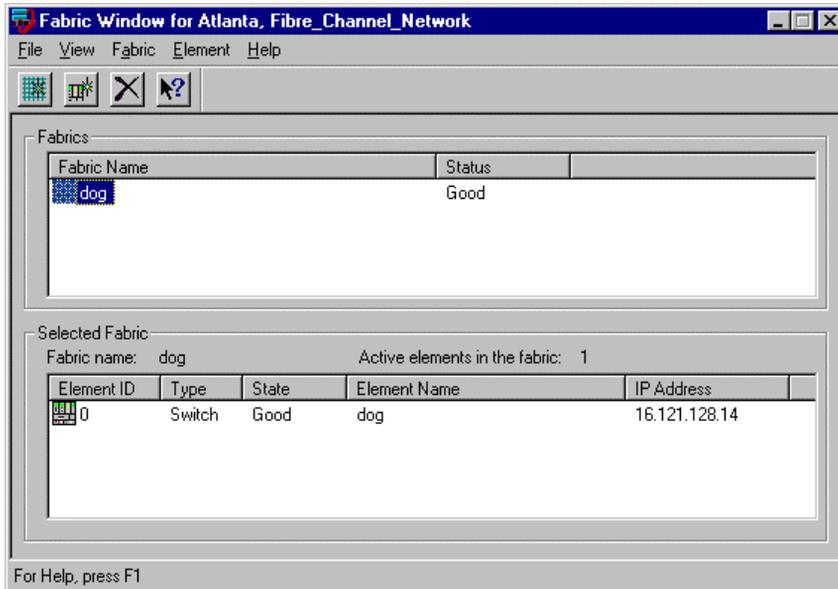


Figure 4-2. Fibre Channel Network Window

Accessing Switch Web Tools

From the Command Console *Fabric Window* you can enable Switch Web Tools. Chapter 5 details how to use Web Tools to manage the Switch and Fabric.

- To display the Web Tools Fabric View Page (a web tool that allows you to manage a Switch or Fabric topology), double-click on the icon in the *Fabric Name* window pane.
- To display the General Switch View Page (a web tool that allows you to manage a Switch), double-click on the Switch icon in the *Selected Fabric* window.

Managing the Switch over the Web

Introduction to Switch Web Tools

This chapter discusses how to manage and monitor a Switch using Switch Web Tools. To manage the Switch over the web, you log onto a Switch from a host with a Java enabled web browser by means of the Internet or Intranet. Web Tools provide and feature:

- Switch identification in network
- Fabric topology/routing information
- Switches/ports general configuration
- Real-time graphical Switch/port status and statistics report
- Port performance shown graphically (polled up to 2.5 seconds depending on operating system and browser used)
- Four minutes of aggregate bandwidth throughput (polled up to 2.5 seconds depending on operating system and browser used) shown graphically, scaled dynamically, based on activity
- Management with security protection via Administrative Interface (GUI) or management by Telnet commands (Telnet session)
- Five screens for monitoring information
- Two screens for administrative interfaces
- Help functions
- Popup help for error conditions

Fabric View Page

The Fabric View Page shows the number of network Switches and confirms worldwide names, domain IDs, and Switch names.

Fabric Topology View Page

The Fabric Topology View Page shows the physical configuration including active domains, paths and routing information. For example, the hop count which is the number of Switches that handle a data frame from origination through to the destination.

General Switch View Page

The General Switch View Page displays Switch enclosure information, confirms general Switch information, and includes GUI buttons for quick access to the Administrative Interface, Telnet, and the Performance View.

The front panel identifies the type of interface module installed in each Switch slot, the industry media (GBIC, or Gigabit Interface Converter) used by the ports, and each port's LED status. From this view, more information is available about the Switch by moving to either the Performance View or the Port Detail View.

Performance View Page

The Performance View Page shows graphically real-time data throughput for each port and Switch bandwidth utilization.

Two types of performance data: throughput of each port, and total Switch throughput. Bandwidth utilization is critical information needed to make decisions about optimizing performance, for instance, if one port begins to handle a disproportionate amount of traffic.

Port Detail View Page

The Port Detail View Page shows statistics and general information for all ports, including LED status.

The Port Detail View appears for whatever port you select in the General Switch View. Once in this view, every port for that Switch may be viewed sequentially, by selecting its file folder. Each folder's tab replicates the port's

LED status which allows you to monitor all port status at the same time. Port details include statistics about frames, interrupts, and errors that are helpful when troubleshooting.

Administrative Interface Page

The Administrative Interface Page is used to perform routine functions such as enabling and disabling ports. Upgrading firmware can also be initiated from this page.

Telnet Interface Page

The Telnet Interface Page uses Telnet commands (configuration, diagnostics, displaying, and routing) for Switch diagnostics, troubleshooting, and management.

Installing Web Tools and Logging on to the Switch

Fabric Management and Licensing

All Compaq Switches are license. It is possible that other Switches in a Fabric may not have the Web browser license key installed. This does not prevent a Switch from appearing in the Fabric view page on the browser, but attempting to click on an unlicensed Switch in order to manage that Switch results in a failure. Each Switch must contain a web management license in order for the web browser to display detailed performance data on ports, enter administrative data, and to perform Switch management functions on that Switch using the web. Telnet and SNMP can always be used to manage a Switch without a license.

License Installation

Web management requires a license to operate. Without a License key installed in the Switch, Web browsers are not able to connect to the Switch. The License Key has been installed at the factory for Compaq Switches.

CAUTION: If an invalid key number is entered the existing license (if any) is overwritten, thus eliminating any/all valid license keys. The license key is unique to each Switch; therefore, a license for one Switch will not operate on another.

To install the License Key:

1. Log on the Switch via Telnet.
2. On the Telnet command line, type:

licenseShow
3. Verify the current license keys, if the Web key is not installed continue with the next step.
4. On the Telnet command line, type:

```
licenseAdd "key"
```

where, "key" is the license key string of alphanumeric characters in double quotes ("key") that must be entered exactly as given including case. For example, "RdxS9S9ezSdcdTs".

5. Once the license is entered, check for it with the licenseShow command and if present reboot the Switch.

Logging On to the Switch Via the Web

The Switch web management JAVA code runs on the following browsers:

- Internet Explorer 4.0 /Netscape 4.0 or above on Windows NT or Windows 95.
- Netscape 4.0/HotJava 1.1 or above on Compaq Tru64, and Solaris 2.5.

To log on to the Switch Via the Web:

1. Launch a Web browser.
2. Connect to the Switch by entering a URL for the Ethernet IP address or Switchname or such as http://IP Address or http://switchname.
3. To access the administration screens, click on the Admin button then enter your username and password at the prompt.

NOTE: Users with User (via Telnet) or Admin Level privilege can access these pages. The User Level is more restrictive and cannot perform configuration commands. The administrative page via a browser can only be accessed from the Admin Level all other accesses are rejected.

Web Tools Operational Concepts

When using Switch Web Tools note the following:

Clickable areas are highlighted with a hint displayed in the left side bottom bar of your browser when the mouse is positioned over them (Switches on the Fabric View page, ports and thermometer on the General Switch View page; the Admin/ Telnet/performance buttons are not highlighted, however, glossaries in the Switch general Information area are not highlighted).

When making changes in the Admin page, the Response Page shows whether each individual configuration change was committed or rejected.

Java is disabled in some versions of Netscape and must be enabled by checking both Enable Java and Enable Java Script buttons in the Preferences/Advanced menu.

Netscape or IE may hang with Java applications on Windows NT after SP3 due to True Color. To work around this problem, either change the NT display settings to other than True Color, or download Microsoft's hotfix to modify WIN32K.SYS. The hotfix is available from Microsoft Technical Support.

Using Web Tools

This section contains general information and examples on managing and monitoring the Switch via the Web Tools. It discusses each of the Web pages. They are:

- Fabric View Page
- Fabric Topology View Page
- General Switch View Page
- Port Detail View Page
- Performance View Page
- Administration Interface Page
- Telnet Interface Page.

The Web interface Switch management system provides a Graphical User Interface (GUI) for users to display Fabric topology, general Switch information, port traffic statistics and throughput performance. The GUI enables Switch administrators to configure the Switch and its ports.

To use the Web interface:

Position the cursor over an object (such as a port or the thermometer) and click on the object or button to access a screen (page). You make selections and data in text boxes on the screen.

Fabric View Page

The Fabric View Page, Figure 5-2 is the first Web Page displayed. This is a global page and shows all Switches that comprise the Fabric. Note that any Switch in the Fabric can show the overall Fabric view, therefore it is not critical which Switch is accessed initially.

The Fabric View Page can show a maximum of 16 Switches in a grid and uses Switch names to connect to individual Switches. Each Switch has a unique name and the name should match its IP address

If a Switch name is not recognized by the name resolution protocol, it can be accessed by typing in its IP address from the Fabric View Page. To enter an IP address, double-click on the Switch image while pressing down the shift key to open a dialog box and enter the IP address or host name).

Double-click on a Switch to display the Switch's General Switch View Page, shown in Figure 5-5.

Click the Fabric Topology button to display the Fabric Topology View Page, shown in Figures 5-3 and 5-4.

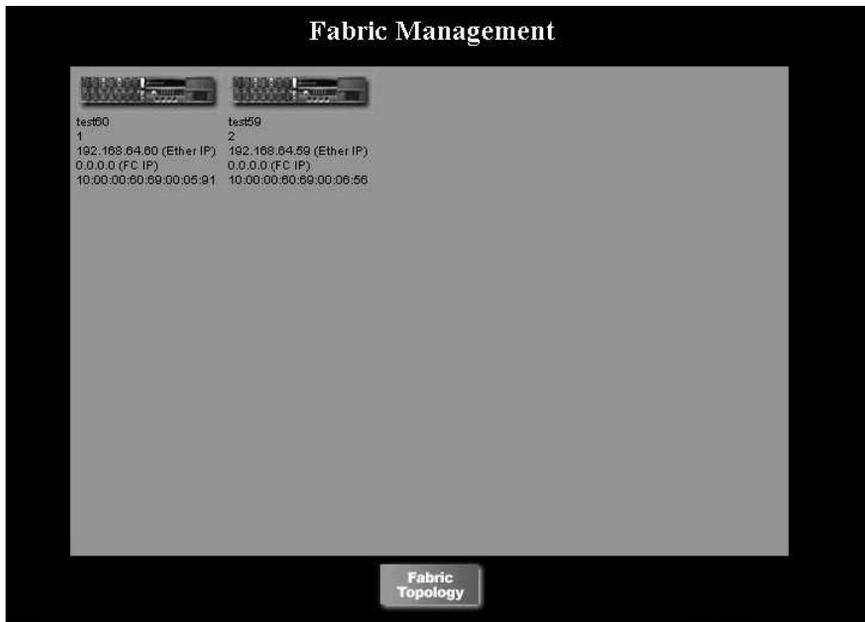


Figure 5-2. Fabric View Page

Fabric Topology View Page

The Fabric Topology View Page, displayed by clicking on the *Fabric Topology* button, shows the physical configuration including active domains and paths, and routing information.

Figure 5–3 and Figure 5–4 show the Fabric Topology View Page. The Fabric topology shown is viewed from the host domain (or host Switch) which is initially requested from the web browser. This page is broken up into two figures and shows the physical configuration including active domains, paths and routing information. For example, the hop count which is the number of Switches a data frame must pass through from source to the destination (see Table 5–1 for field details).

The first item that appears in this page is a list of active domains (or Switches) in the Fabric. Following the active domain list is a table unfolding the views of active paths from the local domain to all remote domains in the Fabric. This table is grouped by domains. The worldwide name and IP address are included under each domain. Each active path table displays the local Switches output port number, destination Switch input port number, the hop count and metrics (costs) from the local domain to the remote domain and the path flag.

View Fabric Topology from Switch open178:

There are total of 12 domains in the fabric

| |
|--|
| Local Domain ID: 17 (Switch Name: open178) |
| Domain ID: 2 (Switch Name: test176) |
| Domain ID: 4 (Switch Name: test175) |
| Domain ID: 5 (Switch Name: open180) |
| Domain ID: 6 (Switch Name: test174) |
| Domain ID: 7 (Switch Name: test173) |
| Domain ID: 8 (Switch Name: open179) |
| Domain ID: 9 (Switch Name: test177) |
| Domain ID: 10 (Switch Name: test171) |
| Domain ID: 11 (Switch Name: test170) |
| Domain ID: 17 (Switch Name: open178) |
| Domain ID: 18 (Switch Name: open182) |
| Domain ID: 19 (Switch Name: test172) |

Active Paths:

| |
|--|
| Destination Domain ID: 2 (Switch Name: test176) |
| Destination's World Wide Name: 10:00:00:60:69:00:01:8d |
| Number of Path(s) to Domain 17: 2 |

| Path Number 1: | | | | |
|-----------------------|-------------|-----------|--------|------|
| Output Port | Input Ports | Hop Count | Metric | Flag |
| 3 | 2 | 3 | 3000 | D |

| Path Number 2: | | | | |
|-----------------------|-------------|-----------|--------|------|
| Output Port | Input Ports | Hop Count | Metric | Flag |
| 1 | | 3 | 3000 | D |

Figure 5-3. Fabric Topology View Page

Active Paths:

Destination Domain ID: 2 (Switch Name: test176)
 Destination's World Wide Name: 10:00:00:60:69:00:01:8d
 Number of Path(s) to Domain 17: 2

Path Number 1:

| Output Port | Input Ports | Hop Count | Metric | Flag |
|-------------|-------------|-----------|--------|------|
| 3 | 2 | 3 | 3000 | D |

Path Number 2:

| Output Port | Input Ports | Hop Count | Metric | Flag |
|-------------|-------------|-----------|--------|------|
| 1 | | 3 | 3000 | D |

Destination Domain ID: 4 (Switch Name: test175)
 Destination's World Wide Name: 10:00:00:60:69:00:02:c6
 Number of Path(s) to Domain 17: 1

Path Number 1:

| Output Port | Input Ports | Hop Count | Metric | Flag |
|-------------|-------------|-----------|--------|------|
| 2 | 1,3 | 3 | 3000 | D |

Figure 5-4. Fabric Topology View Page

**Table 5-1
Fabric Topology Fields**

| Field | Description |
|--------------------------------------|--|
| List of Active Domains in the Fabric | Displays the number of active domains in the Fabric including Switch names and Switch domain ID. |
| List of Active Paths by Domain. | Displays the domain ID associated with the Switch name, WWN, and total number of paths by domain. Each path is displayed including: <ul style="list-style-type: none">■ Output Ports■ Input Ports■ Metric■ Flag |

General Switch View Page

The General Switch View Page, Figure 5-5, shows a graphic representation of the Switch's front panel. Normal long-term monitoring is conducted from this page which provides you with a real-time view of each Switch's overall health and status in the Fabric.

The admin button links to the system administration pages where you can Disable/ Enable a port depending on the appropriate authentication. The performance button links to the Performance View page. The Telnet button launches a Telnet session.

Under normal conditions, the browser's lower right corner holds animated thermometers and spinning fans. The color and blinking speed of the port LEDs are updated every 1 to 2.5 seconds depending on the operating system and browser used. Warning messages show up in a popup window automatically if problems occur. For example, temperature exceeding maximum value, a fan stops rotating or a port state becomes problematic. Push buttons are placed in the bottom of the warning message popup window. These buttons are connected to a separate browser providing basic trouble shooting guides.

The thermometer indicates the highest temperature from the last data sample. Click on the thermometer to display the temperature readings from all five Switch sensors.

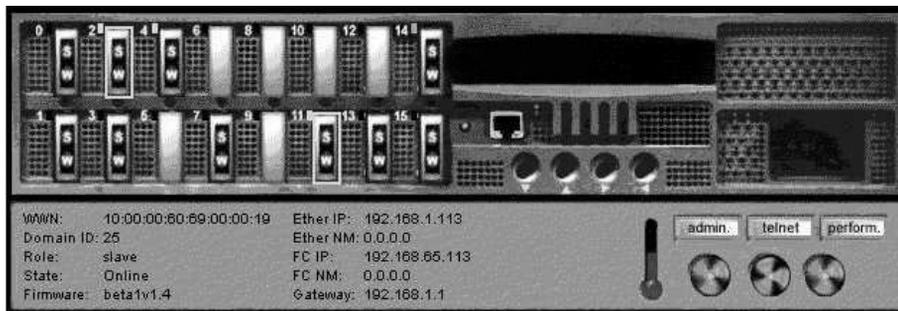


Figure 5-5. General Switch View Page

Table 5-2
General Information Fields

| Field | Description |
|-----------|---|
| WWN | The Switch's WWN is a unique numeric identifier for each Switch and it is assigned by the manufacturer. A numbering scheme administrated globally assures that this WWN is unique to this Switch. |
| Domain ID | The domain ID 0 to 31. This number uniquely identifies the Switch in a Fabric. |
| Role | The three possibilities for role including: <ul style="list-style-type: none"> ■ Principal—the principal Switch as defined in FC-SW ■ Subordinate—this Switch is enabled and not the principal Switch ■ Disabled—the Switch is disabled. |
| State | The Switch state. Possible values include Online, Offline, Testing and Faulty. |
| Firmware | The firmware version. |
| EtherIP | The default Ethernet IP address is a temporary number derived from the Switch's WWN. You must enter a valid IP address |
| Ether NM | The default Ethernet subnetmask value is none. |
| FC IP | The default Fibre Channel IP address is a temporary number derived from the Switch's WWN. You must enter a valid IP address in order to manage one Switch from another over the Fibre Channel.. |
| FC NM | The default Fibre Channel subnetmask is none. |
| Gateway | The default gateway address is 0.0.0.0. You must enter a valid gateway address, if required. |

On the left side of the display, the upper half shows port and LEDs status and the lower half contains general Switch information. Table 5-2 describes the fields. Selecting the label on each text field displays a popup dialog that explains the field.

In the Switch picture, LEDs indicate problems or status. Refer to Table 5-3 for LED definitions. Each port module is a clickable hyperlink which takes you to a third page, the Port Detail View page. Each port includes the port number, a status LED and port detail information.

If a port card is not installed, a solid black rectangle is displayed and the port status is indicated as "No_Card." If the interface is installed but no GBIC is present, a silver rectangle is displayed and the port status is indicated as "No_Module."

If the port contains a GBIC, one of the following is shown:

- For copper GBICs, a graphic representation of a copper GBIC with the letters “CU”
- For short wave fiber GBICs, a graphic representation of a GBIC with the letters “S” and “W”
- For long wave fiber GBICs, a graphic representation of a GBIC with the letters “L” and “W”
- If the port is on an arbitrated loop, the letters “F/L” are displayed in an oval between the ports associated with the card.

If the port has failed, the port is outlined in amber to indicate a failure. The color and flash speed of each LED, as described in Table 5-3, indicates port status.

Table 5-3
Port LED Status Indicators

| Port LEDs | Definition |
|------------------|--|
| No light showing | No light (no module, no cable) for media interface LEDs, power not applied for power indicator LED |
| Steady yellow | Receiving light, but not yet online. If the port transitions to this state while being monitored, the applet presents you with a dialog recommending a course of action. |
| Slow yellow | Disabled (result of diagnostics or portDisable command). Flashes every 2 seconds. The applet presents you with a dialog recommending a course of action. |
| Fast yellow | Error, fault with port. Flashes every 1/2 second. The applet presents you with a dialog recommending a course of action. |
| Steady green | Online (connected with device over cable) |
| Slow green | Online, but segmented (loopback cable or incompatible Switch) flash every 2 seconds. |
| Fast green | Internal loopback (diagnostic). Flashes every 1/2 second. |
| Flickering green | Online and frames flowing through port. |

Port Detail View Page

The Port Detail View Page, Figure 5-6, provides statistics for each port. The page features 16 cascaded folders (tabs) one for each port. Each folder has a tab on the top to show the port number and a status light to tell the port state.

The port information is updated once per second. However, the time interval maybe as long as 2.5 seconds depending on the browser used. By glancing at those 16 or 8 tabs, a system administrator will gain the knowledge of each port state. The default top folder displayed on this page is for the port number checked from the General Switch View Page. Clicking on a tab brings the corresponding port folder to the front.

NOTE: This page shows an FL_Port as being offline if you are running cross port connected testing, the reason is that you can have only one Principle per Switch. The FL_Port to FL_Port testing still proceeds even though this is NOT the correct way to connect FL_Ports.

Below the folders is a push button linked to the Administrative Interface Page where port enable/ disable can be performed. A push button linked to the Performance View Page where port and Switch throughput data is plotted. A Done push button is used to exit from the page.

Each port folder contains general port status information such as the port number, port type (E-Port, G-Port), port's WWN name and some detailed information, such as the number of interrupts, number of link failures, number of parity errors, number of time outs and the size of free buffer.

The LED located in the upper right corner in each tab resembles the port LED in the Switch front panel.

Port Detail View Page field are described in Table 5-4.

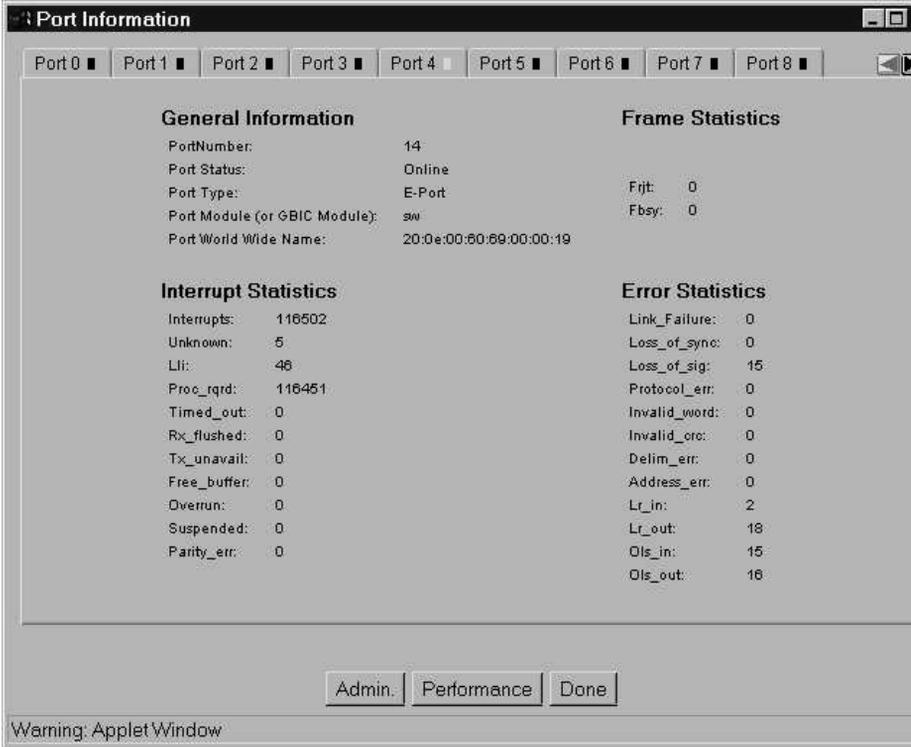


Figure 5-6. Port Detail View Page

Table 5-4
Port Detail View Page Fields

| Field | Description |
|------------------------------|---|
| Port Number | The port number. |
| Port Status | The port state follows the GBIC type. The possible port states include: <ul style="list-style-type: none"> ■ No_Card no card present in this Switch slot ■ No_Module no GBIC module in this port ■ No_Light the module is not receiving light ■ No_Sync the module is receiving light but is out of sync ■ In_Sync the module is receiving light and is in sync ■ Laser_Flt the module is signaling a laser fault (defective GBIC) ■ Port_Flt the port has been marked faulty (defective GBIC, cable, or device) ■ Diag_Flt the port failed diagnostics (defective G_Port or FL_Port card or motherboard) ■ Online the port is up and running ■ Lock_Ref the port locking to the reference signal |
| Port Type | The port type (E_Port, G_Port or FL_Port). |
| Port Module (or GBIC Module) | The GBIC type follows the port number. The four GBIC types include: <ul style="list-style-type: none"> ■ no GBIC present ■ sw shortwave GBIC ■ lw longwave GBIC ■ cu copper GBIC |
| Port World Wide Name | The World Wide Name for this port. |
| Interrupts | Total number of interrupts. |
| Unknown | Number of unknown interrupts. |
| Lli | Number of low level interface (LLI) interrupts. |
| Proc_rqrd | Number of interrupts with processing (CPU) required. |
| Timed_out | Number of timed out interrupts. |

continued

Table 5-4
Port Detail View Page Fields *continued*

| Field | Description |
|--------------|--|
| Rx_flushed | Number of flushed transmissions. |
| Tx_unavail | Number of interrupted transmissions. |
| Free_buffer | Number of buffer interrupts. |
| Overrun | Number of buffer overruns. |
| Suspended | Number of suspended interrupts. |
| Parity_err | Number of parity errors. |
| Frjt | Number of Frame rejected. |
| Fbsy | Number of frames busy. |
| Link_Failure | Number of link failure. |
| Loss_of_sync | Loss of synchronization. |
| Protocol_err | Protocol error. |
| Invalid_word | Invalid word (encoding errors inside of frames). |
| Invalid_crc | Invalid CRC in a frame. |
| Delim_err | Delimiter error (order set) |
| Address_err | Address id error (S_ID D_ID) |
| Lr_in | Link reset in (primitive sequence). Does not apply to FL_Port. |
| Lr_out | Link reset out (primitive sequence). Does not apply to FL_Port. |
| Ols_in | Offline resent in (primitive sequence). Does not apply to FL_Port. |
| Ols_out | Offline resent in (primitive sequence). Does not apply to FL_Port. |

Performance View Page

The Performance View Page, Figure 5-7, displays port and Switch throughput in bytes per second. Each port is numbered and throughput for the entire Switch is displayed under the individual port readings.

The first 16 graphs show the port throughput for port number 0 through 15. Throughput for the entire Switch is displayed in the long rectangular graph at the bottom.

Horizontal axis represents time elapsed. The port throughput graphs hold up to 60 seconds of performance data. The Switch throughput graph at the bottom holds up to 4 minutes of performance data. Vertical axis in each graph shows throughput (in byte per second). It is automatically scaled depending on the Switch activity. The display is updated roughly once per second.

The total throughput value is the throughput sum for all ports. The throughput number represents the number of bytes received plus the number of bytes transmitted each second. Note that, because the Switch also transmits all data it receives, the total throughput for the Switch could, alternately, be stated as one-half ($1/2$) of the throughput sum of all ports.

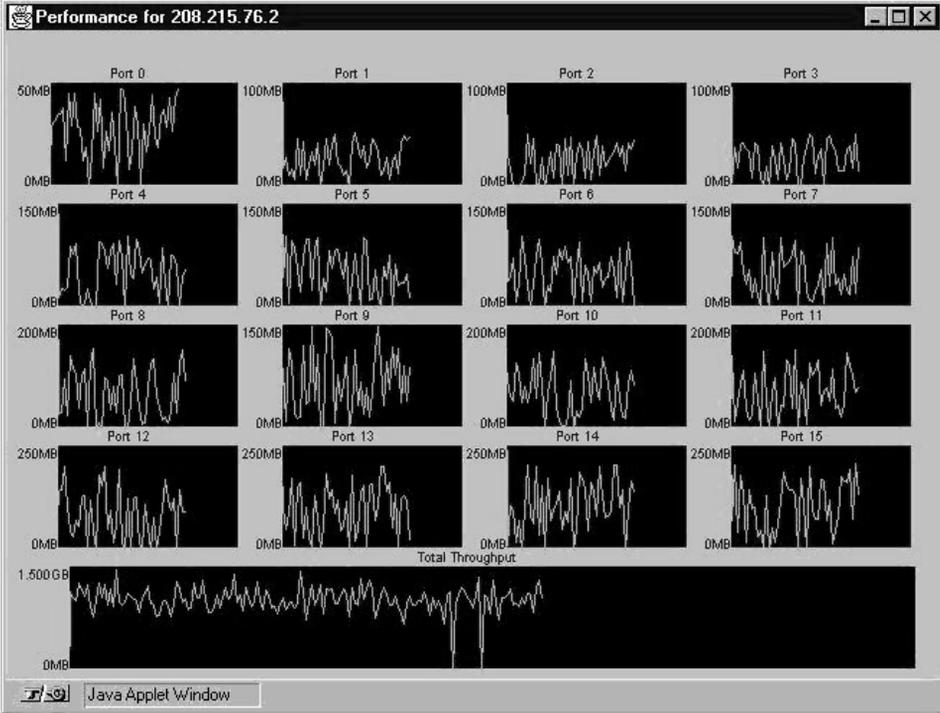


Figure 5-7. Performance View Page

Administrative Interface Page

The Administrative Functions Page, Figure 5-8, is used to enable (or disable) the Switch or ports, and change the Switch name, date/time, IP addresses, user name, and password. It is also used to download firmware, and to reboot a Switch. Only users with admin privilege can access this page. Any changes made through this page may fundamentally change the Switch/port status and its role in the Fabric.

Check and input boxes are provided on the Administrative Interface page for you to type in the changes. Submit buttons are used to apply the changes.

sw24 Switch Configuration

Switch Disabled: Switch Domain: Switch Name:

Network Configuration:

Ethernet IP: Subnet Mask: Gateway:

Fibre Channel IP: Subnet Mask:

Switch Port Configuration:

| Port No | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|----------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Port Disabled: | <input type="checkbox"/> |

User Administration:

Access Level Change User Name To: Change Password To: Verify Password:

1 [admin]

2 [user]

Firmware Upgrade (Flash Download) or Reboot Switch:

Host Name or Host IP: Remote User Name:

Download File From:

Figure 5-8. Administrative Functions Page

Table 5-5
System Administration Fields

| Category | Field | Description |
|------------------------|---------------------|--|
| Switch Administration | Switch Disabled | <p>If the box is checked, the Switch is disabled. It may need to be enabled after firmware upgrades, maintenance, and diagnostic tests.</p> <p>To enable the Switch, click the check box to remove the check and select the Commit Configuration Changes button.</p> |
| | Switch Domain | The Switch domain text box displays or sets the Switch domain. To update the Switch domain, enter the new domain and select the Commit Configuration Changes button. |
| | Switch Name | The switchName text box displays or sets the Switch's name. To update the Switch name, enter the new name and select the Commit Configuration Changes button. |
| Network Administration | Ethernet IP | The IP address for the Ethernet connection to the Switch. The default IP address is a temporary number derived from the Switch's WWN. Refer to the network administrator for the appropriate IP address. |
| | Ethernet Subnetmask | The default subnetmask value is none. Refer to the network administrator for the appropriate subnet mask value to enter here. |

continued

Table 5-5
System Administration Fields *continued*

| Category | Field | Description |
|--------------------------------------|------------------------------|---|
| | Gateway | The gateway address. Refer to the network administrator for the appropriate gateway address value to enter here. |
| | Fibre Channel IP | The Fibre Channel IP address. The default IP address is a temporary number derived from the Switch's WWN. Refer to the network administrator for the appropriate IP address. |
| | Fibre Channel Subnetmask | The default subnetmask value is none. Refer to the network administrator for the appropriate subnet mask value to enter here. |
| Switch Port Configuration | Port Number | The port number on a particular Switch. |
| | Port Disabled | If the box is checked, the port is disabled. It may need to be enabled after maintenance and diagnostic tests. To enable the port, click the check box and select the Commit Configuration Changes button. |
| | Commit Configuration Changes | Applies administrative changes. |
| Switch User Administration | Change User Name | Only users with admin level can change user name for admin and user. |
| | Change Password | To change passwords, enter new password here. |
| | Verify Password | For new passwords, re-enter the password here for verification. |
| Commit Username and Password Changes | | Applies administrative changes. |

continued

Table 5-5
System Administration Fields *continued*

| Category | Field | Description |
|----------------|------------------------|--|
| Reset | | Resets the display to previous defaults. |
| Flash Download | Host Name or Host IP | The host name or Host IP address |
| | Remote User Name | The remote user name |
| | Download File From | The absolute directory path from the source host where the binary firmware file resides. Note that you must use UNIX style forward slashes (/) when downloading firmware from a Windows NT system. |
| | Download Flash Now | Downloads firmware into flash memory. |
| | Reboot This Switch Now | Pressing this button causes the Switch to immediately exit all current processes and states. |

Telnet Interface Page

The Telnet Interface Page, Figure 5-9, allows you to launch a Telnet session directly from your Web browser. Only users with admin or user privilege can access this page and is not in the help menu. To launch a Telnet session click on the Telnet button in the General Switch View Page. Refer to Appendix B for Telnet commands.

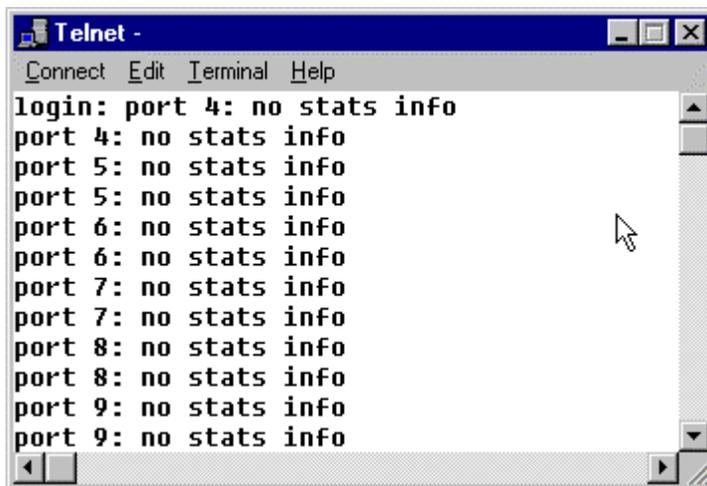


Figure 5-9. Telnet Interface Page

NOTE: Users with User (via Telnet) or Admin Level privilege can access admin pages. The User Level is more restrictive and cannot perform configuration commands. The administrative page via a browser can only be accessed from the Admin Level all other accesses are rejected. HotJava browsers do not support Telnet commands

Popup Help Dialog Box

The Popup Help Dialog Box, Figure 5-10, displays all glossary help and warning messages in a single popup dialog box. This popup dialog box can contain up to 100 entries, each with a time stamp. The top item is deleted sequentially in order to display a new message when over 100 entries are recorded. A single click on each item brings up a separate browser displaying glossary help or troubleshooting information. The history is maintained upon browser Reload/Refresh. The history is cleared upon exiting from the browser.

Browser Reload/Refresh closes all popup windows (Help Dialog Box, Performance Window and Port Detail Window) properly without leaving orphan windows for the OS to handle.

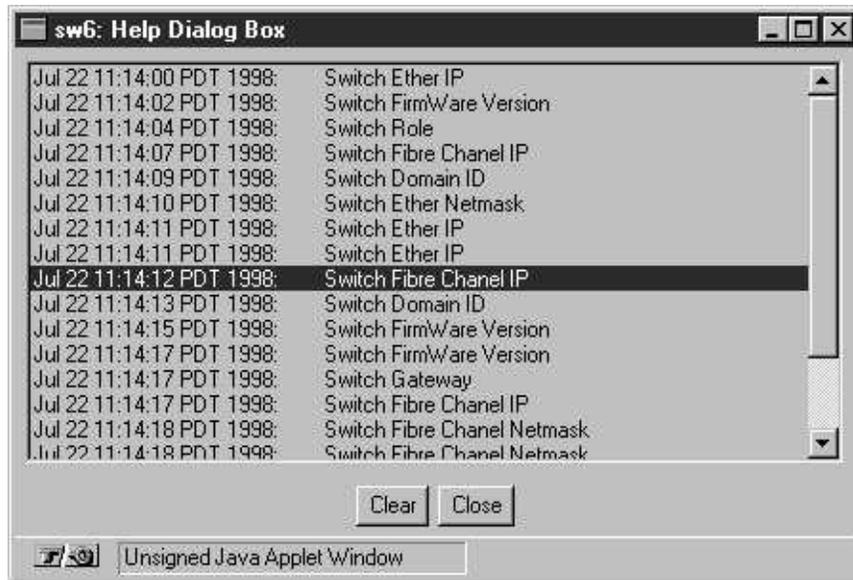


Figure 5-10. Popup Help Dialog Box

Chapter 6

Zoning

Zoning Overview

This chapter discusses general information about managing and monitoring the Switch using Zoning, as follows

- Zoning Components
- Zone Management
- Zone Enforcement
- Multi Switch Fabrics.

Zoning is used to setup barriers between different operating environments, to deploy logical Fabric subsets by creating defined user groups, or to create test and/or maintenance areas that are separate within the Fabric.

Zoning allows you the flexibility to manage a SAN to meet different closed user groups objectives.

Figure 6-1 shows a typical use of Zoning. Zoning is a Fabric management service used to create logical device subsets within a Storage Area Network (SAN), and enables resource partitioning for management and access control.

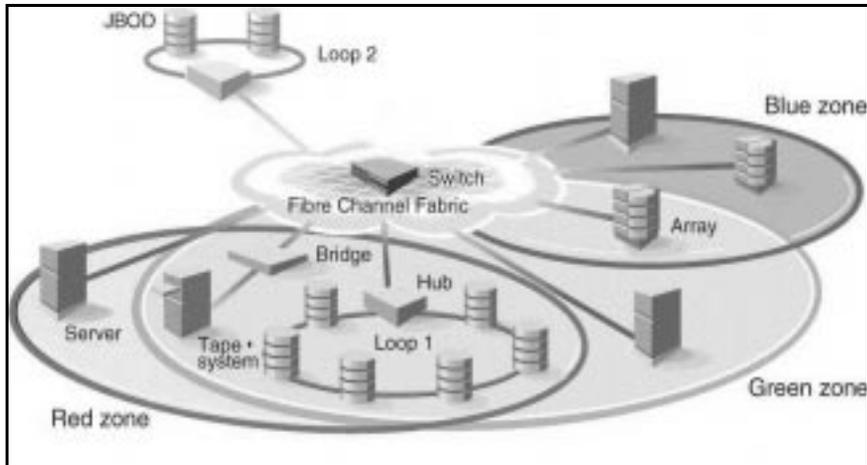


Figure 6-1. Fabric with Three Zones

The benefits of Zoning include:

- Increased environmental security where and when needed
- Optimization of Information Technology (IT) resources in response to user demand and changing user profiles
- Versatility to customize environments as and when needed.

One or more Switches create the Fibre Channel Fabric. This intelligent infrastructure is the backbone for deploying and managing Information Technologies (IT) resources as a network. Using Zoning, Fabric connected devices are arranged into logical groups over the physical Fabric configuration. Zoning is one of the Fabric services that provide management for the SAN both automatically and transparently.

Increased SAN Control

The Fabric provides a fast, reliable, and seamless information access within the SAN for anyone, anywhere, at anytime. Zoning allows you to create segmentation or zones within a Fabric. The zones are comprised of selected storage devices, servers, and/ or workstations. It also enforces access of information to only the devices in the defined zone.

Zones may be configured dynamically. The number of zones and zone membership are effectively unlimited. Zones vary in size and shape, depending on the number of Fabric connected devices and device locations. Devices may be members of more than one zone. In addition, temporary zones can be created, as an example, for enterprise backup,

Zone members see only members in their zones and, therefore, access only one another. A device not included in a zone is not available to the zone devices.

The Simplicity of Zoning

Zoning involves:

- Zone Specification – Telnet commands are used to create, delete, and display zones, to add or remove zone members, and to configure zone sets.
- Zone Enforcement – the Fabric automatically and transparently restricts access to only the devices that are defined zone(s) members.
- Zone Management – you create and manipulate the zones.

Fibre Channel Fabric Customization

Uses for Zoning include:

- Integrated support for heterogeneous environments by isolating systems that have different operating environments or uses.
- Creating Fabric functional areas by separating test or maintenance areas from production areas.
- Designating closed user groups by including certain zone devices for exclusive use by zone members.
- Simplifying resource utilization by consolidating equipment logically for convenience.
- Facilitating time sensitive functions by creating a temporary zone used to backup a set of devices that are members of other zones.
- Securing Fabric areas by providing another level of software security to control port level access.

The Fibre Channel Fabric Value-Add

Services in the Fabric help Information Technology personnel manage the Fibre Channel Fabric. Zoning Fabric characteristics are the same as other Fabric services:

- Administration from any Fabric Switch

- Automatic, transparent distribution throughout the Fabric, a single failure cannot interrupt Zoning Enforcement to other SAN connections
- Automatic service scaling with Fabric size, no requirement to upgrade systems as Switches are added and connectivity increases
- Automatic, transparent deployment, no requirement for human intervention unless Zoning Specification must change.

Questions and Answers about Zoning

1. What is Zoning?

Zoning is a Fabric service that provides an IT administrator more control over the SAN, more management, and security for customizing environments. Using Zoning, Fabric connected devices are arranged into logical groups over the physical Fabric configuration. Zoning automatically and transparently enforces access of information to the zone devices.

2. Why would I implement zones?

Zones can be configured to:

- Unify heterogeneous environments
- Create functional Fabric areas
- Design closed user groups
- Simplify resource utilization
- Facilitate time sensitive functions
- Secure Fabric areas.

3. Does Zoning minimize the Switch performance?

No. Zoning is based on the Simple Name Server (SNS), a Fabric service, for this product version. And, Zoning does not impact SNS. Switch performance is hardware-based.

4. Why is Zoning considered a Fabric service?

Services in the Fabric have these characteristics:

- Administration from any Fabric Switch
- Automatic, transparent distribution throughout the Fabric
- Automatic service scaling with Fabric size
- Automatic, transparent deployment.

5. Why is this service a software service, wouldn't the zones be more stable in hardware?

The Fabric retains the Zoning specification in two ways:

- Information persists until it is deleted or changed.
- Zoning information is recorded in the Switch's flash memory.

Zoning Specifications

Zoning Specifications, they are:

- Administration
- Zoning Enforcement
- Zoning Management
- Zoning Backup.

Administration

Zoning management functions:

- Creation
- Deletion
- Display of deleted/changed by any zone
- Addition and deletion of zone members
- Display of zone members for all zones, or by individual zone or configuration
- Creation of aliases
- Configuration of a set of zones
- Creation of temporary zones.

Zoning Enforcement

Zone enforcement is by Simple Name Server.

Zoning Management Methods

Zones are managed by Telnet commands.

Zoning Backup

When the Switch is powered off and back on, Zoning configuration data is retained in Switch flash memory.

Zoning Concepts

This section discusses the Zoning concepts and components.

Zoning Components

Zoning has several components besides the zones themselves, as follows:

- Zone members
- Zone configurations
- Zone aliases.

These components are generically referred to as zone objects.

Zone Definition

A zone is a set of devices that access one another. All devices connected to a Fabric may be configured into one or more zones. Devices that are in the same zone can see each other, devices that are in different zones can not.

Every zone has a name that begins with a letter and followed by any number of letters, digits and the underscore character “_”. Names are case sensitive, for example “Zone_1” and “zone_1” are different zones. Note that spaces are not allowed.

Every zone has a member list, consisting of one or more member (empty zones are not allowed.).

The maximum number of zones and the maximum number of members in a zone are constrained by memory usage. Since these limits are far larger than the number of devices connected to a Fabric, they are effectively unlimited.

Zone definitions are persistent. That is the definition remains in effect across reboots and power cycles until it is deleted or changed.

A device may be a member of multiple zones.

Zone Members

Zone members may be specified using one of the following notations:

- Node World Wide Name
- Port World Wide Name
- Physical Fabric port number.

A physical Fabric port number notation is specified as a pair of decimal numbers s,p, where:

s - is the Switch number (domain ID)

p - is the Switch port number

For example, 2,12 specifies port 12 on Switch number 2. When a zone member is specified by a physical Fabric port number, then any and all devices connected to that port are in the zone. If this port is an arbitrated loop, then all loop devices are in the zone.

A World Wide Name notation (node and port) is specified as an eight hex number separated by colons. For example 10:00:00:60:69:00:00:8a. Zoning has no field knowledge within a World Wide Name, the eight bytes are simply compared with the Node and Port Names presented by a device in a login frame (FLOGI or PLOGI). When a zone member is specified by Node Name, then all ports on that device are in the zone. When a zone member is specified by Port Name then only that single device port is in the zone.

The type of zone members used to define a zone may be mixed and matched. For example, a zone defined with the following members:

```
2,12; 2,14; 10:00:00:60:69:00:00:8a
```

would contain what ever devices are connected to Switch 2, ports 12 and 14, and the device with either Node Name or Port Name of 10:00:00:60:69:00:00:8a whichever port in the Fabric it is connected to.

Zone Aliases

Zone aliases simplify repetitive port numbers entries or World Wide Names. A zone alias is a C-style name for one or more port numbers or World Wide

Names. For example, the name “host” could be used as an alias for 10:00:00:60:69:00:00:8a.

Zone Configurations

A zone configuration is a set of zones. At any one time, zoning may be disabled or one zone configuration may be in effect. When a zone configuration is in effect, all zones that are members of that configuration are in effect. You select which zone configuration is currently in effect.

The set of zone configurations defined in a Fabric, may not be the same as the configuration that is currently in effect, and may also not be the same as the configurations saved in the Switches flash memory.

Defined Configuration

The Defined Configuration is the complete set of all zone objects that have been defined in the Fabric. There may be multiple zone configurations defined (although only one can be in effect at a time). There may be inconsistencies in the definitions, there may be zones or aliases that are referenced but are not defined, there may be duplicate members. The Defined Configuration is the current state of the administrator’s input.

Effective Configuration

The Effective Configuration is a single zone configuration that is currently in effect. The devices that an initiator sees are based on this configuration.

The Effective Configuration is built when you enable a specified zone configuration. This configuration is compiled by checking for undefined zone names, or zone alias names, or other inconsistencies by expanding zone aliases, removing duplicate entries, and then building the Effective Configuration.

Saved Configuration

The Saved Configuration is a copy of the defined configuration plus the name of the effective configuration which is saved in flash memory by the `cfgSave` command. There may be differences between the saved configuration and the defined configuration if you have modified any zone definition and have not saved them.

The Saved Configuration is automatically reloaded by the Switch on power up, and if a configuration was in effect when it was saved, the same configuration is reinstated with an automatic `cfgEnable` command.

Using Zoning

This section contains general information and examples on managing and monitoring the Switch using Zoning. The section discusses:

- Zoning Components
- Easy Setup and Administration of Zoning
- Zone Management
- Zone Enforcement
- Multi Switch Fabrics.

Zoning Components

Zoning has several components. In addition to the zones themselves, zoning is comprised of: zone members, zone aliases, and zone configurations. These components are referred to as zone objects.

Easy Setup and Administration of Zoning

A zone is specified by a zone name. A zone member is specified by a physical Fabric port number, a node world wide name, or a port world wide name.

Aliases (symbolic names) are used to reduce the amount of typing required for Zoning administration. A set of zones is configured during Zone Specification.

You select which zone configuration is currently in effect. At any one time, you might decide that Zoning is disabled or one Zoning configuration is in effect, such as for backup.

Non-zoned Components

When a zone configuration is enabled, components that are not in the configuration can not see each other across the Fabric.

Zone Management

Zoning Management is performed using Telnet via either out-of-band or in-band communication by logging into a Switch. Any Switch in the Fabric can be used, a change made to the Zoning information on one Switch is replicated through all Fabric Switches.

Zoning uses logical device subsets within an SAN network for resource partitioning for management and access control. Within a zone the device sets may access one another. All Fabric connected devices can be configured into one or more zones. Devices that are in different zones do not see each other.

Zoning allows you to setup:

- Barriers between systems with different operating environments or uses.
- Logical subsets of closed user groups within the Fabric.
- Special areas separate from the rest of the Fabric. For example, for testing or maintenance.
- Temporary access among devices for specific purposes. For example, enterprise backup.

Additionally, Zoning provides:

- Greater flexibility – to manage a SAN with multiple operational objectives
- Finer configuration granularity to logically configure resources for improved optimization and seclude environments for security
- Versatility to meet application demands.

Zone Enforcement

A zone is enforced via software by:

- Implementation based on Simple Name Server (SNS)
- Is enforced across all Fabric Switches

SNS functionality is not degraded by supporting zones because:

- There is no change to the SNS access protocol
- If no zones are in force an SNS query responds with all ports
- If one or more zones are in force an SNS query only responds with the ports that are part of the requestor's zone. If the requestor is not part of the zone, an SNS query responds with no ports.

Setting Up Zones

Zoning supports:

- Zone creation, deletion and display

- Zone member additions and removals.

Zone members can be displayed for all zones or by individual zone or configuration.

The Telnet commands are based on the three object types:

- Alias
- Configuration
- Zone.

They provide five “same set” commands for each object type:

- Create
- Delete
- Add
- Remove
- Show.

Zone Management Example

Figure 6-2 shows a single configuration USA_cfg that has three zones defined, as follows:

- The Red and Green zones share six disk drives on a loop.
- The Blue and Green zones share one storage array.
- The Blue zone has a dedicated storage array.

NOTE: the JBOD with Loop 2 is not in any zone cannot be accessed from any zone where the configuration is in effect.

The disks are specified by World Wide Name and the hosts are specified by physical port.

Figure 6-3 is a graphical representation of the configuration with an additional disk drive loop that none of the zones “see”.

```
admin> cfgCreate "USA_cfg", "Red_zone; Blue_zone; Green_zone"
admin> zoneCreate "Red_zone", "0,0; loop1"
admin> zoneCreate "Blue_zone", "0,1; array1; 0,2; array2"
admin> zoneCreate "Green_zone", "0,0; loop1; 0,2; array2"
```

```
admin> aliCreate "array1", "21:00:00:20:37:0c:76:85;  
21:00:00:20:37:0c:71:df"  
admin> aliAdd "array1", "21:00:00:20:37:0c:72:51;  
21:00:00:20:37:0c:71:0a"  
admin> aliCreate "array2", "21:00:00:20:37:0c:66:23;  
21:00:00:20:37:0c:73:7f"  
admin> aliAdd "array2", "21:00:00:20:37:0c:9c:6b;  
21:00:00:20:37:0c:66:3a"  
admin> aliCreate "loop1", "21:00:00:20:37:0c:67:e3;  
21:00:00:20:37:0c:76:1f"  
admin> aliAdd "loop1", "21:00:00:20:37:0c:6a:40;  
21:00:00:20:37:0c:59:7e"  
admin> cfgEnable "USA_cfg"  
zone config "USA_cfg" is in effect
```

Figure 6-2. Zone Management Example

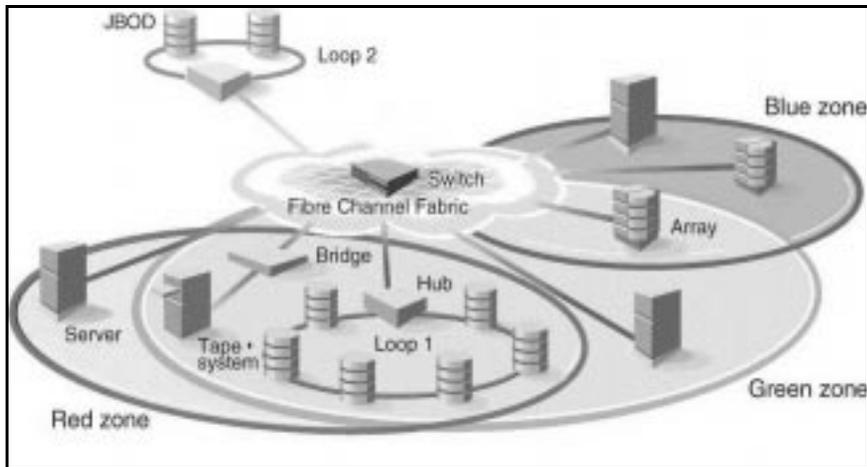


Figure 6-3. Zone Management Example 2

Zone Enforcement

Zoning is enforced by the Simple Name Server (SNS) and Zoning does not change the SNS protocol. Host device drivers query SNS using existing commands and have no knowledge that Zoning is in effect. If no zone configuration is in effect, then responses to SNS queries are based on all Fabric connected devices. If a zone configuration is in effect, then responses to SNS queries contain information about only those devices that are in the requestor's zone.

Multi-Switch Fabrics

There are two databases used by Zoning:

- The zone configuration data
- The N_Port login data.

Zone Configuration Data

This data is shown as the defined configuration by the `cfgShow` command, and is stored in flash by the `cfgSave` command. This data is a replicated database, all Fabric Switches have a complete copy. Whenever you make a configuration change, the Switch where the change is made forwards the change to all Fabric Switches using vendor unique interSwitch protocol.

N_Port Login Data

N_Port Login Data is stored locally on each Switch, and is used to translate World Wide Names into physical port numbers when world wide names are used in zone definitions. The zone checking procedure runs entirely on the local Switch when a match can be made by physical port number alone, but when physical port number is not sufficient, the local Switch has to query the remote Switch to get login data. This data is then cached on the local Switch until a State Change Notification renders it stale.

Adding a New Switch

A new Switch is a Switch that has not previously been connected to a Fabric with Zoning configured, and has had no zone configuration data entered into it. If a Switch has been connected to a zoned Fabric, or has had zone configuration data previously entered, see below. A Switch that has been configured for Zoning may be returned to this new Switch state by using the `cfgClear` command before connecting it to the Fabric.

When a new Switch is connected to a Fabric, all zone configuration data is immediately copied from the Fabric into the new Switch. If a zone configuration is enabled in the Fabric, then the same configuration becomes enabled in the new Switch. After this operation, the `cfgShow` command displays the same output on all Switches in the Fabric, including the new Switch.

Adding a New Fabric

Adding a new Fabric (a Fabric where there is no zone configuration information) to an existing Zoned Fabric is similar to adding a new Switch. All Switches in the new Fabric inherit the zone configuration data. If a zone configuration is enabled, then the same configuration becomes enabled in the new Switches. After this operation, `cfgShow` displays the same output on all Switches in the joined Fabric, including the new Switches.

Merging Two Fabrics

If two Fabrics that have zone configuration information are joined it is more complex. The Zoning software attempts to merge the two zone configurations.

The simplest and safest case is where both Fabrics have identical zone configuration data and the same configuration is enabled. In this case, the Fabrics join to make one larger Fabric with the same zone configuration in effect across the whole new Fabric.

If the Fabrics have different zone configuration data, then the two sets of information are merged if possible, or the Inter Switch Link (ISL) is segmented if a merge is not possible. Merging is not possible if:

- Zoning is enabled in both Fabrics and the zone configuration that is enabled is different (cfg mismatch)
- The name of a zone object in one Fabric is used for a different type of zone object in the other Fabric (type mismatch)
- The definition of a zone object in one Fabric is different from its definition in the other Fabric (content mismatch).

When this condition is detected by the Switches between the ISL, each Switch displays an error message on its LCD, Telnet console and syslog.

Splitting a Fabric

If an ISL goes down, causing a Fabric to split into two separate Fabrics, then each new Fabric retains the same zone configuration.

If the ISL is replaced and no changes have been made to the zone configuration in either new Fabric, then the two Fabrics are guaranteed to merge back into one single Fabric. If changes have been made to either zone configuration, then the rules under Merging Two Fabrics apply.

Zoning Commands

Zoning is managed by logging into a Switch via Telnet. Any Fabric Switch can be used to manage Zoning. A change made to the Zoning information on the master Switch is replicated through all Switches in the Fabric.

This chapter contains information and examples on managing zones, including:

- Zone Alias Commands
- Zone Configuration Commands
- Zone Commands
- Configuration Management Commands.

The Zoning commands are added to the shell admin account to manage zones, zone aliases, and zone configurations. All commands other than the Show command return zero if successful and -1 on error.

All Add, Create, Delete, and Remove commands modify the defined configuration. This has no effect on the effective configuration until a `cfgEnable` command is executed. As these commands are executed, the parameter syntax is checked but the changes are not in force until the next enable command is given. Table 6-1 summarizes the commands.

Table 6-1
Zoning Commands

| Command | Description |
|----------------|------------------------------------|
| aliAdd | Adds a member to a zone alias |
| aliCreate | Creates a zone alias |
| aliDelete | Deletes a zone alias |
| aliRemove | Removes a member from a zone alias |
| aliShow | Shows zone alias definition |
| cfgAdd | Adds a zone to a configuration |
| cfgCreate | Create a zone configuration |
| cfgDelete | Deletes a zone configuration |

continued

Table 6-1
Zoning Commands *continued*

| Command | Description |
|------------|-------------------------------------|
| cfgRemove | Removes a zone from a configuration |
| cfgShow | Show zones configuration definition |
| zoneAdd | Adds a member to a zone |
| zoneCreate | Creates a zone |
| zoneDelete | Deletes a zone |
| zoneRemove | Removes a member from a zone |
| zoneShow | Shows zone definition |
| cfgClear | Clears all zone configurations |
| cfgDisable | Disables a zone configuration |
| cfgEnable | Enables a zone configuration |
| cfgSave | Saves zone configurations in flash |
| cfgShow | Shows zone configuration definition |

Zone Alias Commands

Zone Alias commands allow you to manipulate the zone aliases. Table 6-2 summarizes the commands.

Table 6-2
Zone Alias Command Descriptions

| Command | Description |
|-----------|------------------------------------|
| aliAdd | Adds a member to a zone alias |
| aliCreate | Creates a zone alias |
| aliDelete | Deletes a zone alias |
| aliRemove | Removes a member from a zone alias |
| aliShow | Shows zone alias definition |

aliAdd

Figure 6-4 shows the `aliAdd` command adds one or more new `alias_members` to an existing zone alias and is a list of one or more physical Fabric port numbers (for example, 1,2) or World Wide Names (for example, 10:00:00:60:69:00:00:8a) separated by semicolons. White space are ignored. The `alias_members` list cannot contain another zone aliases.

```
admin> aliAdd "array1", "21:00:00:20:37:0c:72:51;  
21:00:00:20:37:0c:71:0a"  
admin> aliAdd "array2", "21:00:00:20:37:0c:9c:6b;  
21:00:00:20:37:0c:66:3a"  
admin> aliAdd "loop1", "21:00:00:20:37:0c:6a:40;  
21:00:00:20:37:0c:59:7e"  
value = 0 = 0x0
```

Figure 6-4. aliAdd Command

aliCreate

Figure 6-5 shows the `aliCreate` command which creates a new zone alias. `alias_name` is a C-style name for this zone alias and cannot already used for any other zone object. `alias_members` is a list of one or more physical Fabric port numbers (for example, 1,2) or World Wide Names (for example, 10:00:00:60:69:00:00:8a) separated by semicolons. White space are ignored. The `alias_members` list cannot contain another zone aliases.

```
admin> aliCreate "array1", "21:00:00:20:37:0c:76:8c;  
21:00:00:20:37:0c:71:d2"  
admin> aliCreate "array2", "21:00:00:20:37:0c:66:23;  
21:00:00:20:37:0c:73:7f"  
admin> aliCreate "loop1", "21:00:00:20:37:0c:67:e3;  
21:00:00:20:37:0c:76:1f"  
value = 0 = 0x0
```

Figure 6-5. aliCreate Command

aliDelete

Figure 6-6 shows the `aliDelete` command which deletes an existing zone alias.

```
admin> aliDelete "array2"  
value = 0 = 0x0
```

Figure 6-6. aliDelete Command

aliRemove

Figure 6-7 shows the `aliRemove` command which removes one or more `alias_members` from an existing zone alias. The members removed are found by an exact string match when removing multiple members order is important. If this command results in all members being removed the zone alias is deleted.

```
admin> aliRemove "array1",
"21:00:00:20:37:0c:71:d2"
value = 0 = 0x0
```

Figure 6-7. aliRemove Command

aliShow

Figure 6-8 shows the `aliShow` command which prints the specified zone alias definition if a parameter is given, otherwise all zone configuration information is printed.

```
admin> aliShow
Defined configuration:
cfg:   USA_cfg Red_zone; Blue_zone
zone:  Blue_zone
      0,1; array1; 0,2; array2
zone:  Red_zone
      0,0; loop1
alias: array1 21:00:00:20:37:0c:76:8c;
21:00:00:20:37:0c:71:02
alias: array2 21:00:00:20:37:0c:66:23;
21:00:00:20:37:0c:73:7f
alias: loop1  21:00:00:20:37:0c:76:85;
21:00:00:20:37:0c:71:df

Effective configuration:
no configuration in effect

value = 1 = 0x1
```

Figure 6-8. aliShow Command

Zone Configuration Commands

Zone Configuration commands allow you to manipulate the zone configurations. Table 6-3 summarizes the commands.

Table 6-3
Zone Configuration Command Descriptions

| Command | Description |
|-----------|-------------------------------------|
| cfgAdd | Adds a zone to a configuration |
| cfgCreate | Creates a zone configuration |
| cfgDelete | Deletes a zone configuration |
| cfgRemove | Removes a zone from a configuration |
| cfgShow | Shows zone configuration definition |

cfgAdd

Figure 6-9 shows the `cfgAdd` command which adds one or more new `cfg_members` to an existing zone configuration.

```
admin> cfgAdd "USA_cfg", "Green_zone"
value = 0 = 0x0
```

Figure 6-9. `cfgAdd` Command

cfgCreate

Figure 6-10 shows the `cfgCreate` command which creates a new zone configuration. `cfg_name` is a C-style name for this zone configuration and cannot already be used for any other zone object. `cfg_members` is a list of one or more zone names separated by semicolons. White space is ignored.

```
admin> cfgCreate "USA_cfg", "Red_zone; Blue_zone;
Green_zone"
value = 0 = 0x0
```

Figure 6-10. `cfgCreate` Command

cfgDelete

Figure 6-11 shows the `cfgDelete` which deletes an existing zone configuration.

```
admin> cfgDelete "USA_cfg"  
value = 0 = 0x0
```

Figure 6-11. `cfgDelete` Command

fgRemove

Figure 6-12 shows the `cfgRemove` command which removes one or more `cfg_members` from an existing zone configuration. The members removed are found by an exact string match when removing multiple members order is important. If this command results in all members being removed the zone configuration is deleted.

```
admin> cfgRemove "USA_cfg", "Green_zone"  
value = 0 = 0x0
```

Figure 6-12. `cfgRemove` Command

cfgShow

Figure 6-13 shows the `cfgShow` command which prints the specified zone configuration definition if a parameter is given, otherwise all zone configuration information is printed.

```
admin> cfgShow
Defined configuration:
cfg:   USA_cfg Red_zone; Blue_zone; Green_zone
zone:  Blue_zone
        0,1; array1; 0,2; array2
zone:  Red_zone
        0,0; loop1
alias: array1  21:00:00:20:37:0c:76:8c; 21:00:00:20:37:0c:71:02
alias: array2  21:00:00:20:37:0c:76:22; 21:00:00:20:37:0c:76:28
alias: loop1   21:00:00:20:37:0c:76:85; 21:00:00:20:37:0c:71:df

Effective configuration:
cfg:   USA_cfg
zone:  Blue_zone
        0,1
        21:00:00:20:37:0c:76:8c
        21:00:00:20:37:0c:71:02
        0,2
        21:00:00:20:37:0c:76:22
        21:00:00:20:37:0c:76:28
zone:  Red_zone
        0,0
        21:00:00:20:37:0c:76:85
        21:00:00:20:37:0c:71:df

value = 1 = 0x1
```

Figure 6-13. `cfgShow` Command

Zone Commands

Zone commands allow you to manipulate the zones within a Fabric. Table 6-4 summarizes the commands.

Table 6-4
Zone Command Descriptions

| Command | Description |
|------------|------------------------------|
| zoneAdd | Adds a member to a zone |
| zoneCreate | Creates a zone |
| zoneDelete | Deletes a zone |
| zoneRemove | Removes a member from a zone |
| zoneShow | Shows zone definition |

zoneAdd

Figure 6-14 shows the zoneAdd command which adds one or more new zone_members to an existing zone.

```
admin> zoneAdd "Blue_zone", "array2"  
value = 0 = 0x0
```

Figure 6-14. zoneAdd Command

zoneCreate

Figure 6-15 shows the zoneCreate command which creates a new zone. zone_name is a C-style name for the zone and cannot already be used for any other zone object. zone_members is a list of one or more physical Fabric port numbers (for example, 1,2), World Wide Names (for example, 10:00:00:60:69:00:00:8a), or zone alias names separated by semicolons. White space is ignored.

```
admin> zoneCreate "Red_zone", "0,0; loop1"
admin> zoneCreate "Blue_zone", "0,1; array1; 0,2;
array2"
admin> zoneCreate "Green_zone", "0,0; loop1; 0,2;
array2"
value = 0 = 0x0
```

Figure 6-15. zoneCreate Command

zoneDelete

Figure 6-16 shows the zoneDelete command which deletes an existing zone.

```
admin> zoneDelete "Blue_zone"
value = 0 = 0x0
```

Figure 6-16. zoneDelete Command

zoneRemove

Figure 6-17 shows the zoneRemove command which removes one or more zone_members from an existing zone. The members removed are found by an exact string match when removing multiple members order is important. If this command results in all members being removed the zone is deleted.

```
admin> zoneRemove "Blue_zone", "array2"
value = 0 = 0x0
```

Figure 6-17. zoneRemove Command

zoneShow

Figure 6-18 shows the zoneShow command which prints the specified zone definition if a parameter is given, otherwise all zone configuration information is printed.

```
admin> zoneShow
Defined configuration:
cfg:   USA_cfg Red_zone; Blue_zone; Green_zone
zone:  Blue_zone
        0,1; array1; 0,2; array2
zone:  Red_zone
        0,0; loop1
alias: array1  21:00:00:20:37:0c:76:8c; 21:00:00:20:37:0c:71:02
alias: array2  21:00:00:20:37:0c:76:22; 21:00:00:20:37:0c:76:28
alias: loop1   21:00:00:20:37:0c:76:85; 21:00:00:20:37:0c:71:df

Effective configuration:
cfg:   USA_cfg
zone:  Blue_zone
        0,1
        21:00:00:20:37:0c:76:8c
        21:00:00:20:37:0c:71:02
        0,2
        21:00:00:20:37:0c:76:22
        21:00:00:20:37:0c:76:28
zone:  Red_zone
        0,0
        21:00:00:20:37:0c:76:85
        21:00:00:20:37:0c:71:df

value = 1 = 0x1
```

Figure 6-18. zoneShow Command

Configuration Management Commands

Configuration Management commands allow you to configure the zones. Table 6-5 summarizes the commands.

Table 6-5
Configuration Management Command Descriptions

| Command | Description |
|------------|-------------------------------------|
| cfgClear | Clears all zone configurations |
| cfgDisable | Disables a zone configuration |
| cfgEnable | Enables a zone configuration |
| cfgSave | Saves zone configurations in flash |
| cfgShow | Shows zone configuration definition |

cfgClear

Figure 6-19 shows the `cfgClear` command should be used with caution. If a zone configuration is enabled, it is first disabled. All defined zone objects are then deleted. The zone configuration stored in flash is then erased. After this command has been executed there is no longer any zone information stored in the Fabric.



CAUTION: Use of this command removes all zone information from the Fabric.

```
admin> cfgClear
value = 0 = 0x0
```

Figure 6-19. `cfgClear` Command

cfgDisable

Figure 6-20 shows the `cfgDisable` command which disables the current zone configuration. The Fabric returns to non zoning mode where all devices see each other.

```
admin> cfgDisable "USA_cfg"  
value = 0 = 0x0
```

Figure 6-20. `cfgDisable` Command

cfgEnable

Figure 6-21 shows the `cfgEnable` which requires a license. The specified zone configuration is compiled by checking for undefined zone names, zone alias names, or other inconsistencies by expanding zone aliases, removing duplicate entries, and then building the effective configuration. If the compilation fails the previous state is unchanged (zoning is disabled if it was previously disabled or the previous effective configuration remains in effect). If the compilation succeeds the previous effective configuration is disabled and this new configuration installed.

```
admin> cfgEnable "USA_cfg"  
zone config "USA_cfg" is in effect  
value = 0 = 0x0
```

Figure 6-21. `cfgEnable` Command

cfgSave

Figure 5-22 shows the `cfgSave` command writes a copy of the defined configuration plus the name of the effective configuration to flash memory in all Fabric Switches. The saved configuration is automatically reloaded by the Switch on power up and if a configuration was in effect when it was saved the same configuration is reinstated with an automatic `cfgEnable` command.

```
admin> cfgSave  
Updating flash ...  
value = 0 = 0x0
```

Figure 6-22. `cfgSave` Command

cfgShow

Figure 6-23 shows the `cfgShow` command output, the specified zone configuration definition if a parameter is given, otherwise all zone configuration information is printed.

```
admin> cfgShow
Defined configuration:
cfg:   USA1   Blue_zone
cfg:   USA_cfg Red_zone; Blue_zone
zone:  Blue_zone
           0,1; array1; 0,2; array2
zone:  Red_zone
           0,0; loop1
alias: array1 21:00:00:20:37:0c:76:8c; 21:00:00:20:37:0c:71:02
alias: array2 21:00:00:20:37:0c:76:22; 21:00:00:20:37:0c:76:28
alias: loop1  21:00:00:20:37:0c:76:85; 21:00:00:20:37:0c:71:df

Effective configuration:
cfg:   USA_cfg
zone:  Blue_zone
           0,1
           21:00:00:20:37:0c:76:8c
           21:00:00:20:37:0c:71:02
           0,2
           21:00:00:20:37:0c:76:22
           21:00:00:20:37:0c:76:28
zone:  Red_zone
           0,0
           21:00:00:20:37:0c:76:85
           21:00:00:20:37:0c:71:df
value = 1 = 0x1
```

Figure 6-23. `cfgShow` Command Example

Appendix **A**

Glossary

Definition of Terms

Table A-1 contains terms relating to the Switch and Fibre Channel connections.

Table A-1
Switch Terminology

| Term | Definition |
|-----------------|---|
| Alias Server | A Fabric software facility that supports multicast group management. |
| Arbitrated Loop | The FC Arbitrated Loop (FC-AL) is a standard defined on top of the FC-PH standard. It defines the arbitration on a loop where several FC nodes share a common medium. |

continued

Table A-1
Switch Terminology *continued*

| | |
|------------------|---|
| Community (SNMP) | An SNMP community is a relationship between an SNMP agent and a set of SNMP managers that defines authentication, access control, and proxy characteristics. |
| Credit | Credit, applied to a Switch, is a numeric value that represents the maximum number of receive buffers provided by an F_Port or FL_Port to its attached N_Port or NL_Port respectively such that the N_Port or NL_Port may transmit frames without over-running the F_Port or NL_Port. |
| Class 2 | In Class-2 service, the Fabric and destination N_Port provide connectionless service with notification of delivery or nondelivery between the two N_Ports. |
| Class 3 | Class-3 service provides a connectionless service without notification of delivery between N_Ports. The transmission and routing of Class-3 frames is the same as for Class-2 frames. |
| Domain_ID | The domain number uniquely identifies the Switch in a Fabric. This Switch domain ID is normally automatically assigned by the Switch and may be any value between 0 and 31. The default domain ID number may also be assigned manually. |

continued

Table A-1
Switch Terminology *continued*

| | |
|---------------------------------------|---|
| E_Port | A port is designated an E_Port when it is used as an interSwitch expansion port to connect to the E_Port of another Switch to build a larger Switch Fabric. |
| E_D_TOV (Error Detect Time Out Value) | E_D_TOV (Error-Detect Time-Out Value) defines the time the Switch waits for an expected response before declaring an error condition. The error detect time out value is adjustable in 1ms increments from two seconds up to ten seconds. |
| Fabric | The name applied to a network resulting from the interconnection of Switches and devices comprised of high-speed fiber connections. A Fabric is an active, intelligent, interconnect capable of routing frames using only the destination ID of the frame. |
| Fibre | A generic term used to cover all transmission media specified in the Fibre Channel physical and signaling standard. |
| FL_Port | The FL_Port is the Fabric access port used to connect NL_Ports to the Switch in a loop configuration. |
| F_Port | The F_Port is the Fabric access port used to connect an N_Port. |
| FSPF | Fibre-Channel shortest path first. |
| G_Port | A port is designated as a G_Port when it has not assumed a specific function. A G_Port is a generic Switch port that can operate either as an E_Port or an F_Port. A port is defined as a G_Port, for example, when it is not connected or has not yet assumed a specific function in the Fabric. |

continued

Table A-1
Switch Terminology *continued*

| | |
|--|---|
| Interswitch Link (ISL) | ISL is a fiber link between two Switches |
| Loop | A loop is a configuration of devices (for example, JBODs) connected to the Fabric via an FL_Port interface card. |
| Multicast | Multicast is used when multiple copies of data are to be sent to designated multiple destinations. |
| N_Port | The N_Port is the designation of an equipment port connected to the Fabric. |
| NL_Port | The NL_Port is the designation of an equipment port connected to the Fabric in a loop configuration via an FL_Port. |
| Power-on self-test (POST) | The POST is a series of self-tests which run each time the unit is booted or reset. |
| R_A_TOV (Resource Allocation Time Out Value) | R_A_TOV is used to time out operations that depend on the maximum possible time that a frame could be delayed in a Fabric and still be delivered. The value of R_A_TOV is adjustable in 1-microsecond increments over a range from 10 to 120 seconds. Frames stored in the Switch and not delivered with R_A_TOV are deleted. |

continued

Table A-1
Switch Terminology *continued*

| | |
|---|---|
| Isolated E_Port | ISL is online but not operational between Switches because of overlapping domain ID or nonidentical parameters such as E_O_TOVs. |
| Simple Network Management Protocol (SNMP) | SNMP is a TCP/IP protocol that generally uses the User Datagram Protocol (UDP) to exchange messages between a management information base and a management client residing on a network. Since SNMP does not rely on the underlying communication protocols, it can be made available over other protocols, such as UDP/IP. |
| SNMPv1 | The original standard for SNMP is now referred to as SNMPv1. |
| Trap (SNMP) | A trap is a mechanism for SNMP agents to notify the SNMP management station of significant events. |
| Unicast | Unicast routing provides one or more optimal path(s) between any of two Switches that make up the Fabric. This is for a single copy of the data to be sent to designated destinations. |
| Worldwide Name (WWN) | A WWN uniquely identifies a Switch on local and global networks. |

Appendix **B**

Telnet Commands

Introduction to Telnet Commands

This Appendix contains information and examples on managing and monitoring the Switch via Telnet, including:

- General Commands
- Diagnosis Commands
- Routing Commands
- License Commands

Telnet Zoning commands are in Chapter 6.

The user can configure, operate, and test the Switch using the following commands and settings through the Telnet interface.

NOTE: Screen displays in this Appendix are generic, your display will vary depending on configuration, licenses, and port type.

General Commands

General commands allow you to control basic Switch operations.

agtcfgSet

Figure B-1 shows the `agtcfgSet` command which is used to set the SNMP agent configuration to a fiber channel Switch. The fields are described in Table B-1.

NOTE: Any change to the SNMP configuration are not shown until you reboot the Switch. This is because SNMP polls from cache not from the flash prom so you will not be able to see the changes

```
admin> agtcfgSet
Customizing MIB-II system variables ...
At each prompt, do one of the followings:
  o <Return> to accept current value,
  o enter the appropriate new value,
  o <Control-D> to skip the rest of configuration, or
  o <Control-C> to cancel any change.
To correct any input mistake:
<Backspace> erases the previous character,
<Control-U> erases the whole line,
sysDescr: [Fibre Channel Switch.]
sysLocation: [End User Premise]
sysContact: [Field Support.]
authTrapsEnabled (true, t, false, f): [false]
SNMP community and trap recipient configuration:
Community: [Secret C0de]
Trap Recipient's IP address in dot notation: [0.0.0.0]
Community: [OrigEquipMfr]
Trap Recipient's IP address in dot notation: [0.0.0.0]
Community: [private]
Trap Recipient's IP address in dot notation: [0.0.0.0]
Community: [public]
Trap Recipient's IP address in dot notation: [0.0.0.0]
Community: [common]
Trap Recipient's IP address in dot notation: [0.0.0.0]
Community: [FibreChannel]
Trap Recipient's IP address in dot notation: [0.0.0.0]
value = 0 = 0x0
```

Figure B-1. agtcfgset Command Example

agtcfgShow

Figure B-2 shows agtcfgShow command displays SNMP agent configuration. The fields are described in Table B-1.

```
admin> agtcfgShow
Current SNMP Agent Configuration
Customizable MIB-II system variables:
  sysDescr = Fibre Channel Switch.
  sysLocation = End User Premise
  sysContact = Field Support.
  authTraps = 0 (OFF)

SNMPv1 community and trap recipient
configuration:
Community 1: Secret C0de (rw)
  No trap recipient configured yet
Community 2: OrigEquipMfr (rw)
  No trap recipient configured yet
Community 3: private (rw)
  No trap recipient configured yet
Community 4: public (ro)
  No trap recipient configured yet
Community 5: common (ro)
  No trap recipient configured yet
Community 6: FibreChannel (ro)
  No trap recipient configured yet
value = 0 = 0x0
```

Figure B-2. agtcfgShow Command Example

Table B-1
agtcfgShow Field Command Descriptions

| Field | Description |
|---|--|
| sysDescr | System description: the default value is set as "Fibre Channel Switch" |
| sysLocation | The node's physical location. The default setting is "End User Premise". |
| sysContact | The identification and contact information for this system. By default, this is set as "Field Support". |
| authTrapsEnabled | Trap authentication. Possible values include 0 (OFF), 1 (ON) |
| SNMPv1 community and trap recipient configuration | This example shows six communities available with which to register and define the recipients of SNMP traps. The recipient is the host which has SNMP management installed. Values include read and write (rw) and read only (ro). |

aliasShow

Figure B-3 shows the `aliasShow` command which displays local Alias Server information. If there is no local alias group, a message stating that is displayed. If there are one or more local entries, the output looks like.

```
admin> aliasShow
The Local Alias Server has 1 entry
Alias ID Creator Token [rb, type, grptype, qlfr] Member
List
ffffb01 fffffd [40, 05, 10000060 69000015] {2d0113 2d0813}
```

Figure B-3. `aliasShow` Command Example

Table B-2
aliasShow Command Field Descriptions

| Field | Description |
|---------------|---|
| Alias ID | This is the multicast address and has the format of FFFBxx, where xx is an odd number starting at 01 - 31. This is the name of the multicast group. |
| Creator | Is the Fibre Channel address ID of the N_Port that created this Alias group. |
| Creator Token | Is the Alias Token that has been provided to map to the Alias group and it consists of 4 sub-fields: rb – Routing bits. type – Upper level application type. grptype – The alias group type, and can only be ?? for multicast. qlfr – Alias Qualifier of the group. |
| Member List | A list of member address IDs. |

date

Figure B-4 shows the `date` command entered by itself displays the system date and time. You can also set the date as shown below:

To set the date:

1. Type the command followed by the date in the format “mmddHHMMyy” where:
 - mm is the month
 - dd is the day
 - HH is the hour
 - MM is the minutes
 - yy is the year – Year 2000 compliant, where 00 through 69 equals 20xx and 70 through 99 equals 19xx
2. Press enter to set date and time.

```
admin> date  
  
Mon Jul 7 08:48:01 1997  
value = 25 = 0x19  
  
admin> date "060811241998"  
Mon Jun 8 11:24:00 1998
```

Figure B-4. `date` Command Example

dateShow

Figure B-5 shows the dateShow command which displays system and firmware dates.

```
admin> dateShow
Current date:   Mon Nov 16 21:34:08 1998
Booted at:     Mon Nov 16 21:26:33 1998
Firmware date: Mon Nov 16 18:15:26 PST 1998
Flash date:    Mon Nov 16 18:15:42 PST 1998
Boot prom date: Tue Feb 18 09:30:53 PST 1997
value = 45 = 0x2d = '--'
```

Figure B-5. dateShow Command Example

Table B-3
DateShow Command Field Descriptions

| Fabric Element | Description |
|----------------|--|
| Current date | Date and time the command was entered. |
| Booted at | Last date and time the Switch was booted. |
| Firmware date | Date and time the firmware was built. |
| Flash date | Date and time the flash memory was last updated. This can be from any source. For example, a configuration change, new firmware, Zoning change, etc. |
| Boot prom date | Date and time the boot PROM was updated. |

errDump

The errDump command which displays the contents of the error log with no page breaks. See Figure B-6 for log display example.

errShow

Figure B-6 shows the errShow command which displays all detected errors. The error log stores the last 30 error types sensed by the Switch. The log shows:

- Error number (01-30)

- Date and time of the first occurrence each error type was sensed
- Total number of occurrences of each error type (up to 999)
- The maximum error number is 999.
- Error type
- Error level for each error type
 - 0–Panic (when this level is reached, the Switch automatically reboots and the display no longer shows the error)
 - 1–Critical
 - 2–Error
 - 3–Warning
 - 4–Debug

The following information is displayed in Figure B-6:

The Switch detected two errors.

- The task ID and task name that incurred the error (task names are displayed using the `i` command). For example, 0x103dc470.
- The error type, date and time, the error level, and description.
- If there is more than one occurrence of an error type, the number of occurrences is shown in brackets following the error date and time.

```

admin> errShow

Error 02
-----
0x103dc470 (tSilkworm): Apr  9 10:41:06
    Error SENSOR-FAILED, 3, sensor 7 (Fan 2) is below
    minimum

Type <CR> to continue, Q<CR> to stop:

Error 01
-----
0x103dc470 (tSilkworm): Apr  9 10:40:51
    Error DIAG-TIMEOUT, 1,
    Port 2 receive timeout.

Type <CR> to continue, Q<CR> to stop:
value = 1 = 0x1

```

Figure B-6. errShow Command Example

fabricShow

Figure B-7 shows the fabricShow command which displays a list of Switches and multicast alias groups in a Fabric. The fields are described in Table B-4.

```

admin> fabricShow
Switch ID   Worldwide Name           Enet IP Addr   FC IP Addr     Name
-----
  0: fffc40 10:00:00:60:69:00:10:63 192.168.1.1    0.0.0.0        "sw1"
  1: fffc41 10:00:00:60:69:00:0a:12 192.168.1.2    0.0.0.0        "sw2"
  2: fffc42 10:00:00:60:69:00:01:b4 192.168.1.3    0.0.0.0        >"sw3"

value = 1 = 0x1

```

Figure B-7. fabricShow Command Example

Table B-4
fabricShow Command Field Descriptions

| Fabric Element | Description |
|-----------------------|--|
| switch n | Each line shows: The Switch's domain ID (0 - 31) The Switch's embedded port ID The Switch's WorldWide Name The Switch's Ethernet and FC IP addresses The Switch's name (a ">" indicates the Principle Switch in the Fabric) |
| multicast alias group | Each line shows: The alias group number (0-30) The alias group ID The alias token Alias groups are only created on demand by requests to the alias server, typically no groups are listed. |

fastboot

Figure B-8 shows the `fastboot` command which is a warm reboot that bypasses POST and takes about one minute to reboot the Switch. The Switch maybe in any operational state (enabled or disabled) before rebooting.

```
admin> fastboot

Updating flash ...
done

Rebooting...
```

Figure B-8. fastboot Command Example

flashDefault

Figure B-9 shows the `flashDefault` command resets the Switch to the factory default configuration values.

This command may not be executed on an operational Switch. You must first disable the Switch using the `switchDisable` command.

```
admin> flashDefault
value = 0 = 0x0
```

Figure B-9. `flashDefault` Command Example

`flashDefault` also configures the Switch to boot from its flash prompts (removes any network boot parameters), erases the SNMP database, and erases the Zoning database. If any changes have been made to the SNMP configuration or Zoning configuration from the default values, then the factory default does not take effect until the next reboot because the values are stored in cache. For this reason it is recommended to always reboot the Switch immediately after `flashDefault`.

`flashDefault` does not change the Switches identity: WorldWide Name, Ethernet IP address and subnetmask, gateway address, symbolic name, or license keys.

This command should be used with care; `flashDefault` restores the configurable parameters to factory default values, as follows:

- Switch modes: `tachyon`, `isolated`, `notypes`, `nomcast`, `nopost`
- FC parameters: `domain`, `BB_credit`, `RA_TOV`, `ED_TOV`
- FL_Port parameters: `collection method`, `credit`, `FAN frames`
- Virtual channel parameters
- `syslogd` IP address
- Fibre channel IP address and subnetmask
- Display error level
- OEM customizing
- Static paths
- Usernames and passwords

flashDownload

The flashDownload command is used to download firmware into flash memory. This command can be executed on an operational Switch. A reboot is required to initiate the new firmware after the download has completed.

Firmware can be downloaded from either a Unix host, Windows95 or NT host. For a Unix host, no special software is needed. For Windows95 or NT, a daemon to support a remote shell (RSH) is required. Firmware download is via RCP command running on top of TCP between the Switch and the host.

A Compaq StorageWorks Fibre Channel Switch will come with the firmware preloaded in it. In most cases there is no need to update the firmware on a new Compaq StorageWorks Fibre Channel Switch. The firmware version can be determined from the front panel. The command is listed under the Status Menu.

Version 1.0 of the Compaq StorageWorks Fibre Channel Switch CD contains Compaq StorageWorks Fibre Channel Switch version V1.6b. New functionality is added with whole number changes, fixes are fractions and small letters after the fraction determine the final release.

In the event that an upgrade to the firmware of a Compaq StorageWorks Fibre Channel Switch is needed from the latest version of the Compaq StorageWorks Fibre Channel Switch CD, use one of the three following procedures (NT Intel, NTAAlpha, Tru64):

To load the Compaq StorageWorks Fibre Channel Firmware from a Compaq PC running NT (NTIntel):

1. Copy the files Rshd.exe and Cat.exe from
D:\DSGGA\Firmware\NTIntel\Rshd.exe,
D:\DSGGA\Firmware\NTIntel\Cat.exe, and
D:\DSGGA\Firmware\NTIntel\V1.6b to the top directory C:\

Where D:\ is the drive letter for the CD and C:\ is the root directory for your system and V1.6b is the latest version of the Compaq StorageWorks Fibre Channel Switch Firmware.

2. Double-click on Rshd.exe in the root directory C:\. Rshd will run in a separate window. Leave Rsh running. RSH is a small server program that allows the Switch to request the firmware from the host (PC) over the Ethernet.
3. Place the cursor over the Start button, press the left mouse button

4. and hold it down and select RUN.
5. Let go of the left mouse button and type in Telnet.
6. Select Connect and a menu will open.
7. Select Remote System. A text box will show up.
8. In the box labled Host Name: Type in XXX.XXX.XXX.XXX

where XXX.XXX.XXX.XXX is the IP address of the Compaq StorageWorks Fibre Channel Switch that you want to download.

9. Connect to the Switch and login as:

```
admin
password:
password
```

10. Then type:

```
flashDownload "192.168.60.200",
"administrator", "V1.6b"
```

The 192.168.60.200 above must be replaced with the IP address of your host computer (PC). You may have to change the V1.6b to whatever the current Firmware file is called. If you are logged into an NT system under an account other than administrator you will have to modify "administrator" to the account you are using to run Rshd.exe which must also be run from the directory that contains cat.

The output will look something like:

```
1330320+203572+427356
writing flash 0 .....
writing flash 1 .....
download complete
value = 0 = 0x0
switch:admin>
```

11. You can then click on the RSHD window and type Control C or select File and Exit to stop Rshd from running.
12. Select the Telnet window and type reboot to cause the Switch to reboot and copy the flash into the ram and come up running the latest Compaq StorageWorks Switch Firmware.

To load the Compaq StorageWorks Fibre Channel Firmware from an ALPHA NT machine:

1. Copy the files Rshd.exe and Cat.exe from
D:\DSGGA\Firmware\NTAlpha\Rshd.exe,
D:\DSGGA\Firmware\NTAlpha\Cat.exe, and the firmware file
D:\DSGGA\firmware\NTAlpha\V1.6b onto the top root directory C:\.

Where D:\ is the drive letter for the CD and C:\ is the root directory for your system.

2. Double-click on Rshd.exe. Rshd will just run in the background. Leave Rsh running. RSH is a small server program that allows the Switch to request the firmware from the host over the Ethernet.
3. Run Telnet to connect to the Switch and login as:

```
admin
password:
password
```

4. Then type:

```
flashDownload "192.168.60.200",
"administrator", "V1.6b"
```

The 192.168.60.200 above must be replaced with the IP address of your Alpha host computer. You may have to change the V1.6b to what ever the current Firmware file is called. If you are logged into an NT system under an account other than administrator you will have to modify "administrator" to the account you are using to run Rshd.exe which must also be run from the directory that contains cat. An example of the output follows:

```
1330320+203572+427356
writing flash 0 .....
writing flash 1 .....
download complete
value = 0 = 0x0
switch:admin>
```

5. Click on the RSHD window and type Control C or select File and Exit
6. to stop Rshd from running.
7. Select the Telnet window and type reboot to cause the Switch to reboot and copy the flash into the ram and come up running the latest Compaq StorageWorks Switch Firmware.

To load the firmware from Compaq Tru64 (UNIX):

1. The first step in downloading the firmware from a Compaq Tru64 (UNIX) machine is to copy it from the Compaq StorageWorks CD as follows:

```
mount -t cdfs -r /dev/rz5c /mnt
```

2. You may have to change the 5 to the unit number of your CD drive.

```
cd /mnt
```

This will change to the CD directory.

```
cp DSGGA/Firmware/v1.6b /mary/tmp/v1.6b
```

where: mary is the user name on the Compaq Tru64 system. The Compaq StorageWorks Fibre Channel Switch uses remote shell capabilities of unix to log in to the Compaq TRu64 host on which the f/w image resides and copy the image over to the Compaq StorageWorks Fibre Channel Switch. As such, the user (mary) and Compaq StorageWorks Fibre Channel Switch host (IP address) must be in the .rhosts file of the Compaq Tru64 host to allow login without password. The basic steps are:

3. Telnet to the Switch CLI:
4. Telnet <switch_hostname>

```
user: admin
```

```
pswd: <password>
```

You can substitute the IP address of the Switch for <switch_hostname>.

5. Instruct the Switch to copy over and download the firmware image:

```
<switch>:admin> flashDownload "16.140.32.60", "mary",
"/tmp/V1.6b"
```

where: "<switch>:admin>" is the prompt that the Switch presents

16.140.32.60 is the ip address of the host w/ the image

mary is the user to rsh under

/tmp/V1.6b is the f/w image to be loaded into the Compaq StorageWorks Fibre Channel Switch flash rom.

NOTE: The quotes are very important in the command line above. "rsh" w/o a password must be enabled for the user that rsh is executing under (e.g. add the Switch ip name to ~<user>/rhosts). The format of .rhosts is: hostname [user].

6. Instruct the Switch to reboot on the new firmware image

```
<switch>:admin> reboot
```

flashSet

Figure B-10 shows the `flashSet` command which is used to set the Switch's configuration parameters. This command may not be executed on an operational Switch. You must first disable the Switch using the `switchDisable` command.

Values may be changed by typing the new value after the prompt or left unchanged by pressing the Return. The fields are described in Table B-5.

```
admin> flashSet
changing flash configuration

domain_id [1]:
b_to_b credit [16]:
r_a_tov [10000]:
e_d_tov [2000]:
op_mode [16]:
vc_link_ctl [0]:
vc_class2 [2]:
vc_class3 [3]:
vc_multicast [7]:
vc_priority 2 [2]:
vc_priority 3 [2]:
vc_priority 4 [2]:
vc_priority 5 [2]:
vc_priority 6 [3]:
vc_priority 7 [3]:
collection method: (0)piling, (1)bundling
[0]:
alternate bb_credit [0]:
open/opened bb_credit [4]:
send FAN frames: (0)yes, (1)no [0]:

no changes
value = 0 = 0x0
```

Figure B-10. flashSet Command Example

Table B-5
flashSet Command Field Descriptions

| Field | Description |
|------------------|---|
| domain_id | The domain number uniquely identifies the Switch in a Fabric. Normally, this Switch ID is automatically assigned by the Switch and may be any value between 0 and 31. |
| b_to_b credit | The number represents the number of buffers, in a range from 1 to 16, available to the host. For a complete description of this function, the buffer-to-buffer credit, refer to the industry specification <i>Fibre Channel Physical and Signalling Interface (FC-PH)</i> . |
| r_a_tov | <p>Resource Allocation Time Out Value (R_A_TOV) is displayed in milliseconds. This variable works with the variable E_D_TOV to determine the Switch's actions when presented with an error condition. Allocated circuit resources with detected errors are not released until the time value has expired. If the condition is resolved prior to the timing out, the internal time out clock resets and waits for the next error condition.</p> <p>The range is 4000 to 120000 milliseconds.</p> <p>The set value must be larger than the set value for the Error Detect Time Out Value.</p> |

continued

Table B-5
flashSet Command Field Descriptions *continued*

| Field | Description |
|---------|---|
| e_d_tov | <p data-bbox="482 326 1072 352">Error Detect Time Out Value E_D_TOV) is displayed in milliseconds.</p> <p data-bbox="482 374 1215 493">This timer is used to flag a potential error condition when an expected response is not received (an acknowledgment or reply in response to packet receipt, for example) within the set time limit. If the time for an expected response exceeds the set value, then an error condition is met.</p> <p data-bbox="482 517 836 543">The range is 1000 to 5000 milliseconds.</p> <p data-bbox="482 565 1208 621">The set value must be less than the set value for the Resource Allocation Time Out Value.</p> |

continued

Table B-5
flashSet Command Field Descriptions *continued*

| Field | Description |
|---------|---|
| op_mode | <p>The administrator determines the adapter, then sets the Switch for the corresponding operating mode. The modes are:</p> <p>0 - Normal operating mode, none of the following modes are in effect</p> <p>1 - Tachyon operating mode. Set this mode when there is one or more Tachyon host adapters connected to the Fabric, and a protocol other than SCSI-FCP is being used over this host adapter. When this mode is set, multiple Sequences from different sources will be interleaved to Tachyon at Sequence boundaries rather than at frame boundaries, resulting in better performance from Tachyon.</p> <p>2 - Isolated operating mode. Set this mode only if the Switches E_Port discovery process (transmission of a Class F frame) causes some attached device to fail. When this mode is set, Switches will not join to become a Fabric.</p> <p>4 - No_Probe operating mode. Set this mode only if the Switches N_Port discovery process (PLOGI, PRLI, INQUIRY) causes some attached device to fail. When this mode is set, devices that do not register themselves with the Name Server will not be present in the Name Server data base</p> <p>8 - No_MCast operating mode. Set this mode only if buffer-to-buffer credit values greater than 16 are needed, and broadcast and multicast are not needed. When this mode is set, the normal range of buffer-to-buffer credit is changed from 1-16 to 1-62 and broadcast and multicast are disabled.</p> <p>The default is 0.</p> <p>These modes are additive, for example to set a Switch in Tachyon mode and in No_MCast mode, the operating mode should be set to 9. Any combination of bit maps can be set up to 15, all values above 15 are ignored.</p> |

continued

Table B-5
flashSet Command Field Descriptions *continued*

| Field | Description |
|--------------|--|
| vc_link_ctl | <p>The Virtual Channel Link Control changes the link control channel. There are two options: 0 and 1.</p> <p>Option 0 forces data receipt acknowledgments on Class 2 channels to be sent back on the data channel. This traffic consumes a portion of the available data channel bandwidth.</p> <p>Option 1 allows data receipt acknowledgment packets to use the VC-1 (internal Switch traffic channel) which frees additional bandwidth in the data channel, and transfers the data receipt traffic load to the Switch's internal traffic channel.</p> |
| vc_class2 | <p>Can be set to virtual channel 2, 3, 4, or 5.</p> <p>The Switch provides the ability to tune the Switch in a specific application.</p> <p>The first two virtual channels are reserved for the Switch's internal functions and are not available.</p> <p>The default virtual channel settings are already optimized for Switch performance. Changing the default values, if properly selected, may improve Switch performance somewhat, but may also severely degrade performance. You should not change these settings without full understanding the changes effects.</p> |
| vc_class3 | Can be set to virtual channel 2, 3, 4, or 5. |
| vc_multicast | The virtual channel multicast default is channel 7. You may change the multicast transmission channel to either virtual channel 6 or 7. Verify that the multicast channel has the frame class priority set to the frame class of the expected traffic. |
| priority 2-7 | The numbers displayed show the priorities assigned to each of the Switch's virtual channels. They can have only a 2 or a 3 indicating that the channel gives priority to either Class 2 frame traffic or to Class 3 frame traffic. |

continued

Table B-5
flashSet Command Field Descriptions *continued*

| Field | Description |
|--------------------------|---|
| collection method | <p>FL_Port supports 2 frame collection methods, piling and bundling. If NL_Ports can handle multiple frame context in a loop, using piling can minimize loop tenancies, reduce overhead and increase loop efficiency. The modes are:</p> <p>0 - piling (frames are accumulated per destination AL_PA)</p> <p>1 - bundling (frames are separated in different queues based on source/destination pairs)</p> <p>The default is piling [0].</p> |
| alternate bb_credit | <p>This is the value used in an NL_Port's FLOGI. If the value is 1, this can reduce the loop turnaround time and increase performance. For a detail description of Alternate BB_Credit management, refer to the FC-AL specification.</p> <p>0 - An NL_Port must wait for an R_RDY before it can send a frame to the FL_Port in a loop</p> <p>1 - An NL_Port can immediately send a frame to the FL_Port without waiting for an R_RDY</p> <p>The default is [0].</p> |
| open/opened bb_credit | <p>The maximum number of R_RDY's an FL_Port issues (provided buffers are available) at the beginning of each loop tenancy. Configuring a higher value allows NL_Ports to send out more frames to the Fabric in a loop and can potentially increase performance, especially in bigger loops.</p> <p>The default is [4].</p> |
| send FAN frames | <p>Fabric Address Notification (FAN frames are sent by the Fabric to notify the public loop devices about their node ID and address.</p> <p>0 - yes, send frames</p> <p>1- no, do not send frames</p> <p>The default is [0].</p> |

flashShow

Figure B-11 shows the flashShow command which displays the Switch's configuration status. The display shows remote host and flash configuration information for flash-0 and flash-1 (a mirrored image of flash-0 and included as a fail safe device).

```

admin> flashShow
Ethernet address: 0:60:69:0:4:64
Nvram data: ei(0,0)host:/usr/switch/firmware
e=192.168.64.146:ffffff00 g=192.168
.64.1 u=user tn=open146
  Config          fl-0          fl-1
  -----
version          0002          0002
flags            0000          0000
domain           0001          0001
syslogd_ip      0.0.0.0      0.0.0.0
fc_ip_addr      0.0.0.0      0.0.0.0
fc_ip_mask      0.0.0.0      0.0.0.0
bb_credit       0010          0010
df_size         0840          0840
r_a_tov         2710          2710
e_d_tov         07d0          07d0
op_mode         0000          0000
vc_link_ctl     0000          0000
vc_class2       0002          0002
vc_class3       0003          0003
vc_multicast    0007          0007
vc_priorities  0,1,2,2,2,2,3,3
0,1,2,2,2,2,3,3
vc_pid_map      767625432    767625432
frm collection  piling       piling
alt bb_credit   0000          0000
open bb_credit  0004          0004
send FAN frames yes          yes
ql_ports       n/c           n/c
ql_peer        n/c           n/c
csum           4cc2 OK      4cc2 OK

```

Figure B-11. flashShow Command Example

| | | |
|-------------------|----------|----------|
| Code | f1-0 | f1-1 |
| ---- | ---- | ---- |
| text off | 00000020 | 00000020 |
| text addr | 10330000 | 10330000 |
| text size | 0000d990 | 0000d990 |
| data off | 0000d9b0 | 0000d9b0 |
| data addr | 1033d9c0 | 1033d9c0 |
| data size | 00001b48 | 00001b48 |
| magic | 2112 | 2112 |
| tsum | 2638 | 2638 |
| dsum | 376d | 376d |
| hsum | b87b OK | b87b OK |
| value = 25 = 0x19 | | |

Figure B-11. flashShow Command Example (continued)

Table B-6
flashShow Command Field Descriptions

| Field | Description |
|------------------|--|
| Ethernet address | Switch's Ethernet MAC address for an Ethernet connection |
| Nvram data: | Remote host information including Ethernet interface |
| f1-0 | Flash 0 data contained on the CPU board. |
| f1-1 | Flash 1 data contained on the CPU board. |
| version | Used by Technical Support. |
| flags | These are various system state flags OR'ed together. |
| domain | The domain number. This number uniquely identifies the Switch in a Fabric. |
| syslogd_ip | The system log daemon IP address. |
| fc_ip_addr | The Fibre Channel IP address. |
| fc_ip_mask | The Fibre Channel IP subnetmask. |
| bb_credit | The buffer to buffer credit. |

continued

Table B-6
flashShow Command Field Descriptions *continued*

| Field | Description |
|----------------|---|
| df_size | The receive data field size. |
| r_a_tov | The resource allocation time out value. |
| e_d_tov | The error detect time out value. |
| op_mode | Operating mode. |
| vc_link_ctl | Virtual channel link control. |
| vc_class2 | Virtual channel class 2. |
| vc_class3 | Virtual channel class 3. |
| vc_multicast | Virtual channel multicast. |
| vc_priorities | <p>The numbers displayed show the priorities assigned to each of the Switch's virtual channels. Positions 1 and 2, starting at the left of the display, are fixed and displays 0 or 1.</p> <p>The first position a 0 shows and indicates that this virtual channel, assigned to handle internal Switch traffic, has the highest priority. This priority value cannot be changed.</p> <p>The second position, indicated with a 1, shows the priority assigned by the virtual channel link control.</p> <p>The third through eighth positions they can have only a 2 or a 3 indicating that the channel gives priority to either Class 2 frame traffic or to Class 3 frame traffic.</p> |
| vc_pid_map | Virtual channel Port ID time out map. |
| frm collection | Supports 2 frame collection methods, piling and bundling. |
| alt bb_credit | This is the value used in an NL_Port's FLOGI. |

continued

Table B-6
flashShow Command Field Descriptions *continued*

| Field | Description |
|------------------------------|---|
| <code>open bb_credit</code> | The maximum number of R_RDY's an FL_Port issues (provided buffers are available) at the beginning of each loop tenancy. |
| <code>send FAN frames</code> | Fabric Address Notification (FAN frames are sent by the Fabric to notify the public loop devices about their node ID and address. |
| <code>csum</code> | Checksum. |
| <code>text off</code> | Text offset in flash. |
| <code>text addr</code> | Text address in RAM. |
| <code>text size</code> | Text size (bytes). |
| <code>data off</code> | Data offset in flash. |
| <code>data addr</code> | Data address in RAM. |
| <code>data size</code> | Data size (bytes). |
| <code>magic</code> | The magic number represents the maximum frame size. |
| <code>tsum</code> | Test checksum. |

continued

Table B-6
flashShow Command Field Descriptions *continued*

| Field | Description |
|-------|------------------|
| dsum | Data checksum. |
| hsum | Header checksum. |

h

Figure B-12 shows the `h` command which displays the shell history of the previous 20 commands. The older commands are replaced by new commands. The shell history is similar to the Unix Korn shell history facility with a built-in line editor (similar to Unix `vi`) that allows previously typed commands to be edited.

NOTE: The shell history is reset by a reboot.

```
admin=> h
 11 date
 12 dateShow
 13 switchName
 14 date "0117130198"
 15 nsShow
 16 fabricShow
 17 portDisable 5
 18 portEnable 5
 19 portLogShow 100
 20 h
 21 portShow 5
 22 portStatsShow 5
 23 ipAddrShow
 24 diagShow
 25 switchDisable
 26 switchShow
 27 portLoopbackTest
 28 portShow 5
 29 diagShow
 30 switchEnable
```

Figure B-12. `h` Command Example

help

Figure B-13 shows the `help` command which displays a list of commands in alphabetical order. With an additional lists of “grouped” commands:

NOTE: The help display changes depending on the login user level and will display only those commands that are available to the current user. This example shows admin level commands.

- General Commands
- Diagnosis Commands
- Routing (Show) Commands
- Zoning Commands

NOTE: In addition, commands for optionally licensed products are only displayed if the appropriate license key has been installed.

```
admin> help
agtcfgSet          Set SNMP agent configuration
agtcfgShow         Print SNMP agent configuration
aliasShow          Print Alias Server information
date               Print/set the system date and time
dateShow           Print system and firmware dates
errDump            Print error log (no page breaks)
errShow            Print error log
fabricShow         Print fabric membership info
fastboot           Reboot this switch, bypassing POST
flashDefault       Reset config to factory default
flashDownload      Download firmware into flash
flashSet           Set switch config parameters
flashShow          Print switch config parameters
h                  Print shell history
help               Print this list
i                  Print task summary
ifShow             Print network interface information
ipAddrSet          Set ethernet and FC IP addresses
ipAddrShow         Print ethernet and FC IP addresses
login              Login as a new user
logout             Logout from remote session
nsAllShow          Print global Name Server information
nsShow             Print local Name Server information
passwd             Set usernames and passwords
portDisable        Disable a specified port
portEnable         Enable a specified port
portLogClear       Clear port activity log
portLogDump        Print port log (no page breaks)
portLogShow        Print port activity log
portPerfShow       Print port throughput numbers
portShow           Print state of specified port
portStatsShow      Print hardware statistics
reboot             Reboot this switch
syslogdIp          Print/set syslog daemon IP address
switchDisable      Disable this switch
switchEnable       Enable this switch
switchName         Print/set this switch's name
switchShow         Print switch and port status
tempShow           Print temperature readings
version            Print firmware version
diagHelp           Print diagnostic help info
licenseHelp        Print licensing help info
routeHelp          Print routing help info
zoneHelp           Print zoning help info
```

Figure B-13. help Command Example

i

Figure B-14 shows the `i` command which displays a currently running task summary. The fields are described in Table B-7.

```
admin>i
```

| NAME DELAY | ENTRY | TID | PRI | STATUS | PC | SP | ERRNO | |
|---------------|--------------|----------|-----|--------|----------|----------|--------|-----|
| tExcTask | _excTask | 103f7eb0 | 0 | PEND | 1014f718 | 103f8200 | 3d0001 | 0 |
| tLogTask | _logTask | 103f5f30 | 0 | PEND | 1014f718 | 103f6280 | 0 | 0 |
| tShell | _shellTask | 103c6e40 | 1 | READY | 101367c0 | 103c70b0 | c0002 | 0 |
| tRlogind | _rlogind | 103ee0f0 | 2 | PEND | 101331e0 | 103ee7e0 | 0 | 0 |
| tTelnetd | _telnetd | 103ec160 | 2 | PEND | 101331e0 | 103ec5d0 | 0 | 0 |
| tTelnetOutT | _telnetOutTa | 103711b0 | 2 | READY | 101331e0 | 103717b0 | 0 | 0 |
| tTelnetInTa | _telnetInTas | 1036d330 | 2 | READY | 101330e4 | 1036d9b0 | 0 | 0 |
| tTimers | _timerTask | 103fbd80 | 10 | PEND | 1014f718 | 103fc100 | 0 | 0 |
| tNetTask | _netTask | 103f0370 | 50 | READY | 10134280 | 103f0740 | 0 | 0 |
| tSwitch | _switchTask | 103e9500 | 80 | PEND+T | 1014f718 | 103e9900 | 3d0004 | 36 |
| tPMenu | _menuTask | 103d7c20 | 90 | PEND | 1014f718 | 103d7fe0 | 0 | 0 |
| tReceive | _portRxTask | 103d4450 | 100 | PEND | 1014f718 | 103d47d0 | 0 | 0 |
| tTransmit | _portTxTask | 103d2eb0 | 100 | PEND | 1014f718 | 103d3230 | 0 | 0 |
| tFabric | _fabricTask | 103b9530 | 100 | PEND | 1014f718 | 103b98f0 | 3d0004 | 0 |
| tFspf | _fspfTask | 103b7340 | 100 | PEND | 1014f718 | 103b76c0 | 0 | 0 |
| tFcpH | _fcphTask | 103bde50 | 120 | PEND+T | 1014f718 | 103be1d0 | 3d0004 | 31 |
| tZone | _cfgTask | 10374ef0 | 130 | PEND | 1014f718 | 10375270 | 0 | 0 |
| tFcp | _fcpTask | 103bbd00 | 150 | PEND+T | 1014f718 | 103bc080 | 3d0004 | 773 |
| tSnmpd | 101394b0 | 103b3500 | 150 | PEND | 101331e0 | 103b4250 | 5b0002 | 0 |
| tHttpD | _STARTUP_Web | 103b1e70 | 150 | PEND | 101331e0 | 103b2330 | 0 | 0 |
| tNSd | _ns_svr | 103aca10 | 150 | PEND | 1014f718 | 103acda0 | 0 | 0 |
| tASd | _as_svr | 103812d0 | 150 | PEND | 1014f718 | 10381650 | 0 | 0 |

value = 0 = 0x0

Figure B-14. `i` Command Example

Table B-7
i Command Field Descriptions

| Field | Description |
|--------|--|
| Name | Task name |
| Entry | Task entry point ID |
| TID | Task ID |
| PRI | Task priority with VxWorks |
| Status | Current executing state of task |
| PC | Program counter |
| SP | Stack pointer |
| ERRNO | Last error number generated by this task |
| Delay | For pending tasks, the amount of time a task has been waiting to execute |

ifShow

Figure B-15 shows the `ifShow` command which displays network interface information. The display includes three sections organized by interface:

- `ei` – Ethernet 10-BaseT port
- `lo` – loopback interface
- `fc` – Fibre Channel. This section is omitted if IP over Fibre Channel is not configured

```
admin> ifShow
ei (unit number 0):
  Flags: (0x63) UP BROADCAST ARP RUNNING
  Internet address: 192.168.64.146
  Broadcast address: 192.168.64.255
  Netmask 0xffffffff Subnetmask 0xffffffff
  Ethernet address is 00:60:69:00:04:64
  Metric is 0
  Maximum Transfer Unit size is 1500
  2089 packets received; 156 packets sent
  0 input errors; 0 output errors
  3 collisions
lo (unit number 0):
  Flags: (0x69) UP LOOPBACK ARP RUNNING
  Internet address: 127.0.0.1
  Netmask 0xff000000 Subnetmask 0xff000000
  Metric is 0
  Maximum Transfer Unit size is 4096
  0 packets received; 0 packets sent
  0 input errors; 0 output errors
  0 collisions
value = 18 = 0x12
```

Figure B-15. `ifShow` Command Example

ipAddrSet

Figure B-16 shows the ipAddrSet command which is used to set the Switch's Ethernet IP Address, Ethernet Subnetmask, Fibre Channel IP Address, Fibre Channel Subnetmask, and Gateway Address. The fields are described in Table B-8.

```
admin> ipAddrSet
Ethernet IP Address [192.158.1.14]:
Ethernet Subnetmask [255.255.255.0]:
Fibre Channel IP Address [none]:
Fibre Channel Subnetmask [none]:
Gateway Address [192.158.1.1]:
value = 0 = 0x0
```

Figure B-16. ipAddrSet Command Example

Table B-8
ipAddrSet Command Descriptions

| Field | Description |
|--------------------------|---|
| Ethernet IP Address | The default IP address on a new Switch is a temporary number derived from the Switch's WWN. Enter a valid IP address. |
| Ethernet Subnetmask | The Ethernet subnetmask value. The default subnet mask value is none. Refer to the network administrator for the appropriate subnet mask value to enter here. |
| Fibre Channel IP Address | The Fibre Channel IP address for the Switch. Enter a valid IP address. |
| Fibre Channel Subnetmask | The Fibre Channel subnetmask for the Switch. The default is none. The default subnetmask value is none. |
| Gateway IP Address | The gateway IP address. The default gateway address on a new Switch is none. You must enter a valid gateway address, if required. |

NOTE: Consult your network administrator for the appropriate subnetmask..

login

Figure B-17 shows the `login` command which logs in a user from a remote host. If a user is already logged in, the command logs out the user and allow a new user login.

```
admin> login
```

Figure B-17. login Command Example

ipAddrShow

Figure B-18 shows the `ipAddrShow` command which is used to display the Switch's IP addresses. The fields are described in Table B-8.

```
admin> ipAddrShow
Ethernet IP Address: 192.158.1.14
Ethernet Subnetmask: 255.255.255.0
Fibre Channel IP Address: none
Fibre Channel Subnetmask: none
Gateway Address: 192.158.1.1
value = 30 = 0x1e
```

Figure B-18. ipAddrShow Command Example

logout

Figure B-19 shows the `logout` command which logs out from a remote session.

```
admin> logout
Connection closed by foreign host.
```

Figure B-19. logout Command Example

nsAllShow

Table B-20 shows the `nsAllShow` command which displays a list of PIDs of nodes connected to the Fabric. The `nsAllShow` command optionally takes an integer parameter, the value of the FC-PH type. For example, `nsAllShow 8` shows all SCSI-FCP nodes. If the parameter is not provided, then `Nx_Ports` are displayed.

```
admin> nsAllShow
2 Nx_Ports in the Fabric {
  614001 614301
}
value = 0 = 0x0

admin> nsAllShow 8
2 FCP Ports {
  6042ef 6045e8
}
value = 0 = 0x0
```

Figure B-20. nsAllShow Command Example

nsShow

Figure B-21 shows the `nsShow` command which displays the local name server information. If there is no local information, a message stating that is displayed. Only local entries are displayed.

```
admin> nsShow
The Local Name Server has 2 entries {
Type Pid   CO      PortName                               NodeName                               TTL(sec)
NL  614001; 3;00:00:00:00:00:00:00:00:00:00:00:00; na
NL  614301; 3;00:00:00:00:00:00:00:00:00:00:00:00; na
}
value = 0 = 0x0
```

Figure B-21. nsShow Command Example

passwd

Figure B-22 shows the `passwd` command which is used to set user names and passwords.

```
admin> passwd
username 1 [admin]:
"admin" password:
username 2 [user]:
"user" password:
username 3 [other]:
"other" password:
```

Figure B-22. `passwd` Command Example

The command syntax is `passwd ["user name"]`

The optional parameter `<user name>` is a double-quoted, valid user name.

NOTE: If the current password is incorrect the command exits without saving any changes. If the number of retries attempts is exceeded the command either steps to the next user or exits, saving any changes made thus far.

If the current password is incorrect the command exits without saving any changes. If the number of retries attempts is exceeded the command either steps to the next user or exits, saving any changes made thus far.

Special Inputs

- Return Key – Accepts the default value (if applicable) and moves to the next prompt.
- <Ctrl-C> – Aborts the `passwd` command immediately and ignores all changes made.
- <Ctrl-D> – Entered alone at a prompt without any preceding input, terminates the `passwd` command and writes all changes to flash memory.

Examples

The following is a list of possible examples:

1. Invalid user name.

```
admin> passwd "nobody"  
passwd: nobody is not a valid user name.
```

2. Invalid command usage.

```
admin> passwd ""  
Usage: passwd [username]
```

3. Permission denied.

```
admin> passwd "root"  
passwd: Permission denied.
```

4. Just change the user name.

```
admin> passwd "admin"  
New username [admin]: maint  
Old password:  
passwd: Password unchanged.
```

Updating flash...done.

5. Change the user name and password.

```
maint> passwd "maint"  
New username [maint]: admin  
Old password:  
New password:  
Re-enter new password:
```

Updating flash...done.

6. Skip through the prompts w/o changes.

```
admin> passwd  
New username [admin]:  
Old password:  
passwd: Password unchanged.  
New username [user]:  
Old password:  
passwd: Password unchanged.  
New username [other]:  
Old password:  
passwd: Password unchanged.
```

7. Surpass failure limit, then cancel the command.

```
admin> passwd
New username [admin]:
Old password:
New password:
Re-enter new password:
passwd: Passwords do not match; try again.
New password:
Re-enter new password:
passwd: Passwords do not match; try again.
New password:
Re-enter new password:
passwd: Number of failure attempts exceeded.
New username [user]: ^C
```

8. Change the user name and then finish with Ctrl-D.

```
admin> passwd
New username [admin]: maint
Old password: ^D

Updating flash...done.

maint>
```

portDisable

Figure B-23 shows the `portDisable` command which is used to disable a specific port. Devices attached to a disabled port cannot communicate with the Fabric. The command syntax is `portDisable <port #>`.

```
admin> portDisable 2
value = 0 = 0x0
```

Figure B-23. `portDisable` Command Example

NOTE: Unlike inserting a GBIC into an interface card, `portDisable` and `portEnable` do NOT generate SNMP traps.

portEnable

Figure B-24 shows the `portEnable` command which is used to enable a specific port. The first example shows a L-Port and the second an F-Port (as displayed by the `switchShow` command). The command syntax is `portEnable <port #>`.

```
admin> portEnable 2
value = 0 = 0x0

admin> portEnable 5
admin> fabric: reconfiguring
5 4 3 2 1
10 9 8 7 6 5 4 3 2
value = 0 = 0x0
```

Figure B-24. `portEnable` Command Example

portLogClear

Figure B-25 shows the `portLogClear` command which clears the data from the port log. The command syntax is `portLogClear`.

```
admin> portLogClear
value = 2031619 = 0x1f0003
```

Figure B-25. `portLogclear` Command Example

portLogDump

Figure B-26 shows the `portLogDump` command which displays the port log without page breaks. Note that the `portLogDump` and `portLogShow` commands are the same except for how much information the port log displays without intervention. The fields are described in Table B-9. The command syntax is `portLogDump`.

```

admin> portLogDump
time                task                event port  cmd  args
-----
May 18 21:35:21.000 tSwitch            create                tTimers
May 18 21:35:22.383 tSwitch            create                tPBmenu
May 18 21:35:22.383 tSwitch            create                tReceive
May 18 21:35:22.383 tSwitch            create                tTransmit
May 18 21:35:22.383 tSwitch            start                 100
May 18 21:35:22.633 tSwitch            pstate 4 OL1
May 18 21:35:22.633 tSwitch            pstate 5 OL1
May 18 21:35:22.633 tSwitch            pstate 6 OL1
May 18 21:35:22.633 tSwitch            pstate 7 OL1
May 18 21:35:38.066 tSwitch            Tx3 3 2112
02ffffffd,00ffffffd,4723bcbc
May 18 21:35:38.083 tReceive           Rx3 3 2112
02ffffffd,00ffffffd,4723bcbc
May 18 21:35:38.083 tSwitch            ioctl 3 80 a,0
May 18 21:35:38.083 tSwitch            Tx3 5 2112
02ffffffd,00ffffffd,4723bcbc
May 18 21:35:38.083 tReceive           Rx3 5 2112
02ffffffd,00ffffffd,4723bcbc
May 18 21:35:38.083 tSwitch            ioctl 5 80 a,0
May 18 21:35:38.083 tSwitch            Tx3 7 2112
02ffffffd,00ffffffd,4723bcbc
May 18 21:35:38.099 tReceive           Rx3 7 2112
02ffffffd,00ffffffd,4723bcbc
May 18 21:35:38.099 tSwitch            ioctl 7 80 a,0
May 18 21:35:41.049 tSwitch            disable 0 2
May 18 21:35:41.083 tSwitch            pstate 2 OL1
May 18 21:35:41.583 tSwitch            start 0
May 18 21:35:41.599 tSwitch            pstate 0 LF2
May 18 21:35:41.599 tSwitch            pstate 1 LF2
May 18 21:35:41.599 tSwitch            pstate 2 OL1
May 18 21:35:41.599 tSwitch            pstate 3 LF2
May 18 21:35:54.216 tSwitch            enable 16 0
May 18 21:35:55.266 tSwitch            errlog 3 FANS-
1_FAILED
value = 0 = 0x0

```

Figure B-26. `portLogDump` Command Example

portLogShow

Figure B-27 shows the `portLogShow` command which displays the Switch's port activity. Entries consist of Fabric login (ext. Link Service request to a Fabric F_Port, 22ffffffe), Port login (ext. Link Service request to the management server, 22ffffffa), and a SES Inquiry request (unsolicited command to the management server, 06ffffffa). Note the entries like the initial handshake between an F_Port and the Host Bus Adapter. The fields are described in Table B-9.

```

admin> portLogShow
time          task          event   port  cmd   args
-----
Jun 15 16:00:21.899 tReceive    pstate    2    OL2
Jun 15 16:00:21.899 tReceive    pstate    2    LR3
Jun 15 16:00:21.899 tReceive    pstate    2    AC
Jun 15 16:00:21.899 interrupt   scn        2    2
Jun 15 16:00:21.899 interrupt   scn        2    1
Jun 15 16:00:21.899 tFspf       ioctl     2    ab    fffffff,16
Jun 15 16:00:21.899 tFspf       ioctl    16    ab    fffffff,2

Jun 15 16:00:21.899 tReceive    Rx3        2    116   22ffffffe,
00000000, 04000000
Jun 15 16:00:21.899 tReceive    ioctl     2    a2    210213,2
Jun 15 16:00:21.899 tReceive    scn        2    6
Jun 15 16:00:21.899 tFspf       ioctl     2    ac    0,0
Jun 15 16:00:21.899 tFspf       ioctl     2    aa    fffffff,16
Jun 15 16:00:21.899 tFspf       ioctl    16    aa    fffffff,2
Jun 15 16:00:21.899 tFspf       ioctl     2    ad    0,0
Jun 15 16:00:21.899 tFspf       Tx3        2    116   23210213,
00ffffffe, 02000000

Jun 15 16:00:21.899 tReceive    Rx3        2    116   22ffffffa,
00210213, 03000000
Jun 15 16:00:21.899 tSwitch     Tx3        2    116   23210213,
00ffffffa, 02000000
Jun 15 16:00:21.899 tFcp        Tx3        2    116   22210213,
00fffc41, 03000000

Jun 15 16:00:21.899 tReceive    Rx3        2    32    06ffffffa,
00210213, 00000000
Jun 15 16:00:21.899 tFcp        Tx3        2    36    01210213,
00ffffffa, 0d000302
Jun 15 16:00:21.899 tFcp        Tx3        2    24    07210213,
00ffffffa, 00000000

```

Figure B-27. portLogShow Command Example

Table B-9
portlogShow Command Field Descriptions

| Field | Description |
|--|--|
| <p>NOTE: Lower case entries are defined in the "cmd" section in Table 5-9. Upper case entries in the "cmd" field are summarized in Table 5-9 and detailed in the Fibre Channel ANSI Standard (FC-PH).</p> | |
| Time | The event's date and time in milliseconds. |
| Task | The task name that logged the event, or "interrupt" if the event was recorded from interrupt level code. |
| Event | <p>The possible Switch events include:</p> <ul style="list-style-type: none"> start – the Switch first starts running. disable – a port is disabled. enable – a port is enabled. ioctl – a port I/O control is executed. Tx – a frame is transmitted. Rx – a frame is received. scn – a state change notification is posted. pstate – a port changes physical state. ctin - a CT based requested is received ctout - a CT based requested is transmitted |

continued

Table B-9
portlogShow Command Field Descriptions *continued*

| Field | Description |
|-------|---|
| Port | Either the port number of the affected port, or the last byte of a well-known address (e.g. fc for the well-known Name Server address). |
| cmd | <p>The cmd field represents different values depending on the task and event. The following definitions are included:</p> <p>For ioctl events, cmd is the I/O control command code. More explanations are provided shortly.</p> <p>For Tx and Rx events, cmd is the payload size.</p> <p>For scn events, cmd is the new state.</p> <p>For pstate events, the new physical state.</p> <p>For ctin events, cmd consists of two 2-byte sub-fields. More explanations are provided shortly.</p> <p>For ctout events, cmd consists of two 2-byte sub-fields. More explanations are provided shortly.</p> |

continued

Table B-9
portlogShow Command Field Descriptions *continued*

| Field | Description |
|-------|---|
| | For ioctl events, the cmd field entries in upper case are Fibre Channel ANSI Standard (FC-PH) as follows: |
| | AC - Active State |
| | LR1 - Link Reset: LR Transmit State |
| | LR2 - Link Reset: LR Receive State |
| | LR3 - Link Reset: LRR Receive State |
| | LF1 - Link Failure: NOS Transmit State |
| | LF2 - Link Failure: NOS Receive State |
| | OL1 - Offline: OLS Transmit State |
| | OL2 - Offline: OLS Receive State |
| | OL3 - Offline: Wait for OLS State |

continued

Table B-9
portlogShow Command Field Descriptions *continued*

| Field | Description |
|-------|--|
| | <p>For ioctl events, the cmd field entries in lower case are Switch specific as follows:</p> <ul style="list-style-type: none"> a1 - port is an E_Port a2 - port is an F_Port a3 - port is segmented a4 - domain name is known a5 - port enable a6 - port disable a7 - link reset a8 - add unicast route a9 - delete unicast route aa - add multicast route ab - delete multicast route ac - unicast routing table done ad - multicast routing table done ae - add a phantom device af - remove a phantom device <p>For ctin event, the first sub-field indicates whether "argument 1" and "argument 2" would be valid:</p> <ul style="list-style-type: none"> 0000 no argument 1 and 2 0001 argument 1 is valid 0003 arguments 1 and 2 are valid <p>For ctout event, the cmd field consists of two 2-byte sub-fields, similar to ctin. The second sub-field should contain a CT command code indicating an accept or reject:</p> <ul style="list-style-type: none"> 8001 reject 8002 accept |
| args | <p>The args field represents different values depending on the task and event. The following definitions are included:</p> <ul style="list-style-type: none"> For ioctl events, the I/O control arguments. For Tx and Rx events, the first two header words and the first payload word. For ctin events, the args field generally represents the first and second words of the CT payload where they are valid. Note however, in the case where an IP address is involved and if it is an IPv4 address, then this field will show the value of the IPv4 address, which is neither the first nor second word of the CT payload. For ctout events, if the event is associated with an accept, then the args field generally represents the first and second words of the CT payload. In the case where an IP address is involved and if it is an IPv4 address, then this field will show the value of the IPv4 address, which is neither the first nor second word of the CT payload. If the event is associated with a reject, the args field contains the reject reason and explanation code. |

portPerfShow

Figure B-28 shows the `portPerfShow` command which displays the throughput for all ports. The output is terminated by typing Return or Ctrl-C. The throughput number represents the number of bytes received plus the number of bytes transmitted and is displayed as bytes/second (B/s). Throughput numbers are shown either as bytes/second, kilobytes/second (the number is followed by 'k') or megabytes/second (the number is followed by 'm'). This information is used to monitor port performance. One line is printed per second summarizing the traffic on all ports.

```
admin> portPerfShow
 0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0

value = 2 = 0x2
```

Figure B-28. `portPerfShow` Command Example

portShow

Figure B-29 shows the portShow command which displays a summary of all ports. The fields are described in Table B-10.

The command syntax is portShow <port#>.

```

admin> portShow 2
portFlags: 0x20021          PRESENT L_PORT LED
portType:  2.2
portState: 2      Offline
portPhys:  4      No_Light
portScn:   0
portRegs:  0xa0008000
portData:  0x103ce320
portId:    614200
portWwn:   20:02:00:60:69:00:04:64

Interrupts:  0      Link_failure: 0      Frjt:      0
Unknown:    0      Loss_of_sync: 0      Fbsy:     0
Lli:        0      Loss_of_sig: 0      Lip_in:   0
Proc_rqrd:  0      Protocol_err: 0     Lip_out:  0
Timed_out:  0      Invalid_word: 0     Lip_rx:   00,00
Rx_flushed: 0      Invalid_crc: 0
Tx_unavail: 0      Delim_err:  0
Free_buffer: 0     Address_err: 0
Overrun:    0      Lr_in:      0
Suspended:  0      Lr_out:     0
Parity_err: 0      Ols_in:     0
                    Ols_out:     0

value = 26 = 0x1a

```

Figure B-29. portShow Command Example

Table B-10
portShow Command Field Descriptions

| Type | Field | Description |
|-----------------|----------------------------|--|
| Port Definition | portFlags | The bitmap port status. |
| | portType | The port type (G_port or FL_Port) |
| | portState | The port SNMP state. Values include Online/Offline. |
| | portPhys | The port physical state - Insync |
| | portScn | The port LED state |
| | portRegs | Pointer of hardware register. |
| | portData | Pointer to driver private data. |
| | portId | The port address ID. |
| | portWwn | The port worldwide name. |
| | Interrupt Statistics | Interrupts |
| Unknown | | Number of unknown interrupts. |
| Lli | | Number of low level interface (LLI) interrupts |
| Proc_rqrd | | Number of interrupts with processing (CPU) required. |
| Timed_out | | Number of timed out interrupts. |
| Rx_flushed | | Number of flushed transmissions. |
| Tx_unavail | | Number of interrupted transmissions |
| Free_buffer | | Number of buffer interrupts. |
| Overrun | Number of buffer overruns. | |

continued

Table B-10
portShow Command Field Descriptions *continued*

| Type | Field | Description |
|------------------|--------------|--|
| | Suspended | Number of suspended interrupts |
| | Parity_err | Number of parity errors. |
| Error Statistics | Link_failure | Number of link failures. |
| | Loss_of_sync | Loss of synchronization. |
| | Loss_of_sig | Loss of signal (no light). |
| | Protocol_err | Protocol error. |
| | Invalid_word | Invalid word (encoding errors inside of frames). |
| | Invalid_crc | Invalid CRC in a frame. |
| | Delim_err | Delimiter error (order set) |
| | Address_err | Address id error (S_ID D_ID) |
| | Lr_in | Link reset in (primitive sequence). Does not apply to FL_Port. |
| | Lr_out | Link reset out (primitive sequence). Does not apply to FL_Port. |
| | Ols_in | Offline resent in (primitive sequence). Does not apply to FL_Port. |
| | Ols_out | Offline resent in (primitive sequence). Does not apply to FL_Port. |
| | Frjt | Number of frames rejected. |
| | Fbsy | Number of frames busy. |

portStatsShow

Figure B-30 shows the portStatsShow command when used with a port number gives a static view of port status when the Switch executed the command. For example, to update the command and check if an error count is increasing, reissue the portStatsShow command to capture another snapshot.

The command syntax is portStatsShow <port#>.

```
admin> portStatsShow 3
0xa000c100:  stat_wtx          451      4-byte words transmitted
0xa000c104:  stat_wrx          7735     4-byte words received
0xa000c108:  stat_ftx           25      Frames transmitted
0xa000c10c:  stat_frx           626     Frames received
0xa000c110:  stat_c2_frx        0       Class 2 frames received
0xa000c114:  stat_c3_frx        626     Class 3 frames received
0xa000c118:  stat_lc_rx         0       Link control frames received
0xa000c11c:  stat_mc_rx         0       Multicast frames received
0xa000c148:  stat_mc_to         0       Multicast timeouts
0xa000c14c:  stat_mc_tx         0       Multicast frames transmitted
0xa000c120:  tim_rdy_pri        7       Time R_RDY high priority
0xa000c124:  tim_txcrd_z        6       Time BB_credit zero
0xa000c128:  er_enc_in          0       Encoding errors inside of frames
0xa000c12c:  er_crc             0       Frames with CRC errors
0xa000c130:  er_trunc           0       Frames shorter than minimum
0xa000c134:  er_toolong         0       Frames longer than maximum
0xa000c138:  er_bad_eof         0       Frames with bad end-of-frame
0xa000c13c:  er_enc_out         17163   Encoding error outside of frames
0xa000c144:  er_disc_c3         0       Class 3 frames discarded
0xa000c150:  fl_open            25      Number of OPNyx sent
0xa000c154:  fl_opened          25      Number of OPNyx received
0xa000c158:  fl_openfr          0       Number of OPNfr sent
0xa000c15c:  fl_cls_idle        0       CLS sent due to loop idle
0xa000c160:  fl_cls_rx          0       CLS received when OPEN
0xa000c164:  fl_bb_stall        0       OPN/CLS BB_Credit stalls
0xa000c168:  fl_cf_alloc        25      Number of CFIFOs allocated
0xa000c16c:  fl_cf_opn          0       CFIFOs delivered when OPENED
0xa000c170:  fl_cf_full         0       Number of CFIFOs full stalls
0xa000c174:  fl_cf_na           0       CFIFO not available stalls
0xa000c178:  fl_trig_age        0       Number of age count triggers
0xa000c17c:  fl_trig_lp         0       Number of loop not busy triggers
value = 0 = 0x0
```

Figure B-30. portStatsShow Command Example

NOTE: The first column shown in Figure 5-31 is an address and it is not included in the explanations below.

Table B-11
portStatsShow Command Field Descriptions

| Field | Description |
|-------------|---|
| stat_wtx | Number of 4-byte words transmitted from the port. |
| stat_wrx | Number of 4-byte words received by the port. |
| stat_ftx | Number of frames transmitted from the port. |
| stat_frx | Number of frames received by the port. |
| stat_c2_frx | Number of Class 2 frames received. |
| stat_c3_frx | Number of Class 3 frames received. |
| stat_lc_rx | Number of link control frames received. |
| stat_mc_rx | Number of multicast frames received. |
| stat_mc_to | Number of timeouts reported for multicast frames. A single frame could cause this counter to increment if it timed out for each multiple destination. |
| stat_mc_tx | Number of multicast frames transmitted. |
| tim_rdy_pri | The amount of time (measured in proprietary ticks) that R_RDY transmission has higher priority than frame transmission. |
| tim_txcrd_z | Time that this port cannot transmit frames due to a transmit buffer-to-buffer credit of zero. |

continued

Table B-11
portStatsShow Command Field Descriptions *continued*

| Field | Description |
|-------------|--|
| er_enc_in | Received data: the number of 8b/10b encoding errors that have occurred inside frame boundaries. This counter is generally a nonzero value, although occasional errors may occur on a normal link and give a zero result. (Minimum compliance with the link bit error rate specification on a link continuously receiving frames would cause approximately one error every 20 minutes.) |
| er_crc | Received frames: the number of CRC errors detected. |
| er_trunc | Received frames: the number of frames that were shorter than the minimum Fibre Channel frame size (i.e., a header with no payload). |
| er_toolong | Received frames: the number of frames that were longer than the maximum Fibre Channel frame size (i.e., a header with a 2,112-byte payload). |
| er_bad_eof | The number of frames received with a badly formed end-of-frame. |
| er_enc_out | Receive link: the number of 8b/10b encoding errors recorded outside frame boundaries. This number may become nonzero during link initialization but indicates a problem if it increments faster than the allowed link-bit error rate (approximately once every 20 minutes). |
| er_disc_c3 | Receive link: the number of Class 3 frames discarded. Class 3 frames can be discarded due to timeouts or invalid/unreachable destinations. This quantity could increment at times during normal operation but might be used for diagnosing problems in some situations. |
| fl_open | Number of times entering the OPEN state (OPNyx sent by FL_Port) |
| fl_opened | Number of times entering the OPENED state (OPNyx or OPNy received by FL_Port) |
| fl_openfr | Number of broadcast/multicast OPENs (OPNfr sent by FL_Port) |
| fl_cls_idle | Number of times CLOSED sent due to idle loop |

continued

Table B-11
portStatsShow Command Field Descriptions *continued*

| Field | Description |
|-------------|---|
| fl_cls_rx | Number of times the FL_Port has been sent CLS while in the OPEN state |
| fl_bb_stall | Number of times FL_Port could not send or forward CLS because receive BB_Credit was not available (Login BB_Credit = 1) or the number of times FL_Port could not send R_RDY immediately after receiving OPN because receive BB_Credit was not available (Login BB_Credit = 0) |
| fl_cf_alloc | Number of CFIFOs delivered |
| fl_cf_opn | Number of CFIFOs delivered when OPENED |

reboot

Figure B-31 shows the `reboot` command which reboots the Switch to the stored configuration in flash memory and takes about 1 1/2 minutes. The Switch maybe in any operational state (enabled or disabled) before rebooting.

```
admin> reboot
```

Figure B-31. reboot Command Example

syslogdIp

Figure B-32 show the `syslogdIp` command which sets or displays the Switches system log daemon IP address.

The command syntax is `syslogdIp <"ip address">`.

```
admin> syslogdIp  
  
syslog daemon's address: 0.0.0.0  
  
value = 35 = 0x23 = '#'
```

Figure B-32. syslogdIp Command Example

switchDisable

Figure B-33 shows the `switchDisable` command used for diagnostic tests, similar maintenance functions, or replacing a faulty Switch.

You can observe and verify this process by watching the front panel LEDs change color from green to slow flashing amber as each port goes inactive.

```
admin> switchDisable  
value = 0 = 0x0
```

Figure B-33. switchDisable Command Example

switchEnable

The `switchEnable` command enables the Switch and provides Fabric information. The Switch may need to be enabled after maintenance and diagnostic tests.

In Figure B-34, the Switch is enabled with a domain ID of 1. After the Fabric is reconfigured this Switch is the principle address manager that is capable of assigning domain IDs to other Switches in the same Fabric.

You can observe and verify this process by watching the front panel LEDs change color from green to slow flashing amber as each port goes inactive.

```
admin> switchEnable
value = 0 = 0x0
10 9 8 7 6 5 4 3 2 1
fabric: Principal switch
fabric: Domain 1
```

Figure B-34. `switchEnable` Command Example

NOTE: When a Switch is powered on, it is automatically enabled.

switchName

Figure B-35 shows the `switchName` command which displays or sets the Switch's name. If a new name is specified and it is enclosed in quotes "" the command sets the Switch to that name. If no new name is included, the command displays the Switch's name.

```
admin> switchName "sw3"

sw3
value = 0 = 0x0
```

Figure B-35. switchName Command Example

The command syntax is `switchName <"name-of-switch">`.

The `switchName` command displays the name of the current Switch. By supplying an argument, the user may set the name of the current Switch.

Certain restrictions apply to the length and format of the Switch name. Specifically, the name of the Switch:

- May not exceed 20 characters in length.
- May not contain characters other than 'a-z', 'A-Z', '0-9' or '_' (the underscore character), the first character excepted.
- Must have the first character be among 'a-z' or 'A-Z'.

switchShow

Figure B-36 shows the `switchShow` command which displays Switch and port status. The fields are described in Table B-12.

```
admin> switchShow
switchName:    open146
switchState:   Online
switchRole:    Principal
switchDomain:  1
switchId:      fffc41
switchWwn:     10:00:00:60:69:00:04:64
port 0: sw  Online      L-Port  1 private, 1 phantom
port 1: --  No_Module   L-Port
port 2: sw  No_Light    L-Port
port 3: sw  Online      L-Port  1 private, 1 phantom
port 4: --  No_Module
port 5: sw  Online      E-Port  10:00:00:60:69:00:00:12
"sw1"(upstream)
port 6: sw  No_Light
port 7: sw  No_Light
port 8: sw  No_Light
port 9: sw  Online      E-Port  10:00:00:60:69:00:01:b4
"sw3"(downstream)
port 10: sw  No_Light
port 11: sw  No_Light
port 12: sw  No_Light
port 13: sw  No_Light
port 14: sw  No_Light
port 15: sw  No_Light
value = 16 = 0x10
```

Figure B-36. `switchShow` Command Example

Table B-12
switchShow Command Field Descriptions

| Field | Description |
|--------------|---|
| switchName | The Switch name. |
| switchRole | There are three possibilities for switchRole including: Master: the principal Switch, as defined in FC-SW Slave: this switch is enabled and not the principal Switch Disabled: the Switch is disabled. |
| switchDomain | The domain ID of this Switch: 0 to 31. The lowest domain numbered Switch in a Fabric will become the master. |
| switchID | The domain ID of this Switch's embedded port: hex ffc00 to ffc7f. |
| switchWwn | The World Wide Name of this Switch. The WWN is a unique identifier for each Switch and is assigned by the manufacturer. A numbering scheme administrated globally assures that this WWN is unique to each Switch. |
| switchState | The state of this Switch: Online, Offline, Testing or Faulty. |
| Port Number | One line per port is printed after the Switch summary. Each line shows the port number: 0 to 15, the GBIC type, the port state and a comment field. |

continued

Table B-12
switchShow Command Field Descriptions *continued*

| Field | Description |
|---------------|--|
| GBIC type | <p>The GBIC type follows the port number. The four GBIC types include:</p> <ul style="list-style-type: none"> -- no GBIC present sw shortwave GBIC lw longwave GBIC cu copper GBIC |
| Port state | <p>The port state follows the GBIC type. The possible port states include:</p> <ul style="list-style-type: none"> No_Card no card present in this Switch slot No_Module no GBIC module in this port No_Light the module is not receiving light No_Sync the module is receiving light but is out of sync In_Sync the module is receiving light and is in sync Laser_Flt the module is signaling a laser fault (defective GBIC) Port_Flt the port has been marked faulty (defective GBIC, cable, or device) Diag_Flt the port failed diagnostics (defective G_Port or FL_Port card or motherboard) Online the port is up and running Lock_Ref the port locking to the reference signal |
| Comment field | <p>The comment field follows the port state. The possible comments include:</p> <ul style="list-style-type: none"> Disabled the port is disabled Loopback the port is in loopback mode E_Port the WWN and Switch name of the other Switch is shown, the use of this ISL is shown (see FC_SW) F_Port the WWN of the N_Port is shown G_Port the port is online but is not yet an E_Port or F_Port L_Port the port is connected to an arbitrated loop |

tempShow

Figure B-37 shows the `tempShow` command which shows the Switch's temperature as measured by five sensors on the motherboard.

```
admin> tempShow
 29  29  31  27  32  Centigrade
 84  84  87  80  89  Fahrenheit
value = 11 = 0xb
```

Figure B-37. tempShow Command Example

version

Figure B-38 shows the `version` command. The fields are described in Table B-13.

```
admin> version
VxWorks version: 5.3.1
Firmware version: v1.6a
Made on: Mon Nov 16 18:15:26 PST 1998
```

Figure B-38. version Command Example

Table B-13
version Command Field Descriptions

| Field | Description |
|------------------|---|
| VxWorks version | VxWorks operating environment version used on the processor |
| Firmware version | Switch firmware version |
| Made on | Switch firmware release date and time |

diagHelp

Figure B-39 shows the `diagHelp` command which displays the diagnostic help commands available for troubleshooting Switch problems.

```
admin> diagHelp

centralMemoryTest      Central memory diagnostic
crossPortTest          Cross-connected port diagnostic
portLoopbackTest      Port internal loopback diagnostic
portRegTest           Port register diagnostic
ramTest               System DRAM diagnostic
rdramTest             Rambus DRAM diagnostic
spinSilk              Cross-connected line-speed exerciser
diagClearError        Clear diag error on specified port
diagDisablePost       Disable Power-On-Self-Test
diagEnablePost        Enable Power-On-Self-Test
diagShow              Print diagnostic status information

value = 1 = 0x1
```

Figure B-39. `diagHelp` Command Example

routeHelp

Figure B-41 shows the `routeHelp` command which displays the routing help commands

```
admin> routeHelp

bcastShow             Print broadcast tree information
fspfShow             Print FSPF global information
interfaceShow        Print FSPF interface information
LSDBShow            Print Link State Database entry
mcastShow           Print multicast tree information
nbrStateShow        Print neighbor's summary information
topologyShow        Print paths to domain(s)
uRouteShow          Print port's unicast routing info

value = 1 = 0x1
```

Figure B-40. `routeHelp` Command Example

Diagnostic Commands

Diagnostic commands enables you to monitor, test, and evaluate the Switch.

centralMemoryTest

Figure B-42 shows the `centralMemoryTest` command which is used to check the motherboard's memory. A diagnostic pattern is written and read from memory to ensure all memory is functioning properly.

This command may not be executed on an operational Switch. Before issuing `centralMemoryTest`, disable the Switch using the `switchDisable` command.

```
admin> centralMemoryTest

Running Central Memory Test ... passed.
value = 0 = 0x0
```

Figure B-41. `centralMemoryTest` Command Example

crossPortTest

The `crossPortTest` command which is used to check the communication between different interface module ports on the same Switch. The Switch's G_Port and FL_Port ASICs, CPU, the interface cards and their GBIC modules are tested.

The command can be run on a Switch that is online or offline. If the Switch is online, only the ports that are cross connected are tested. If the Switch is offline this test must have all ports on the Switch interconnected. See Figure B-43.

Any port combinations may be cross connected as long as you connect G_Ports to G_Ports and FL_Ports to FL_Ports.

This test passes data between two ports on the Switch. This test verifies the data integrity by using the CPU to compare the data sent to the data received. All optical paths, including GBICs and cables are exercised in this test.

The command syntax is `crossPortTest <nFrames>, <0 or 1>`, where

- `<nFrames>` determines the number of frames to run

If you do not include the `<nFrames>` parameter the test runs until you press Return.

- `<0 or 1>` determines if a single port looped back to itself is allowed:
 - 0 – default, not allowed
 - 1 – allowed

NOTE: The single port feature of `crossPortTest` only supports G_Ports when the Switch is enabled. In order to test a single FL_Port, the Switch must be disabled. If the Switch is disabled, the single port feature of `crossPortTest` runs on all ports that are looped back to themselves.

If no ports are looped back to themselves or to another port of the same type, the Switch shows an error condition when entering the command. When running the cross port test, you must set the operating mode value to 0 or 1. Modes 2 and 3 do not send out the ELP used to discover Switches. If the ELP is not sent, the Switch does not know the port is connected to another port on the same Switch and the test fails.

```

admin> crossPortTest

Running Cross Port Test .....*****

One or more ports is not active,
please doublecheck fibres on all ports.

Port SNMP      Physical  Flags
-----
 0: Offline    Port_Flt  PRESENT L_PORT
 1: Offline    No_Module PRESENT L_PORT CBL_LB
 2: Offline    No_Light  PRESENT L_PORT CBL_LB
 3: Offline    Port_Flt  PRESENT L_PORT
 4: Offline    No_Module PRESENT G_PORT
 5: Offline    No_Module PRESENT G_PORT
 6: Offline    No_Module PRESENT G_PORT
 7: Offline    No_Module PRESENT G_PORT
 8: Offline    No_Light  PRESENT G_PORT
 9: Offline    No_Light  PRESENT G_PORT
10: Offline    No_Light  PRESENT G_PORT
11: Offline    No_Light  PRESENT G_PORT
12: Offline    No_Light  PRESENT G_PORT
13: Offline    No_Light  PRESENT G_PORT
14: Offline    No_Light  PRESENT G_PORT
15: Offline    No_Light  PRESENT G_PORT
16: Testing    In_Sync   PRESENT ACTIVE G_PORT INT_LB
value = 65536 = 0x10000

```

Figure B-42. crossPortTest Command Example

If you do not include the nFrames parameter, the cross port test runs until you press <Return>.

Pressing <Return> after typing the command starts the test.

If the test does not find an error, there is no output during the Telnet session.

portLoopbackTest

Figure B-44 shows the `portLoopbackTest` command which is used to validate the data path to the optical interface and is intended to verify that the `G_Port` or `FL_Port` interface card is error free. This is an internal test and checks all of the Switch's internal firmware and circuitry.

The command syntax is `portLoopbackTest nFrames`.

This command may not be executed on an operational Switch. Before issuing `portLoopbackTest`, disable the Switch using the `switchDisable` command

If you do not include the `nFrames` parameter the loopback test runs continuously until you press Return again. If the test does not find an error there is no output. You can choose to continue the test, view statistics, or view an error log. Table B-14 shows the loopback errors message fields.

While the test is running, all interface module front panel LEDs rapidly flicker green indicating that the test is finding no errors and is processing. After issuing `portLoopbackTest`, you can choose to continue the test, view statistics, or view an error log.

```

admin> portLoopbackTest

Running Port Loopback Test ....

Diags: (Q)uit, (C)ontinue, (S)tats, (L)og: s

Diagnostics Status:  Sun May 18 21:49:58 1970

port#: 0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16
diags:OK  OK  OK
state:UP  UP  UP

fl0:      311 frTx      311 frRx      0 LLI_errs. <looped-0>
fl1:      311 frTx      311 frRx      0 LLI_errs. <looped-1>
fl2:      311 frTx      311 frRx      0 LLI_errs. <looped-2>
fl3:      311 frTx      311 frRx      0 LLI_errs. <looped-3>
st4:      311 frTx      311 frRx      0 LLI_errs. <looped-4>
st5:      311 frTx      311 frRx      0 LLI_errs. <looped-5>
st6:      311 frTx      311 frRx      0 LLI_errs. <looped-6>
st7:      311 frTx      311 frRx      0 LLI_errs. <looped-7>
st8:      311 frTx      311 frRx      0 LLI_errs. <looped-8>
st9:      311 frTx      311 frRx      0 LLI_errs. <looped-9>
st10:     311 frTx      311 frRx      0 LLI_errs. <looped-10>
st11:     311 frTx      311 frRx      0 LLI_errs. <looped-11>
st12:     311 frTx      311 frRx      0 LLI_errs. <looped-12>
st13:     311 frTx      311 frRx      0 LLI_errs. <looped-13>
st14:     311 frTx      311 frRx      0 LLI_errs. <looped-14>
st15:     311 frTx      311 frRx      0 LLI_errs. <looped-15>
st16:     311 frTx      311 frRx      0 LLI_errs.

Central Memory OK
Total Diag Frames Tx: 5287
Total Diag Frames Rx: 5287

Diags: (Q)uit, (C)ontinue, (S)tats, (L)og: q
aborted
value = 1048576 = 0x100000

```

Figure B-43. portLoopbackTest Command Example

Table B-14
portloopbackTest Command Field Descriptions

| Field | Description |
|-----------------------|--|
| Diagnostics Status | The duration of the portLoopbackTest. |
| port# | The port number. |
| diags | Possible values include OK, BAD. |
| state | Possible values include UP (active), DN (inactive). |
| st0-16 | The tested ports. The display shows the diagnostics frames are transmitted and received and Low Level Interface counts (LLI_errs). |
| Central Memory Status | The central memory status. Possible values include OK, FAULTY. |
| Total Diag Frames Tx | The total diagnostics frames transmitted (Tx) since boot. This number usually corresponds to the total frames received (Rx) but may differ because of failure modes. |
| Total Diag Frames Rx | The total diagnostics frames received (Rx) since boot. This number usually corresponds to the total frames transmitted (Tx) but may differ because of failure modes. |

portRegTest

Figure B-45 shows the `portRegTest` command which is used to check each register located on the motherboard and interface card(s) chips. Registers are set under firmware control and are used to control the hardware route selection and other internal hardware functions.

This command may not be executed on an operational Switch. Before issuing `portRegTest`, disable the Switch using the `switchDisable` command

This test validates that all registers can be successfully addressed.

```
admin> portRegTest

Running Port Register Test .... passed.
value = 0 = 0x0
```

Figure B-44. `portRegTest` Command Example

ramTest

Figure B-46 shows the `ramTest` command which is used to check CPU RAM memory. The Switch ships with 2MB of CPU RAM. This test validates proper memory function. If this test fails, replace the memory module on the CPU card as described in [Replacing a Memory Module](#).

```
admin> ramTest

Running System DRAM Test ..... passed.
value = 0 = 0x0
```

Figure B-45. `ramTest` Command Example

rdramTest

Figure B-47 shows the `rdramTest` command which is used to check the memory on the FL_Port interface cards. A diagnostic pattern is written and read from memory to ensure all RDRAM memory is properly functioning.

This command may not be executed on an operational Switch. Before issuing `rdramTest`, disable the Switch using the `switchDisable` command.

```
admin> rdramTest

Running Rambus DRAM Test .....
rdramTest 1/1: 25% DONE (Pass 1/1, WR).
rdramTest 1/1: 50% DONE (Pass 1/1, RD).
rdramTest 1/1: 75% DONE (Pass 1/1, WR Inv).
rdramTest 1/1: 100% DONE (Pass 1/1, RD Inv).
rdramTest 1/1: passed.
value = 0 = 0x0
```

Figure B-46. `rdramTest` Command Example

spinSilk

Figure B-48 and Figure B-49 shows the `spinSilk` command which is used to check the integrity of the hardware paths by sending data between connected ports at a maximum speed of 1 Gbps.

NOTE: Any port combinations may be cross connected as long as you connect G_Ports to G_Ports and FL_Ports to FL_Ports.

This command shows an FL_Port as being offline if you are running cross port connected testing, the reason is that you can have only one Principle per Switch. The FL_Port to FL_Port testing still proceeds even though this is NOT the correct way to connect FL_Ports.

This command may not be executed on an operational Switch. Before issuing `spinSilk`, disable the Switch using the `switchDisable` command

Because the CPU is not comparing data on each frame as with the other two frame-based tests, the `DIAG-DATA` error will never be reported during `spin silk`. However, the other error messages defined for `crossPortTest` and their corresponding probable causes and actions are applicable to the `spin silk` test.

NOTE: When running the Spin Silk Test, you must set the operating mode value to 0 or 1. Modes 2 and 3 do not send out the ELP used to discover Switches. If the ELP is not sent, the Switch does not know the port is connected to another port on the same Switch and the test fails. Using operating mode 0 when running spinSilk is preferred.

If an error is encountered during the test, the error is displayed during the Telnet session. Refer to SpinSilk Test Error Messages.

The spinSilk test is used to transfer frames internally at the maximum hardware rated speed.

```
admin> spinSilk

Running Spin Silk .....
One moment please .....

One or more ports is not active,
please doublecheck fibres on all ports.

Port SNMP      Physical  Flags
-----
0: Offline    Port_Flt  PRESENT L_PORT LED
1: Offline    No_Module PRESENT L_PORT CBL_LB LED
2: Offline    No_Light  PRESENT L_PORT CBL_LB LED
3: Offline    Port_Flt  PRESENT L_PORT LED
4: Offline    No_Module PRESENT G_PORT LED
5: Offline    No_Module PRESENT G_PORT LED
6: Offline    No_Module PRESENT G_PORT LED
7: Offline    No_Module PRESENT G_PORT LED
8: Offline    No_Light  PRESENT G_PORT LED
9: Offline    No_Light  PRESENT G_PORT LED
10: Offline   No_Light  PRESENT G_PORT LED
11: Offline   No_Light  PRESENT G_PORT LED
12: Offline   No_Light  PRESENT G_PORT LED
13: Offline   No_Light  PRESENT G_PORT LED
14: Offline   No_Light  PRESENT G_PORT LED
15: Offline   No_Light  PRESENT G_PORT LED
16: Testing   In_Sync   PRESENT ACTIVE G_PORT INT_LB
value = 65536 = 0x10000
```

Figure B-47. spinSilk Command Example 1

`spinSilk nMillions` where `nMillions` is the number of frames for the test to execute expressed as millions of frames. If you do not include the `nMillions` parameter, the `spinSilk` test runs until `<return>` is pressed.

```

admin> spinSilk 5

Running Spin Silk .....
One moment please ...
Transmitting ... done.
Spinning ...
port 0 Rx/Tx 1 of 5 million frames.
port 1 Rx/Tx 1 of 5 million frames.
port 0 Rx/Tx 2 of 5 million frames.
port 1 Rx/Tx 2 of 5 million frames.
port 0 Rx/Tx 3 of 5 million frames.
port 1 Rx/Tx 3 of 5 million frames.
port 0 Rx/Tx 4 of 5 million frames.
port 1 Rx/Tx 4 of 5 million frames.
port 0 Rx/Tx 5 of 5 million frames.
port 1 Rx/Tx 5 of 5 million frames.
Diagnostics Status: Thu Jul 30 14:43:36 1998
port#:    0    1   16
diags:   OK   OK   OK
state:   UP   UP   UP
  st0:   5022504 frTx 5003329 frRx 0  LLI_errs <looped-1>
  st1:   5003616 frTx 5022790 frRx 0  LLI_errs <looped-0>
  st16:         0 frTx         0 frRx 0  LLI_errs.
Central Memory OK
Total Diag Frames Tx: 48
Total Diag Frames Rx: 0

value = 0 = 0x0

```

Figure B-48. `spinSilk` Command Example 2

diagClearError

The `diagClearError` command clears diagnostic errors detected on a specified port. The command syntax is `diagClearError <port #>`, without this parameter all errors are cleared.

When you issue this command, it resets the port(s) diagnostic errors, but does not clear the error log.

diagDisablePost

Figure B-50 shows the `diagDisablePost` command which disables POST processing. The boot time without POST processing is approximately 25 ~ 30 seconds.

Compaq recommends that POST processing always be executed to ensure the operational status of the Switch during the power on stage.

```
admin> diagDisablePost
Updating flash ... done.
On next reboot, POST will be skipped.
value = 0 = 0x0
```

Figure B-49. `diagDisablePost` Command Example

diagEnablePost

Figure B-51 shows the `diagEnablePost` command which enables POST processing. The choice remains in effect across power cycles until toggled by the user. The boot time with POST processing is approximately 60 ~ 65 seconds. The factory default enables POST processing.

```
admin> diagEnablePost
Updating flash ... done.
On next reboot, POST will be executed.
value = 0 = 0x0
```

Figure B-50. `diagEnablePost` Command Example

diagShow

Figure B-52 shows the `diagShow` command which summarizes the diagnostics results run since the Switch was last booted, including POST results. The fields are described in Table B-15.

NOTE: This command shows an FL_Port as being offline if you are running cross port connected testing, the reason is that you can have only one Principle per Switch. The FL_Port to FL_Port testing still proceeds even though this is NOT the correct way to connect FL_Ports.

The command also allows you to loop on the command. For example, `diagShow 4` executes `diagShow` every 4 seconds continuously unless stopped by pressing Return. This may be used to isolate a bad GBIC. A port with a changing LLI_errs value is prefixed by "***" in the display. The example below shows 2 passes, the first pass without an error on the line st11 (in bold) and the second pass shows an error on the line st11 (in bold). The screen shows:

- Each port number diagnostic status (OK/BAD) and port state (up (online)/down (offline))
- Frames transmitted (frTx) frames received (frRx) and Low Level Interface error count (LLI_errs) for active ports
- Central memory status (OK/FAULTY)
- Total diagnostics frames transmitted (Tx) and received (Rx) since boot, which are normally the same, but may differ because of failure modes.

NOTE: Port 16 is the embedded port.

```

admin> diagShow 4

Diagnostics Status: Thu Jul 30 11:08:26 1998
port#:  0  1  2  3  4  5  6  7 16
diags:  OK  OK  OK  OK  OK  OK  OK  OK  OK
state:  UP  UP  UP  UP  UP  UP  UP  UP  UP
  st0:      4 frTx      4 frRx      1 LLI_errs.  <looped-1>
  st1:      4 frTx      4 frRx      7 LLI_errs.  <looped-0>
  st2:      4 frTx      4 frRx      7 LLI_errs.  <looped-3>
  st3:      4 frTx      4 frRx     14 LLI_errs.  <looped-2>
  st4:      6 frTx      6 frRx     18 LLI_errs.  <looped-3>
  st5:      6 frTx      6 frRx    270303 LLI_errs.  <looped-4>
  st6:      4 frTx      4 frRx      6 LLI_errs.  <looped-5>
  st7:      4 frTx      4 frRx     13 LLI_errs.  <looped-6>
  st16:     0 frTx      0 frRx      2 LLI_errs.

Central Memory OK
Total Diag Frames Tx: 0
Total Diag Frames Rx: 0

Diagnostics Status: Thu Jul 30 11:08:30 1998
port#:  0  1  2  3 10 11 12 13 16
diags:  OK  OK  OK  OK  OK  OK  OK  OK  OK
state:  UP  UP  UP  UP  UP  UP  UP  UP  UP
  st0:      4 frTx      4 frRx      1 LLI_errs.  <looped-1>
  st1:      4 frTx      4 frRx      7 LLI_errs.  <looped-0>
  st2:      4 frTx      4 frRx      7 LLI_errs.  <looped-3>
  st3:      4 frTx      4 frRx     14 LLI_errs.  <looped-2>
  st4:      6 frTx      6 frRx     18 LLI_errs.  <looped-3>
  **st5:      6 frTx      6 frRx    3028342*LLI_errs.  <looped-4>
  st6:      4 frTx      4 frRx      6 LLI_errs.  <looped-5>
  st7:      4 frTx      4 frRx     13 LLI_errs.  <looped-6>
  st16:     0 frTx      0 frRx      2 LLI_errs.

Central Memory OK
Total Diag Frames Tx: 0
Total Diag Frames Rx: 0
Diags: (Q)uit, (C)ontinue, (S)tats, (L)og: q
value = 0 = 0x0

```

Figure B-51. diagShow Command Example

Table B-15
diagShow command field descriptions

| Field | Description |
|-----------------------|---|
| Diag Port Status | The port status |
| port# | The port number |
| diags | Possible values include OK, BAD. |
| state | Possible values include UP (online), DN (offline.) |
| st0-16 | The tested chips. The display shows the diagnostics frames are transmitted and received and Low Level Interface counts (LLI_errs). Note that port 16 is the embedded port. |
| Central Memory Status | The central memory status. Possible values include OK, FAULTY. |
| Total Diag Frames Tx | The total diagnostics frames transmitted (Tx) since boot. This number usually corresponds to the total frames received (Rx) but may differ because of failure modes. |
| Total Diag Frames Rx | The total diagnostics frames received (Rx) since boot. This number usually corresponds to the total frames transmitted (Tx) but may differ because of failure modes. |

Routing Commands

Routing commands allow you to view Switch routing information.

bcastShow

Figure B-53 shows the `bcastShow` command which displays broadcast tree information, and all ports that are currently transmitting and receiving broadcast frames. The fields are described in Table B-16.

This command is used to understand routes the broadcast frames take through the Fabric. A bit set indicates that the corresponding port belongs to a specific set. For instance, the bitmap value `0x00010003` means that port 0, port 1 and port 16 (the embedded port) are members of the set..

```
admin> bcastShow
```

| Group Ports | Member Ports | Member ISL Ports | Static ISL |
|-------------|--------------|------------------|------------|
| 31 | 0x00010003 | 0x00000000 | 0x00000000 |

```
value = 1 = 0x1
```

Figure B-52. bcastShow Command Example

Table B-16
bcastShow Bitmap Field Descriptions

| Bitmap Field | Description |
|------------------|---|
| Group | The multicast group. |
| Member Ports | All ports currently transmitting or receiving broadcast frames. |
| Member ISL Ports | <p>Ports that belong to the interSwitch broadcast distribution tree, as selected by the dynamic broadcast path selection protocol. These are all E_Ports, and this set is a subset of m_port. Broadcast frames use these ports to reach all Fabric Switches and to enter into the Switch.</p> <p>Some of the E_Ports on a Switch may not be part of this set, since the broadcast paths must constitute a tree.</p> |
| Static ISL Ports | <p>Ports that belong to the interswitch broadcast distribution tree, as configured through the shell. This field is normally 0x00000000.</p> |

fspfShow

Figure B-54 shows the fspfShow command which displays Fibre Channel Shortest Path First (FSPF) information. The fields are described in Table B-17.

```
admin> fspfShow

version          = 2
domainID        = 1
isl_ports       = 0x00000000
minLSInterval   = 5
fspfQ           = 0x103ab560
fabP            = 0x103abde0
agingTID        = 0x103a98c0
agingTo         = 10000
flushTID        = 0x0
ddb_sem         = 0x103ab530

fabP:
event_sch       = 0x3
lsrRefreshCnt   = 0

value = 20 = 0x14
```

Figure B-53. fspfShow Command Example

Table B-17
fspfShow Command Field Descriptions

| Field | Description |
|-----------|---|
| version | The version of the FSPF protocol. |
| domainID | The local Switch's domain ID. |
| isl_ports | A bitmap field that shows all local Switch E_Ports. |
| other | The other fields represent internal FSPF variables. |

interfaceShow

Figure B-55 shows the `interfaceShow` command which displays FSPF interface information. This includes static information about the port (for example, variables allocated even when a port is down), and “neighbor” information which includes variables associated with the remote Switch connected to the port. A FSPF interface corresponds to an E_Port. The fields are described in Table B-18.

With no parameters, it shows the information for all Switch interfaces.

The command syntax is `interfaceShow <port#>`

```
admin> interfaceShow
idbP          = 0x103a6490
Interface 9 data structure:
nghbP        = 0x1036d9b0
ifNo         = 9
cost         = 1000
delay        = 1
upCount      = 1
iState       = UP

Neighbor 9 data structure:
state        = NB_ST_FULL
nghbCap      = 0x0
nghbId       = 2
idbNo        = 9
remPort      = 9
nflags       = 0x3
initCount    = 1
&dbRetransList = 0x1036d9d0
&lsrRetransList = 0x1036d9e0
&lsrAckList   = 0x1036d9f0
inactTID     = 0x1036d960
helloTID     = 0x1036d910
dbRtxTID    = 0x1036d8c0
lsrRtxTID    = 0x1036d870
inactTo      = 80000
helloTo      = 20000
rXmitTo      = 5000
nCmdAcc      = 8816
nInvCmd      = 0
nHloIn       = 8437
nInvHlo      = 0
nLsuIn       = 97
nLsaIn       = 282
attHloOut    = 8435
nHloOut      = 8435
attLsuOut    = 282
nLsuOut      = 282
attLsaOut    = 97
nLsaOut      = 97
value = 1 = 0x1
```

Figure B-54. interfaceShow Command Example

Table B-18
interfaceShow Command Field Descriptions

| Field | Description |
|------------------------|---|
| <code>idbP</code> | The port number. |
| <code>nghbP</code> | The neighbor (adjacent) Switch's port |
| <code>ifNo</code> | The port number. It should be identical to the value specified in the command line. |
| <code>cost</code> | The cost of sending a frame over the ISL connected to this port. The value 1000 indicates a 1 Gbps link. |
| <code>delay</code> | The conventional delay incurred by a frame transmitted on this ISL. It is required by the FSPF protocol, and is a fixed value. |
| <code>upCount</code> | The number of times this interface initialized (the transition number from an offline to E_Port state). |
| <code>iState</code> | The current interface state. It must be UP in order for the ISL to forward frames to the adjacent Switch. |
| <code>state</code> | The current neighbor state. Its value must be NB_ST_FULL for the ISL to forward frames to the adjacent Switch. Other values may be transitory, however if a value is retained for more than ten seconds, contact Technical Support. |
| <code>nghbCap</code> | Neighbor capabilities has a value of 0. |
| <code>nghbId</code> | The neighbor (adjacent) Switch's domain ID. |
| <code>idbNo</code> | The port number and it should be equal to No. |
| <code>remPort</code> | The port # on the remote Switch connected to this port. |
| <code>nflags</code> | Internal flags for the Neighbor Finite State Machine. |
| <code>initCount</code> | The number of times this Neighbor Finite State was initialized. |

continued

Table B-18
interfaceShow Command Field Descriptions *continued*

| Field | Description |
|--------------|---|
| Debug fields | These fields are internal Fibre Channel Shortest Path First (FSPF) information and is used by Customer Support for debug purposes only: &dbRetransList, &lSrRetransList, &lSrAckList, inactTIDt, helloTID, dbRtxTID, and lSrRtxTID. |
| inactTo | Inactivity time out (in milliseconds). When this timeout expires, the adjacency with the neighbor Switch expires. When this happens, new paths are computed to all possible destination Switches in the Fabric. |
| helloTo | The Hello timeout. When this timeout expires, a Hello frame is sent to the neighbor Switch through this port. |
| rXmitTo | The retransmit timeout. Is used to transmit topology information to the neighbor Switch. If an acknowledge is not received within rXmitTo, the frame is retransmitted. |
| nCmdAcc | The total number of commands accepted from the neighbor Switch. It includes Hellos, Link State Updates and Link State Acknowledges. |
| nInvCmd | The number of invalid commands received from the neighbor Switch. These are commands with a version higher than the one running on the local Switch. The current version is 1, and there is no version 0. |
| nHloIn | The number of Hello frames received from the neighbor Switch. |
| nInvHlo | The number of invalid Hello frames received from the neighbor Switch. These are Hello frames with invalid parameters. |
| nLsuIn | The number of Link State Updates received from the neighbor Switch. |
| nLsaIn | The number of Link State Acknowledges received from the neighbor Switch. |
| attHloOut | The number of attempted transmissions of Hello frames to the neighbor Switch. |
| nHloOut | The number of Hello frames actually transmitted to the neighbor Switch. |

continued

Table B-18
interfaceShow Command Field Descriptions *continued*

| Field | Description |
|-----------|--|
| attLsuOut | The number of attempted transmissions of Link State Updates to the neighbor Switch. |
| nLsuOut | nLsuOut is the number of Link State Updates actually transmitted to the neighbor Switch. |
| attLsaOut | The number of attempted transmissions of Link State Acknowledges to the neighbor Switch. |
| nLsaOut | The number of Link State Acknowledges actually transmitted to the neighbor Switch. |

LSDbShow

Figure B-56 shows the LSDbShow command which displays domain Link State Database entries. The fields are described in Table B-19. The database record for any Fabric Switch can be displayed from any Switch. It also gives the same information regardless of Switch used to run it (unless there is a database update in progress, which occurs every 10 minutes in a stable network).

Every Switch keeps a database of topology information associated with itself and the other Fabric Switches. The topology information for a Switch consists of all neighbors that are in NB_ST_FULL state, and the associated port numbers.

This replicated database remains in sync at all times, so that every Switch in the Fabric has the same topology view. The topology database, in turn, is used to compute the path from a Switch to all other Fabric Switches.

With no parameters the command shows all the Link State Records in the database instead of the LSR for domain 1.

The command syntax is LSDbShow <domain ID>.

```
admin> LSDbShow
Domain=0, Link State Database Entry pointer=0x10393140
lsrP           = 0x1036b650
earlyAccLSRs  = 0
ignoredLSRs   = 0
lastIgnored   = Never
installTime   = 0x96a64 (617060)
lseFlags      = 0xa
uOutIfs       = 0x2000
uPathCost     = 1000
uHopsFromRoot = 1
mOutIfs       = 0x0
parent        = 0x0
mPathCost     = 0
mHopsFromRoot = 0

Link State Record:
Link State Record pointer = 0x1036b650
lsAge         = 512
reserved      = 0
type          = 1
options       = 0x0
lsId          = 0
advertiser    = 0
incarn        = 0x800003a0
length        = 60
chksum        = 0x9afe
linkCnt = 2,   flags = 0x0
LinkId = 1, out port = 8, rem port = 13, cost = 1000,
costCnt = 0, type = 1
LinkId = 2, out port = 9, rem port = 8, cost = 1000,
costCnt = 0, type = 1
value = 1 = 0x1
```

Figure B-55. LSDbShow Command Example

Table B-19
LSDbShow Command Field Descriptions

| Field | Description |
|--------------|--|
| domain | Indicates that domain 1 is the local Switch's domain ID. |
| lsrP | Link State Database Entry pointer. |
| earlyAccLSRs | The number of LSRs (Link State Records) accepted within the 5 sec window. |
| ignoredLSRs | The number of LSRs ignored because it was inside the 5 sec window. |
| lastIgnored | The time the last LSR was ignored because it was inside the 5 sec window. |
| installTime | This is the database entry for domain 1. The keyword installTime is the time when this database record was installed, in milliseconds from boot. Values are in hexadecimal and decimal format. |
| Debug fields | These fields are internal Fibre Channel Shortest Path First (FSPF) information and is used by Customer Support for debug purposes only: lseFlags, uOutlfs, uPathCost, uHopsFromRoot, mOutlfs, parent, mPathCost, and mHopsFromRoot. |
| lsAge | The record age in seconds since installation time. Records are refreshed throughout the Fabric every 30 minutes, this value should never exceed 3600. When lsAge reaches the value 1800, the record is flushed from the Fabric if the Switch that is described by the LSR is functioning and is connected to the Fabric. |
| reserved | This field is reserved for internal use. |
| type | Always 1 |
| options | Options is currently set to 0. |

continued

Table B-19
LSDbShow Command Field Descriptions *continued*

| Field | Description |
|------------|---|
| lsId | The record's Link State ID, equal to the Switch's domain ID as described by the record. |
| advertiser | Switch ID of the Switch that issued this LSR. Currently set to lsId. |
| incarn | The incarnation number. When a record is refreshed, every 10 minutes, its incarnation number is incremented by 1. If data in the record changes (for example, if an E_Port on a Switch goes offline), the Switch described by that record issues a new instance, and increments the incarnation number by 1. |
| length | The total record length. |
| chksum | The record checksum. It includes all fields except lsAge. |
| linkCnt | The link count, is the number of neighbors in NB_ST_FULL state that are adjacent to the Switch described by this record. The linkCnt field is followed by a number of lines equal to the link count. Each line contains the following information: linkID is the neighbor Switch's domain ID. out port is the ISL port number connecting the neighbor Switch. cost is the cost of sending a frame over the ISL connected to this port. It is the same value as the cost in the neighbor data structure of the Switch described by this record. |
| linkID | The neighbor Switch's domain ID. |
| rem port | The port on the remote Switch that the local port (out port) is connected to |
| costCnt | Always 0 |
| type | Always 1 |

mcastShow

Figure B-57 shows the mcastShow command without parameters it shows multicast tree information for all the multicast groups. Figure B-58 shows mcastShow with a parameter (group number). It shows information about one multicast group only. The fields are described in Table B-20.

```
admin> mcastShow
```

| Group | Member Ports | Member ISL Ports | Static ISL Ports |
|-------|--------------|------------------|------------------|
| 0 | 0x00000084 | 0x00000084 | 0x00000000 |
| 1 | 0x00000084 | 0x00000084 | 0x00000000 |
| 2 | 0x00000084 | 0x00000084 | 0x00000000 |
| 3 | 0x00000084 | 0x00000084 | 0x00000000 |
| 4 | 0x00000084 | 0x00000084 | 0x00000000 |
| 5 | 0x00000084 | 0x00000084 | 0x00000000 |
| 6 | 0x00000084 | 0x00000084 | 0x00000000 |
| 7 | 0x00000084 | 0x00000084 | 0x00000000 |
| 8 | 0x00000084 | 0x00000084 | 0x00000000 |
| 9 | 0x00000084 | 0x00000084 | 0x00000000 |
| 10 | 0x00000084 | 0x00000084 | 0x00000000 |
| 11 | 0x00000084 | 0x00000084 | 0x00000000 |
| 12 | 0x00000084 | 0x00000084 | 0x00000000 |
| 13 | 0x00000084 | 0x00000084 | 0x00000000 |
| 14 | 0x00000084 | 0x00000084 | 0x00000000 |
| 15 | 0x00000084 | 0x00000084 | 0x00000000 |
| 16 | 0x00000084 | 0x00000084 | 0x00000000 |
| 17 | 0x00000084 | 0x00000084 | 0x00000000 |
| 18 | 0x00000084 | 0x00000084 | 0x00000000 |
| 19 | 0x00000084 | 0x00000084 | 0x00000000 |
| 20 | 0x00000084 | 0x00000084 | 0x00000000 |
| 21 | 0x00000084 | 0x00000084 | 0x00000000 |
| 22 | 0x00000084 | 0x00000084 | 0x00000000 |
| 23 | 0x00000084 | 0x00000084 | 0x00000000 |
| 24 | 0x00000084 | 0x00000084 | 0x00000000 |
| 25 | 0x00000084 | 0x00000084 | 0x00000000 |
| 26 | 0x00000084 | 0x00000084 | 0x00000000 |
| 27 | 0x00000084 | 0x00000084 | 0x00000000 |
| 28 | 0x00000084 | 0x00000084 | 0x00000000 |
| 29 | 0x00000084 | 0x00000084 | 0x00000000 |
| 30 | 0x00000084 | 0x00000084 | 0x00000000 |
| 31 | 0x00010087 | 0x00000084 | 0x00000000 |

```
value = 1 = 0x1
```

Figure B-56. mcastShow Command Example 1

```

admin> mcastShow 1

Group      Member Ports      Member ISL Ports      Static ISL Ports
-----
   1        0x00000011        0x00000011          0x00000000

value = 1 = 0x1

```

Figure B-57. mcastShow Command Example 2

Table B-20
mcastShow Bitmap Field Descriptions

| Bitmap Field | Description |
|------------------|--|
| Group | The multicast group. |
| Member Ports | All ports currently transmitting or receiving broadcast frames. |
| Member ISL Ports | Ports that belong to the interswitch broadcast distribution tree, as selected by the dynamic broadcast path selection protocol. These are all E_Ports, and this set is a subset of m_port. Broadcast frames use these ports to reach all Fabric Switches and to enter into the Switch. Some of the E_Ports on a Switch may not be part of this set, since the broadcast paths must constitute a tree. |
| Static ISL Ports | Ports that belong to the interswitch broadcast distribution tree, as configured through the shell. This field is normally 0x00000000. |

nbrStateShow

Figure B-59 and Figure B-60 shows the `nbrStateShow` command which displays neighbor's summary information. This information can also be retrieved using `interfaceShow`. The command provides essential information to determine the Fabric topology in a concise way. By using this command, you can discover the domain ID of all Switches directly connected to the local Switch, and the port number on the local and remote Switch. The fields are described in Table B-19.

With no parameters it shows the neighbor's state summary for all the neighbors instead of neighbor connected to port 0 only.

The command syntax is `nbrStateShow` to list all neighbors.

```
admin> nbrStateShow

Local Domain ID: 1

Local Port      Domain      Remote Port   State
-----
0               2           0             NB_ST_FULLL
1               2           1             NB_ST_FULLL
2               2           2             NB_ST_FULLL
4               5           4             NB_ST_FULLL
5               5           5             NB_ST_FULLL
7               5           6             NB_ST_FULLL

value = 1 = 0x1
```

Figure B-58. `nbrStateShow` Command Example

The command syntax is `nbrStateShow <port number>` to list the neighbor on the specified port.

```
admin> nbrStateShow 1

Local Domain ID: 3

Local Port      Domain      Remote Port    State
-----
           1           2           1           NB_ST_FULLL

value = 1 = 0x1
```

Figure B-59. nbrStateShow Command Example

Table B-21
nbrStateShow Command Field Descriptions

| Field | Description |
|-------------|--|
| Local Port | Corresponds to idbNo in the neighbor data structure. |
| Domain | Corresponds to nghbld in the neighbor data structure. |
| Remote Port | Corresponds to remPort in the neighbor data structure. |
| State | The neighbor's current state. Its value must be NB_ST_FULLL for the ISL to forward frames to the adjacent Switch. Other values may be transitory, however if a value is retained for more than ten seconds, contact Technical Support. |

topologyShow

Figure 5-61 and Figure 5-62 shows the topologyShow command which displays all paths to a domain including:

- Output port(s) used to route frames to the domain
- The routing cost to reach the domain
- The input ports routed through the output port

The FSPF protocol supports equal cost multipaths, so there could be multiple 'parallel' paths between two Switches.

The command syntax is topologyShow to list all domains.

```
admin> topologyShow

Local Domain ID: 1

Domain      Metric    Hops    Out Port    In Ports    Flags    Name
-----
   1         2000     2       2           0x00000050  D       "open348"
              2       1           0x00000020  D
              2       0           0x00000080  D

Type <CR> to continue, Q<CR> to stop:

   4         3000     3       2           0x00000050  D       "open375"
              3       1           0x00000020  D
              3       0           0x00000080  D

Type <CR> to continue, Q<CR> to stop: q

value = 1 = 0x1
```

Figure B-60. topologyShow Command Example 1

The command syntax is `topologyShow <domain ID>` to list the specified domain.

```
admin> topologyShow 1

Local Domain ID: 1

Domain    Metric    Hops    Out Port    In Ports    Flags    Name
-----
   1       2000     2        2    0x00000050    D    "open148"
           2        1    0x00000020    D
           2        0    0x00000080    D

value = 1 = 0x1
```

Figure B-61. topologyShow Command Example 2

Table B-22
topologyShow Command Field Descriptions

| Field | Description |
|----------|--|
| Domain | The destination domain |
| Metric | The total cost to reach the destination domain, the sum of all links costs traversed by a frame to reach the destination domain. A metric of 1000 indicates the destination domain is one hop away from the local Switch, since 1000 is the cost of a 1 Gbps link. |
| Hops | The number of hops (Switches) between the local and remote Switches. |
| Out Port | The out port(s) used to route frames to the domain. |
| In Ports | A bitmap field that indicates what ports are routed through the out port to reach the destination domain. |
| Flags | <p>Indicates how the Switch acquired this path. Possible values are:</p> <p>D - The path was dynamically discovered via the FSPF protocol</p> <p>S - The path was statically configured through the shell.</p> |
| Name | The Switch name in the domain. |

uRouteShow

Figure B-63 shows the uRouteShow command which displays the port's unicast routing information which is the output port used to forward frames from a port to the domain. Only one output port is used to forward frames from one input port to a destination domain.

The command uRouteShow now has three different syntax options:

- uRouteShow <port #> <domain ID> – displays the route for port <port #> to domain <domain ID>
- uRouteShow <port #> – displays the route for port <port #> to all the active domains in the Fabric
- uRouteShow – displays the route for all the ports on the Switch to all the active domains in the Fabric

In addition, in all three formats uRouteShow shows for each route, the domain ID of the next hop and the port # on the next hop.

```
admin> uRouteShow
Local Domain ID: 1
```

| In Port | Domain | Out Port | Metric | Hops | Flags | Next (Dom,Port) |
|---------|--------|----------|--------|------|-------|-----------------|
| 0 | 5 | 7 | 1000 | 1 | D | 5,6 |
| | 6 | 7 | 2000 | 2 | D | 5,6 |
| | 7 | 7 | 3000 | 3 | D | 5,6 |
| | 8 | 7 | 4000 | 4 | D | 5,6 |
| | 9 | 7 | 5000 | 5 | D | 5,6 |
| 1 | 5 | 5 | 1000 | 1 | D | 5,5 |
| | 6 | 5 | 2000 | 2 | D | 5,5 |
| | 7 | 5 | 3000 | 3 | D | 5,5 |
| | 8 | 5 | 4000 | 4 | D | 5,5 |
| | 9 | 5 | 5000 | 5 | D | 5,5 |
| 2 | 5 | 4 | 1000 | 1 | D | 5,4 |
| | 6 | 4 | 2000 | 2 | D | 5,4 |
| | 7 | 4 | 3000 | 3 | D | 5,4 |
| | 8 | 4 | 4000 | 4 | D | 5,4 |
| | 9 | 4 | 5000 | 5 | D | 5,4 |

```
value = 1 = 0x1
```

Figure B-62. uRouteShow Command Example

Table B-23
uRouteShow Command Descriptions

| Field | Description |
|------------------|--|
| In Port | A bitmap field that indicates what ports are routed through the out port to reach the destination domain. |
| Domain | The destination domain |
| Out Port | The out port(s) used to route frames to the domain. |
| Metric | The total cost to reach the destination domain, the sum of all links costs traversed by a frame to reach the destination domain. A metric of 1000 indicates the destination domain is one hop away from the local Switch, since 1000 is the cost of a 1 Gbps link. |
| Hops | The number of hops (Switches) between the local and remote Switches. |
| Flags | Indicates how the Switch acquired this path. Possible values are: D - The path was dynamically discovered via the FSPF protocol S - The path was statically configured through the shell. |
| Next (Dom, Port) | The domain ID of the remote Switch (out port) is connected to, and the port ID on the remote Switch. |

License Commands

licenseHelp

Figure B-64 shows the `licenseHelp` command which displays the license help commands.

```
admin> licenseHelp

licenseAdd          Add a license key to this switch
licenseRemove      Remove a license key from this switch
licenseShow        Show current license key
value = 1 = 0x1
```

Figure B-63. licenseHelp Command Example

NOTE: If you issue a `licenseAdd` you delete any license key if already installed.

licenseAdd

Figure B-65 shows the `licenseAdd` command which adds Licenses can be checked using the `licenseShow` command.

```
admin> licenseAdd "342kj4324KJ23423dn"

value = 7 = 0x1
```

Figure B-64. licenseAdd Command Example

licenseShow

Figure B-66 shows the `licenseShow` command displays the optionally licensed products installed on the fibre channel Switch. The value returned will depend on the license keys installed, the name of each license will be displayed.

```
admin> licenseShow  
  
Webtools  
  
Zoning  
  
SES  
  
value = 7 = 0x1
```

Figure B-65. `licenseShow` Command Example

licenseRemove

Figure B-67 shows the `licenseRemove` command that deletes licenses.products. The value returned will depend on the license keys removed. The value returned will depend on the license keys installed. Remaining licenses can be checked using the `licenseShow` command.

```
admin> licenseRemove "342kj4324KJ23423dn"  
  
value = 0 = 0x1
```

Figure B-66. `licenseRemove` Command Example

Appendix C

Agency Notices

Regulatory Compliance Identification Numbers

For the purpose of regulatory compliance certifications and identification, your Fibre Channel Storage Switch (SWK FC STG Switch) is assigned a Compaq Series Number. The Compaq Series number for this product is: Series NA2101. The Fibre Channel Storage Switch Series Number can be found on the product label, along with the required approval markings and information. When requesting certification information for this product always refer to this Series Number. This series number should not be confused with the marketing name or model number for your Fibre Channel Storage Switch.

Federal Communications Commission Notice

Part 15 of the Federal Communications Commission (FCC) Rules and Regulations has established Radio Frequency (RF) emission limits to provide an interference-free radio frequency spectrum. Many electronic devices, including computers, generate RF energy incidental to their intended function and are, therefore, covered by these rules. These rules place computers and related peripheral devices into two classes, A and B, depending upon their intended installation. Class A devices are those that may reasonably be expected to be installed in a business or commercial environment. Class B devices are those that may reasonably be expected to be installed in a residential environment (i.e., personal computers). The FCC requires devices

in both classes to bear a label indicating the interference potential of the device as well as additional operating instructions for the user.

The rating label on the device shows which class (A or B) the equipment falls into. Class B devices have an FCC logo or FCC ID on the label. Class A devices do not have an FCC ID on the label. Once the class of the device is determined, refer to the following corresponding statement.

Class A Equipment

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

Class B Equipment

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or television technician for help.

Declaration of Conformity for Products Marked with the FCC logo – United States Only

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

For questions regarding your product, contact:

Compaq Computer Corporation
P. O. Box 692000, Mail Stop 530113
Houston, Texas 77269-2000

or call 1-800- 652-6672 (1-800-OK COMPAQ). (For continuous quality improvement, calls may be recorded or monitored.)

For questions regarding this FCC declaration, contact:

Compaq Computer Corporation
P. O. Box 692000, Mail Stop 510101
Houston, Texas 77269-2000

or call (281) 514-3333.

To identify this product, refer to the Part, Series, or Model number found on the product.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by Compaq Computer Corporation may void the user's authority to operate the equipment.

Cables

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods in order to maintain compliance with FCC Rules and Regulations.

Canadian Notice (Avis Canadien)

Class A Equipment

This Class A digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Class B Equipment

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

European Union Notice

Products with the CE Marking comply with both the EMC Directive (89/336/EEC) and the Low Voltage Directive (73/23/EEC) issued by the Commission of the European Community.

Compliance with these directives implies conformity to the following European Norms (in brackets are the equivalent international standards):

- EN55022 (CISPR 22) - Electromagnetic Interference
- EN50082-1 (IEC801-2, IEC801-3, IEC801-4) - Electromagnetic Immunity
- EN60950 (IEC950) - Product Safety

Japanese Notice

ご使用になっている装置にVCCIマークが付いていましたら、次の説明文をお読み下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスB情報技術装置です。この装置は、家庭環境で使用することを目的としています。この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。

取扱説明書に従って正しい取り扱いをして下さい。

VCCIマークが付いていない場合には、次の点にご注意下さい。

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラスA情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

Taiwanese Notice

警告使用者：

這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

Laser Devices

All Compaq systems equipped with a laser device comply with safety standards, including International Electrotechnical Commission (IEC) 825. With specific regard to the laser, the equipment complies with laser product performance standards set by government agencies as a Class 1 laser product. The product does not emit hazardous light; the beam is totally enclosed during all modes of customer operation and maintenance.

Laser Safety Warnings



WARNING: To reduce the risk of exposure to hazardous radiation:

- Do not try to open the laser device enclosure. There are no user-serviceable components inside.
- Do not operate controls, make adjustments, or perform procedures to the laser device other than those specified herein.
- Allow only Compaq Authorized Service technicians to repair the laser device.

Compliance with CDRH Regulations

The Center for Devices and Radiological Health (CDRH) of the U.S. Food and Drug Administration implemented regulations for laser products on August 2, 1976. These regulations apply to laser products manufactured from August 1, 1976. Compliance is mandatory for products marketed in the United States.

Compliance with International Regulations

All Compaq systems equipped with laser devices comply with appropriate safety standards including IEC 825.

Laser Product Label

The following label or equivalent is located on the surface of the Compaq supplied laser device.



This label indicates that the product is classified as a CLASS 1 LASER PRODUCT. This label appears on a laser device installed in your product.

Laser Information

| | |
|-------------|----------------------|
| Laser Type | Semiconductor GaAlAs |
| Wave Length | 780 nm +/- 35 nm |

| | |
|--------------------|---------------------------------------|
| Divergence Angle | 53.5 degrees +/- 0.5 degrees |
| Output Power | Less than 0.2 mW or 10,869 W-m-2 sr-1 |
| Polarization | Circular 0.25 |
| Numerical Aperture | 0.45 inches +/- 0.04 inches |

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