# Brocade SES®

## User's Guide

## Version 2.6

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# *Preface*

Brocade SES is an optionally licensed product, and requires a valid license key to function. It is supported for the SilkWorm® 2000 series of switches, running Brocade Fabric OS v 2.2 or later.

## About This Guide

This guide provides the following information about the Brocade SES software:

| | |
|---|---|
| **Chapter 1**<br>Introduction | Provides an overview of Brocade SES. |
| **Chapter 2**<br>Installing Brocade SES | Provides instructions for installing Brocade SES. |
| **Chapter 3**<br>Brocade SES Basics | Provides information about configuring and using Brocade SES. |
| **Chapter 4**<br>Brocade SES Commands | Provides information about Brocade SES commands. |

## Related Publications

Related product information can be found in the following Brocade publications:

- *Brocade Fabric OS Release Notes*
- *Brocade Fabric OS Reference*
- *Brocade Fabric OS User's Guide*
- *Brocade QuickLoop User's Guide*
- *Brocade Web Tools User's Guide*
- *Brocade Fabric Watch User's Guide*
- *Brocade Distributed Fabrics User's Guide*
- *Brocade MIB Reference*
- *Brocade Zoning User's Guide*
- *Brocade Performance Monitoring User's Guide*

Information about fibre channel standards can be found on the Fibre Channel Industry Association web site, located at:

`http://www.fibrechannel.com`

# Getting Help

Contact your switch supplier for technical support. This includes:

- Hardware and software support
- Product repairs
- Ordering spare components

Be prepared to provide the following information to support personnel:

- Switch serial number
- Switch worldwide name
- Topology configuration
- Output from the `supportShow` telnet command
- Detailed description of the problem
- Troubleshooting steps already performed

# Getting Software Updates

Contact your switch supplier for software updates and maintenance releases. New switch firmware can be installed from the following host operating systems:

- UNIX
- Windows 2000
- Windows NT
- Windows 98
- Windows 95

Utility programs to facilitate loading firmware from the listed operating systems, in addition to MIB files for switch management by SNMP, can be accessed on the Brocade website through the following steps:

1. Open your web browser and enter http://www.brocade.com.
2. Click **Technical Support**.
3. Click **MIBs and RSH Utilities**.
4. Click the download link for the desired product.

# Introduction

Chapter 1

This chapter contains the following sections:



## Overview

This manual describes Brocade SES (SCSI-3 Enclosure Services) on the SilkWorm family of switches.

Brocade SES enables an SES host connected to a fabric switch to manage all the switches in the SAN. This is done remotely, in-band through a fibre channel link. Brocade SES serves as the access management method of choice for SCSI based legacy environments where no fibre channel IP driver is available. A host with fibre channel IP capability typically does not need Brocade SES.

Brocade SES is an optional feature and requires a license key to activate fully. Without a license key only the basic FCP commands are supported.

## Features

The Brocade SES implementation complies with the SCSI-3 protocol standard used for implementing SES. Brocade SES enables the following features:

- Access to and management of every Brocade SilkWorm switch in the fabric
- Any single failure does not stop the fabric's SES capability
- Manage a fabric of Brocade SilkWorm switches in a storage environment that is exclusively SCSI based
- Configuration of switches in a fabric (for example, enabling or disabling a port)
- Performance monitoring (for example, view frame and word counters of a port)
- Enclosure monitoring (for example, view temperature sensor readings)
- Brocade SES management is scalable as the fabric enlarges
- SES-enabled host can immediately begin managing Brocade SilkWorm switches
- Availability of industry-standard SES commands

## Brocade SES Requirements

Brocade SES requires the following:

- SES-enabled host workstation
- Physical connection through a fibre channel link from the host to one switch in the SAN
- Fabric OS version 2.2 (or later) installed on all switches
- Brocade SES software license key

# Managing a Fabric with Brocade SES

To manage a SAN using Brocade SES, a host computer must have a fibre channel link to a switch in the fabric. The host must support FCP (fibre channel protocol for SCSI-3) and recognize the FCP target at the Management Server well-known address (FFFFFAh).

The host needs to perform the normal N_Port login procedure with the Management Server. It may then initiate an appropriate SES request.

Based on the management information obtained through SES, the host may perform a configuration, performance, or enclosure function on the switch. For example, it may enable or disable a switch port, take the temperature sensor readings of a switch, or monitor the performance or error counters of a switch port.

## FCP Constructs, SES Commands, and Diagnostic Pages

FCP constructs and SES commands are used to manage and sense the operational status of the power supplies, cooling devices, displays, indicators, individual drives, and other non-SCSI elements installed in a switch.

The following FCP constructs are supported:

- FCP Information Unit
- FCP Transfer Ready Information Unit
- FCP Data Information Unit
- FCP Response Information Unit

The following basic SES commands are supported:

- Inquiry
- Report LUNs
- Request Sense
- Test Unit Ready
- Reject

The following extended SES commands are supported:

- Read Buffer
- Receive Diagnostics Results
- Send Diagnostic
- Write Buffer

The following diagnostic pages are supported:

- Supported Diagnostics Pages
- Switch Page
- Sensor Table Page
- Fabric Page
- Neighborhood Table Page
- Fibre Channel Port Table Page
- Name Server Local Table Page
- Event Table Page
- Port Error and Interrupt Statistics Table Page
- Fabric Inquiry Data Page
- MIB-II System Group Page
- Port Log Table Page
- Unicast Route Table Page

# SES Address Allocation

A switch is identified at the FCP level by its Logical Unit Number (LUN). The switch domain ID is used to assign the LUN address for each switch in the fabric, including the switch used to access the fabric. To get a list of LUNs in the fabric, the FCP host sends a command to LUN 0 of the target at the Management Server well-known address. From there the host specifies a specific LUN address during an SES command request.

Figure 1-1 on page 1-4 shows sample fabric, managed by a host connected to the switch LUN L5.

**Figure 1-1** Brocade SES Switch Management

Outside the fabric, other SCSI-3 enclosures can also run SES (for example, Just a Bunch of Disks, RAID-5 arrays, SCSI-3 hard drives, and SCSI-3 tape drives). These devices are identified by their fabric and SCSI addresses, and are assigned LUNs using standard SCSI-3 host adapter LUN addressing.

# Installing Brocade SES

Chapter 2

## License Installation

Brocade SES is an optional feature and requires a license key to activate fully. Without a license key, only the basic FCP commands are supported.

**Note:** A license key may have been installed at the factory.

**To install a license:**

1. Log on the switch using telnet. For more information refer to the *Fabric OS Reference Guide*.
2. On the telnet command line, type:

   ```
   licenseShow
   ```

3. Verify the current license keys

   Example:

   ```
   admin> licenseShow
   9A9AaAabaATAS0a:
       Web license
       Zoning license
   ```

   If the SES license is not installed, continue with the next step.

4. On the telnet command line, type:

   `licenseAdd` "`key`"

   where "`key`" is the license key in quotation marks. The license key must be entered exactly as given, including case. For example, "`9A9AaAabaATAS0b`".

   **Note:** Enter the license key exactly as shown in your license agreement.

5. Once the license is entered, check to make sure it was installed correctly by typing `licenseShow` at the telnet command line. If the license is present reboot the switch.

   Example:

   ```
   admin> licenseshow
   9A9AaAabaATAS0a:
       Web license
       Zoning license
   9A9AaAabaATAS0b:
       SES license

   admin> reboot
   ```

# Brocade SES Concepts

Chapter 3

This chapter contains the following sections:



## SES Fabric Distribution

SES is distributed transparently throughout the fabric, with an instance of a distributed SES Device (SESD) on each switch. Each switch must be upgraded with a license key to activate the software. Without the license key on a particular switch, the associated SESD would only respond to the basic set of FCP commands.

## SES Functional Model

Each instance may be accessed by an SES application client by specifying the associated unique LUN. Additionally, Brocade's SES implementation also provides an SES application client and in-band mechanism for managing any fabric switch that it is attached to. Figure 3-1 shows the Brocade SES functional model.

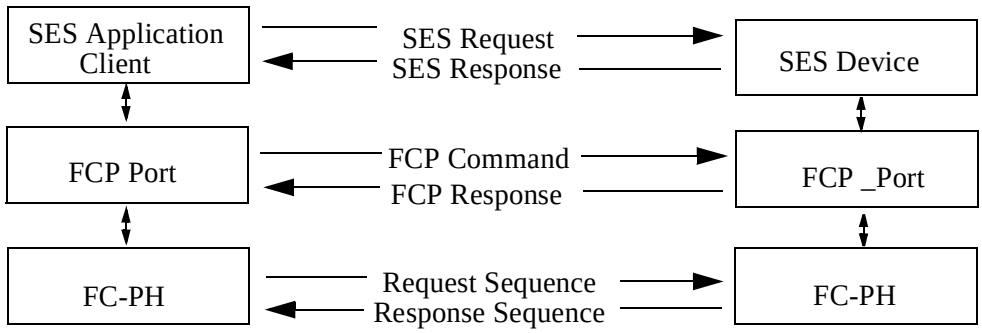


**Figure 3-1** BROCADE SES functional model

At the fibre channel level, each SESD is accessible using the fibre channel well known address, FFFFFAh (Management Server). At the SCSI-3 level, the SESD is associated with a LUN. An SES application client can refer to any distributed SESD within the fabric using its LUN. A LUN value of 0 is always associated with the local switch that is physically attached to the SES application client. The unique LUN value is mapped based on peripheral device addressing.

Table 3-1 identifies the bus number when each switch is set to 010000b. Byte 1 of the Target/ LUN is set using the Domain_ID of the switch. Bytes 2 through 7 are set to zero.

**Table 3-1** Lists the Bus Numbers

| Byte/ Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | Bus Number = 010000b | | | | | |
| 1 | Target or Logical Unit Number (LUN) | | | | | | | |
| ... | | | | | | | | |
| 7 | | | | | | | | |

**Table 3-2** Lists the LUN Values in Hex

| Domain ID | | Unique LUN Value (in Hex) |
|---|---|---|
| 0 | 0h | 10000000 00000000 |
| 5 | 5h | 01050000 00000000 |
| 12 | Ch | 010C0000 00000000 |
| 15 | Fh | 010F0000 00000000 |
| 25 | 19h | 01190000 00000000 |

An SES application client may easily find the LUN values of all distributed SESDs inside the fabric by using the Report LUNs command (see *Basic SES Commands* on page 4-8).

# Access to the Enclosure Services Process

An application client can monitor all enclosures capable of processing the enclosure services command set. Enclosure services can monitor both devices inside and outside of the enclosure (for example, a UPS device). However, the SilkWorm SES pertains only to SES instances inside the fabric.

An application client connects to any SilkWorm switches running the “Fiber Channel Protocol for SCSI (FCP)” using the management server well known address, FFFFFAh. For more information refer to Figure 1-1 on page 1-4. The enclosure services command set uses the RECEIVE DIAGNOSTIC RESULTS and SEND DIAGNOSTIC commands to any switch capable of supporting SES.

# Access Using an Enclosure Services Device

The application client requests information from the SESD to examine the status and warning information from the switch.

An application client that uses FCP calls the enclosure services process running on any SilkWorm Switch as an LUN that has SES enabled. The SESD sets the enclosure services bit (`EncServ`) in the `INQUIRY` command (see *Inquiry Command* on page 4-9 for more information) to indicate that it can transport enclosure services information.

# Indicators and Control Management

An application client uses the `SEND DIAGNOSTIC` command to transport control information to the SESD running the enclosure services process. The control information may include operations to perform or to modify its operating mode.

The application client uses the `RECEIVE DIAGNOSTIC RESULTS` command with the `PVC` (Page Code Valid) bit to obtain enclosure status. See *Receive Diagnostic Results* on page 4-15 for more information.

Additionally, the instructions from the application client may be ignored or overwritten by the enclosure service processor to ensure proper state information. For example, the enclosure may ignore an instruction to clear an error condition because the condition is valid or because the instruction is not supported by the enclosure.

# Brocade SES Commands

Chapter 4

This chapter contains the following sections:



# Constructs, Commands, and Diagnostic Pages

This section summarizes the FCP constructs, basic SES commands, extended SES commands (commands that require a Brocade SES license key), and Diagnostics Pages.

## FCP Construct Summary

Table 4-1 lists the FCP constructs.

**Table 4-1** FCP Construct Summary

| Command | Description | Type |
|---|---|---|
| `FCP Information Unit` | Contains SCSI Command to be executed or a task management request | FCP Construct |
| `FCP Transfer Ready Information Unit` | Contains SCSI-3 data delivery service parameters | FCP Construct |
| `FCP Data Information Unit` | Transfers data | FCP Construct |
| `FCP Response Information Unit` | Contains status and sense information | FCP Construct |

# Basic SES Command Summary

Table 4-2 lists the basic SES commands. These commands do not require a Brocade SES license key.

**Table 4-2** Basic SES Command Summary

| Command | Description | Type |
|---|---|---|
| `Inquiry` | Contains information about the devices and sensors in an enclosure. | Basic SES Command |
| `Report LUNs` | Contains information returned from SESD containing the LUNs attached to the SESD. | Basic SES Command |
| `Request Sense` | Used to sense information from the SESD. | Basic SES Command |
| `Test Unit Ready` | Used to test the operation state of a LUN. | Basic SES Command |
| `Reject` | Contains information and status about a unit's failure. | FCP Response IU |

# Extended SES Command Summary

Table 4-3 lists the extended SES commands. These commands require a Brocade SES license key.

**Table 4-3** Extended SES Command Summary

| Command | Description | Type |
|---|---|---|
| `Read Buffer` | Used to upload diagnostic or configuration data for the SESD. | Extended SES Command |
| `Receive Diagnostics Results` | Contains information returned by the SESD about an enclosure. | Extended SES Command |
| `Send Diagnostic` | Used to configure/diagnose a logical unit. | Extended SES Command |
| `Write Buffer` | Used to download firmware or configuration data for the SESD. | Extended SES Command |

# Diagnostic Page Summary

Table 4-4 lists the diagnostic pages for SES.

**Table 4-4** Diagnostic Page Summary

| Command | Description | Type |
|---|---|---|
| Supported Diagnostics Pages | Contains a list of the diagnostic pages supported. | Diagnostic Page |
| Switch Page | Contains status information about the switch, its operational state and firmware. | Diagnostic Page |
| Sensor Table Page | Contains status information about the state of all sensors in the switch. | Diagnostic Page |
| Fabric Page | Contains information about the fabric, its neighbors and Domain_ID. | Diagnostic Page |
| Neighborhood Table Page | Contains information about the switch's neighbors in the fabric. | Diagnostic Page |
| Fibre Channel Port Table Page | Contains information about the switch's fibre channel ports. | Diagnostic Page |
| Name Server Local Table Page | Contains information about the SESD local name server. | Diagnostic Page |
| Event Table Page | Contains a list of event messages that have been logged. | Diagnostic Page |
| Port Error and Interrupt Statistics Table Page | Contains information about the port errors and interrupt statistics. | Diagnostic Page |
| Fabric Inquiry Data Page | Contains information about fabric data. | Diagnostic Page |
| MIB-II System Group Page | Contains information about the MIB-II system group. | Diagnostic Page |
| Port Log Table Page | Contains information about the port log. | Diagnostic Page |
| Unicast Route Table Page | Contains the unicast route table currently configured for the switch. | Diagnostic Page |

# FCP Constructs

Before initiating any FCP request, the N_Port associated with the SES application client (FCP Initiator) must complete an N_Port Login (PLOGI) with the management server in Class 2 or 3. The destination address in the PLOGI request must be set to FFFFFAh. The FCP Process Login (PRLI) is not required but supported by the SESD.

The format of an FCP Command (FCP_CMND), FCP Transfer Ready (FCP_XFER_RDY), FCP Data (FCP_DATA) and FCP Response (FCP_RSP) conforms to those defined in the *SCSI-3 Fibre Channel Protocol (FCP), Revision 12, X3T10/269, working draft*.

FCP Information Unit Descriptions:

| | |
|---|---|
| FCP_CMND | This information unit contains a SCSI Command to be executed or a task management request on a target. |
| FCP_XFER_RDY | This information unit indicates that the target is ready to perform the data transfer associated with a FCP_CMD. |
| FCP_DATA | This information unit contains the data associated with an I/O operation. |
| FCP_RSP | The Information Unit contains status and sense information. |

# FCP Command Information Unit

Table 4-5 shows the FCP_CMND Information Unit (IU) that carries either a SCSI command to be executed or a task management request to be performed. The table lists the values and control fields defined in its payload.

**Table 4-5** FCP_CMND IU Format

| Field Name | Description | Byte Number | Byte Size |
|---|---|---|---|
| FCP_LUN | Logical Unit Number | 0 - 7 | 8 |
| FCP_CNTL | Control flags and bits for task/ execution management | 8 - 11 | 4 |
| FCP_CDB | SCSI command descriptor block | 12 - 27 | 16 |
| FCP_DL | Data Length | 28 - 31 | 4 |

For local switches, the FCP_LUN value is 0. For remote switches the FCP_LUN value is determined as described in *SES Functional Model* on page 3-1. The FCP_CNTL value is set to 1or 2 depending on whether you are specifying Write Data or Read Data, respectively. All other values are invalid. The FCP_CDB value contains the appropriate command descriptor. The FCP_DL field contains a count of the maximum number of data bytes to be transferred to or from the target for the command.

## FCP Transfer Ready Information Unit

The FCP_XFER_RDY Information Unit contains SCSI-3 data delivery service parameters required by the initiator and must be transmitted preceding each read or write FCP_DATA Information Unit.

## FCP Data Information Unit

The FCP_DATA Information Unit transfers the actual data.

## FCP Response Information Unit

Table 4-6 shows the FCP_RSP that carries the response status and sense information associated with a particular FCP_CMND.

**Table 4-6** FCP_RSP Format

| Byte Size | Field Name | Description |
|---|---|---|
| 8 | Reserved | Reserved |
| 4 | FCP_STATUS | Status of the (linked/previous) request |
| 4 | FCP_RESID | Residual Count |
| 4 | FCP_SNS_LEN | Length of Sense Information (FCP_SNS_INFO) |
| 4 | FCP_RSP_LEN | Length of Response Information (FCP_RSP_INFO) |
| m | FCP_RSP_INFO | FCP Response Information (FCP_RSP_INFO) |
| n | FCP_SNS_INFO | SCSI Sense Information (FCP_SNS_INFO) |

Table 4-7 displays the FCP_STATUS field format.

**Table 4-7** FCP_STATUS Format

| Byte | Bit | Definition |
|---|---|---|
| 0 | 7 .. 0 | Reserved |
| 1 | 7 .. 0 | Reserved |
| 2 | 7 .. 4 | Reserved |
| | 3 | FCP_RESID_UNDER |
| | 2 | FCP_RESID_OVER |
| | 1 | FCP_SNS_LEN_VALID |
| | 0 | FCP_RSP_LEN_VALID |
| 3 | 7 .. 0 | SCSI Status Byte code from the SCSI logical unit |

The reserved bits are set to 0 by the SESD. FCP_RESID_UNDER indicates that the FCP_RESID field is valid and contains the number of bytes expected to be transferred, but were not transferred. FCP_RESID_OVER indicates that the FCP_RESID field is valid and contains the number of bytes that have been truncated because the FCP_DL was not sufficient. These two bits may be set by the SESD.

## Reject Command

The SESD command sends a reject status, that is a “check condition”, in the FCP_SNS_INFO field of the FCP_RSP Information Unit. The “check condition” message is used to indicate any failure of the SES commands previously sent in the FCP_CMND Information Unit by the client. The FCP_SNS_LEN_VALID bit is turned on to indicate the FCP_SNS_LEN field contains a valid length and the sense data such as the Sense Key(SK), Additional Sense Code(ASC), and Additional Sense Code Qualifier(ASCQ) is returned in the FCP_SNS_INFO field in a format specified by the SCSI standard as shown in Table 4-8.

**Table 4-8** Table of Sense Data

| Sense Key | ASC | ASCQ | Description |
|---|---|---|---|
| SK_NOT_READY (02) | ASC_LUN_NOT_READY (04) | 0 | Logical Unit not ready. Request of FCP_CMND or FCP_DATA to a remote switch failed. |
| | ASC_ENC_SVC_FAILED (35) | 0 | Enclosure Service failed. Not enough memory in a local switch for data returned by a remote switch. |
| | ASC_ENC_SVC_UNAVAIL (35) | 2 | Enclosure Service unavailable. Firmware download already in progress. Not enough memory in a local switch for data returned by a local switch. |

**Table 4-8** Table of Sense Data (Continued)

| Sense Key | ASC | ASCQ | Description |
|---|---|---|---|
| SK_ILLEGAL_REQUEST (05) | ASC_PARLIST_LEN_ERR (1A) | 0 | Incorrect Parameter List length in a CDB of FCP_CMND payload (Send Diag or Write Buffer). |
| | ASC_INVALID_CMDCODE (20) | 0 | Invalid or not supported command operation code in FCP_CDB. |
| | ASC_INVALID_FIELD_CDB (24) | 0 | Invalid field in FCP_CDB. For example, invalid bit combination or incorrect buffer ID, Mode, Buffer Offset, Parameter Length, Allocation Length, or Page code. |
| | ASC_LUN_NOT_SUPPORTED (25) | 0 | Logical Unit not supported. Command issued to remote domain (=lun) for commands that do not support remote requests. Domain not part of this fabric or invalid LUN value in FCP_CDB. |
| | ASC_INVALID_FIELD_PARLIST (26) | 0 | Invalid field in parameter list. Invalid Page Code. For Receive Diag, PCV bit=0 in FCP_CDB with no previous Send Diag command. For Send Diag, invalid page length in a specified page of FCP_DATA payload. |
| | ASC_INVALID_PARVALUE (26) | 2 | Invalid parameter value in a specified page of FCP_DATA payload for writable fields. |
| | ASC_ENC_SVC_FAILED (35) | 0 | Enclosure Service failed. FCP_DATA payload null. |
| | ASC_DATA_PHASE_ERR (4B) | 0 | FCP_DATA Phase failed. |
| | ASC_DATA_NOT_AVAIL (82) | 0 | Requested `supportShow` data not available yet. |
| SK_VENDOR_SPECIFIC (09) | ASC_ENC_SVC_FAILED (35) | 0 | Enclosure Service failed. Failed to get event info from switch for Event Table. |

**Table 4-8** Table of Sense Data (Continued)

| Sense Key | ASC | ASCQ | Description |
|---|---|---|---|
| SK_ABORTED_COMMAND (0B) | ASC_PARLIST_LEN_ERR (1A) | 0 | Parameter List length error. Firmware image too large or too small. FCP_CDB Parameter list length not equal to FCP_DATA payload size (Send Diag or Write Buffer). |
| | ASC_LUNCOMM_TIME_OUT (08) | 1 | Logical Unit communication time-out. R_A_TOV time out occurred for firmware download. Requested `supportShow` data discarded due to a timeout. |
| | ASC_INVALID_DATA (26) | 5 | Firmware header data invalid or not for this switch model. |
| | ASC_CSUM_ERR (80) | 0 | Firmware checksum error. |
| | ASC_INTERNAL_ERR (81) | 0 | Switch internal error. Writing to flash failed. |

# Basic SES Commands

Table 4-9 shows the Basic SES commands supported by SESD.

**Table 4-9** Supported Operation Codes for Basic SES Commands

| Command | Operation Code |
|---|---|
| Inquiry | 12h |
| Report LUNs | A0h |
| Request Sense | 03h |
| Test Unit Ready | 00h |

# Inquiry Command

An SES application client may send an `Inquiry` command to obtain information about a switch in the fabric. The format of the `FCP_CDB` is shown in Table 4-10.

**Table 4-10** Inquiry Command

| Byte/Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code = 12h | | | | | | | |
| 1 | Reserved | | | | | | CmdDt=0 | EVPD=0 |
| 2 | Page Code | | | | | | | |
| 3 | Reserved | | | | | | | |
| 4 | Allocation Length | | | | | | | |
| 5 | Control = 0 | | | | | | | |

If the field, `EVPD` (Enable Vital Product Data) is set to 0, the value of the page code must be 0. The SESD then returns the standard `Inquiry Data` as shown in Table 4-11. If the Page Code field is not 0 when both the EVPD and CmdDt are 0, the SESD returns a “check condition”.

**Table 4-11** Standard Inquiry Data Format

| Byte/ Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Peripheral Qualifier = 0 | | | Peripheral Device Type = 0Dh | | | | |
| 1 | RMB=0 | Reserved = 0 | | | | | | |
| 2 | ISO version = 0 | | ECMA version = 0 | | | ANSI version = 3 | | |
| 3 | AERC=0 | TrmTsk=0 | NormACA=0 | Reserved=0 | Response data format = 2 | | | |
| 4 | Additional Length = 31 (1Fh) | | | | | | | |
| 5 | Reserved | | | | | | | |
| 6 | Reserved | EncServ=1 | VS = 0 | MultiP=1 | MChngr=0 | ACKREQQ=0 | Addr32=0 | Addr16=0 |
| 7 | RelAdr=0 | WBus32=0 | Wbus16=0 | Sync=0 | Linked=0 | Trandis=0 | CmdQue=0 | VS=0 |
| 8 ..15 | Vendor identification = (by default the value is “BROCADE”) | | | | | | | |
| 16 .. 31 | Product identification = (by default the value is “FC Switch”) | | | | | | | |
| 32 .. 35 | Product revision level = “v{*N*}{*m*}{*p*}”” (where {N} is a single number designating the major release number, {*m*} is a single number designating the minor release number), and {*p*} is a single alpha character designating a patch. There may be a space indicating there is no patch. For example, v3.0 | | | | | | | |

If the switch does not have the SES license key, the following is returned:

- `Peripheral Device Type = 1Fh` (for unknown or no device type)
- `EncServ = 0`

If `EVPD` is set to 1, then the value of the Page Code may be set to one of the following:

| | |
|---|---|
| Page Code 00h | Supported Vital Product Data pages |
| Page Code 80h | Unit Serial Number Page |
| Page Code 83h | Device Identification Page |

If the Page Code is set to 00h, the SESD returns the information shown in Table 4-12:

**Table 4-12** Supported Vital Product Data pages

| **Byte/ Bit** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
|---|---|---|---|---|---|---|---|---|
| 0 | Peripheral qualifier = 0 | | | Peripheral Device Type = 0Dh (for Enclosure services device) | | | | |
| 1 | Page Code = 00h | | | | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Page length = 3 | | | | | | | |
| 4 | 00h | | | | | | | |
| 5 | 80h | | | | | | | |
| 6 | 83h | | | | | | | |

If the page code is set to 80h, the SESD returns the information shown in Table 4-13:

**Table 4-13** Unit Serial Number Page

| **Byte/Bit** | **7** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
|---|---|---|---|---|---|---|---|---|
| 0 | Peripheral qualifier = 0 | | | Peripheral Device Type = 0Dh | | | | |
| 1 | Page Code = 80h | | | | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Page length = 24 | | | | | | | |
| 4 | Product Serial Number = *the switch World wide Name in ASCII string format* | | | | | | | |
| ... | For example, “10:00:00:60:69:00:01:b4” | | | | | | | |
| 27 | | | | | | | | |

If the page code is set to 83h, the SESD returns the information shown in Table 4-14:

**Table 4-14** Device Identification Page

| Byte/Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Peripheral qualifier = 0 | | | Peripheral Device Type = 0Dh | | | | |
| 1 | Page Code = 83h | | | | | | | |
| 2 | Reserved | | | | | | | |
| 3 | Page length = 32 | | | | | | | |
| 4 | Reserved = 0 | | | | Code set = 2 | | | |
| 5 | Reserved = 0 | | | | Identifier type = 1 | | | |
| 6 | Reserved = 0 | | | | | | | |
| 7 | Identifier length = 28 | | | | | | | |
| 8 | Identifier = Vendor Identification (8 bytes) + Product identification (16 bytes) + Product revision level (4 bytes) | | | | | | | |
| ... | | | | | | | | |
| 35 | | | | | | | | |

**Note:** If the switch does not have the SES license key, the `Peripheral Device Type` is set to `1Fh` in all three pages above.

# Report LUNs Command

An SES Application client sends a `Report LUNs` command to obtain the number of logical units (each is a switch in SCSI impersonation) in the fabric. The `FC_CDB` format is shown in Table 4-15.

**Table 4-15** Report LUNs Command Format

| Byte/Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code = A0h | | | | | | | |
| 1 .. 5 | Reserved | | | | | | | |
| 6 .. 9 | Allocation Length | | | | | | | |
| 10 | Reserved | | | | | | | |
| 11 | Control = 0 | | | | | | | |

The allocation length should be at least 16 bytes. If not, the SESD returns a “check condition” status.

The SESD reports the LUNs of associated switches with the format shown in Table 4-16.

**Table 4-16** Reported LUNs Format

| Byte | Description |
|---|---|
| 0 .. 3 | LUN list length (*n*-7) in unit of bytes |
| 4 .. 7 | Reserved |
| 8 .. 15 | 0 |
| .. | .. |
| (*n*-7)..*n* | LUN Lj |

The LUN list length is 48, and the LUN list consists of 0, L0, L5, L6, L9 and L10.

# Request Sense Command

An SES Application client sends a `Request Sense` command to obtain sense data. The `CDB` format is shown in Table 4-17.

**Table 4-17** Request Sense Command Format

| Byte/Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code = 03h | | | | | | | |
| 1 .. 3 | Reserved | | | | | | | |
| 4 | Allocation length | | | | | | | |
| 5 | Control = 0 | | | | | | | |

The SESD returns a sense key of `NO SENSE` and an additional sense code of `NO ADDITIONAL SENSE INFORMATION`.

# Test Unit Ready Command

An SES Application Client sends a `Test Unit Ready` command to check if the logical unit is ready. The `FCP_CDB` format is shown in Table 4-18.

**Table 4-18** Test Unit Ready Command Format

| Byte/Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code = 00h | | | | | | | |
| 1 .. 4 | Reserved | | | | | | | |
| 5 | Control = 0 | | | | | | | |

The SESD returns the status of "good" or "check condition" with a sense key of NOT READY and an additional sense code of LOGICAL UNIT NOT READY.

# Extended SES Commands

Table 4-19 shows the Extended SES commands supported by SESD. Extended SES commands require a license key to activate. Without a license key, only the basic SES commands are supported.

**Table 4-19** Supported Operation Codes for Extended SES Commands

| Command | Operation Code |
|---|---|
| Read Buffer | 3Ch |
| Receive Diagnostics Results | 1Ch |
| Send Diagnostic | 1Dh |
| Write Buffer | 3Bh |

# Read Buffer Command

This command enables an SES application client to upload configuration data or switch information from the SESD for debugging purposes. The format of the FCP_CDB is shown in Table 4-20.

**Table 4-20** Read Buffer Command

| Byte/ Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code = 3Ch | | | | | | | |
| 1 | Reserved | | | | Mode | | | |
| 2 | Buffer ID | | | | | | | |
| 3..5 | Buffer Offset | | | | | | | |
| 6..8 | Allocation Length | | | | | | | |
| 9 | Control = 0 | | | | | | | |

The Buffer ID's are defined as follows:

'0x00'h - Uploads switch information, equivalent to the supportShow command.

'0x01'h - Uploads configuration data, equivalent to the configUpload command.

The `Read Buffer` command is not distributed throughout a fabric. The SESD only responds with information on locally attached SES clients. If the command is addressed to a remote switch, a “check condition” status will be returned to the client (KEY/ASC=05/25, ILLEGAL REQUEST with LOGICAL UNIT NOT SUPPORTED).

## *Upload Switch Information*

The Buffer ID, '0x00'h, is intended to upload switch information similar to the `supportShow` command. For detailed information about this command, refer to the *Brocade Fabric OS Reference*.

When you run multiple `Read Buffer` commands, the Mode field should be set to '0010'b except in the first command. The Mode field in the first command should be set to '0000'b. For the first `Read Buffer` command (where the Mode is '0000'b) a 4-byte Read Buffer header is returned to the application client. The Buffer Capacity field of the header indicates the total size of the requested information available in the SESD. The maximum size of Buffer Capacity is 320K. Buffer Offset and Allocation Length of the command descriptor block is ignored for this mode.

**Table 4-21** Upload Switch Information

| Byte/ Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Reserved | | | | | | | |
| 1 | Buffer Capacity | | | | | | | |
| 2 | | | | | | | | |
| 3 | | | | | | | | |

The Buffer Offset starts at 0 in the second command in multiple `Read Buffer` commands assuming the first command was already issued and the client knows how much data the SESD has to upload. The subsequent value of the Buffer Offset field is the previous Buffer Offset plus the previous Allocation Length. The Allocation List Length for all transfers except the last is 32K. For example, the second Read Buffer command can contain Buffer Offset = 0 with Allocation Length = 32K and the third command contain Buffer Offset = 32K with Allocation Length = 32K (with the Mode being '0010'b). In the last command, the Allocation Length can be less than 32K.

The application client is responsible for keeping track of offsets and allocation length in order to obtain valid switch information from the SESD. The SESD does not record how much data it returned to the client in the previous commands. It only validates that the offset is a multiple of 32K and the Mode is '0010'b.

If the command contains illegal or invalid fields in the command descriptor block, a “check condition” status will be returned to the client (KEY/ASC=05/24, ILLEGAL REQUEST with INVALID FIELD IN CDB). The client can then resend the command with legal fields.

After receiving the first `Read Buffer` command, the SESD may take about 20 seconds to collect and store requested switch information in a pre-allocated volatile memory before it sends a status to the requesting client. The client application should wait for a “good” status before sending subsequent `Read Buffer` commands. The SESD will keep the requested data for 40 seconds. The client must obtain the entire data with subsequent Read Buffer commands within this time frame. This time-out is necessary in order to free up the allocated memory at the SESD side for efficiency.

If a time-out error occurs while the client is obtaining data, the client receives a “Reject” error with the sense KEY of `'0B'h,Aborted` Command. The client should then restart by sending the very first `Read Buffer` command requesting Buffer Capacity. After time-out or any time when the client sends the command before it received the capacity, a “check condition” status will be returned to the client (KEY/ASC=05/82, ILLEGAL REQUEST with ASC_DATA_NOT_AVAIL).

### *Upload Configuration Data*

The Buffer ID, '0x01'h, is intended to upload configuration data similar to the `configUpload` telnet command. For detailed information about this command, refer to the *Brocade Fabric OS Reference*.

One `Read buffer` command with max Allocation Length being 32K is sufficient to upload configuration data to the SESD. The Mode and Buffer Offset fields can be ignored.

If the allocation length is less than or equal to 32K then the SESD provides data up to the allocation length or the actual size of the configuration data whichever is less.

If the command contains illegal or invalid fields in the command descriptor block, a “check condition” status will be returned to the client (KEY/ASC=05/24, ILLEGAL REQUEST with INVALID FIELD IN CDB). The client should then resend the command with valid fields.

## Receive Diagnostic Results

This command enables an SES Application client to send a `Receive Diagnostic Results` command to receive diagnostic or management data. The `FCP_CDB` format is shown in Table 4-22.

**Table 4-22** Receive Diagnostic Results Command Format

| Byte/Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code = 1Ch | | | | | | | |
| 1 | Reserved | | | | | | | PCV |
| 2 | Page Code | | | | | | | |
| 3 .. 4 | Allocation Length | | | | | | | |
| 5 | Control = 0 | | | | | | | |

A Page Code Valid (`PCV`) bit of 0 indicates that the most recent `Send Diagnostic` command defines the data returned by this command. A value of 1 indicates that the Page Code field defines the data to be returned for this command. The page codes and formats are defined in *Diagnostic Pages* on page 4-19.

## Send Diagnostic Command

This command enables an SES application client can use a `Send Diagnostic` command to configure or diagnose a logical unit. After the command completion, the SES application client can send a `Receive Diagnostic Results` command (see Table 4-22) to confirm the configuration or diagnostic changes made by the most recent `Send Diagnostic` command.

**Table 4-23** Send Diagnostic Command Format

| Byte/ Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code = 1Dh | | | | | | | |
| 1 | Reserved | | | PF | Reserved | selfTest | DevOfL | UnitOfL |
| 2 | Reserved | | | | | | | |
| 3 .. 4 | Parameter list length (in bytes) | | | | | | | |
| 5 | Control = 0 | | | | | | | |

A Page Format (`PF`) bit of 1 specifies that the `Send Diagnostic` parameters conform to the page structure as specified in *SCSI-3 Primary Command (SPC), Revision 11a, X3T10/995D, working draft*. A value of 0 specifies that all parameters are vendor-specific. The SESD only supports the vendor-specific page structures as defined in Table 4-25 on page 4-19, therefore the PF bit should always be 0.

The `selfTest`, `DevOfL` and `UnitOfL` bits are ignored by the SESD at present.

The parameter list length field specifies the length in bytes of the parameter list that is transferred from the SES Application client to the SESD. If the parameter list length is zero, it is not an error condition, but no data is transferred. The Parameter List Length should be equal to 4 plus the Page Length in the supported pages. Otherwise, the SESD returns a “check condition” status.

Three diagnostic pages are supported with the `Send Diagnostic` command:

- 80h Switch Page
- 82h Fabric Page
- 84h Fibre Channel Port Table Page

All other page codes including the Page Code=0x00h will cause a “check condition” status as these three pages are the only ones that contain writable fields in the pages.

# Write Buffer Command

This command enables an SES application client to send one or more `Write Buffer` commands (3Bh) to download firmware or configuration data to the SESD. The format of the `FCP_CDB` is shown in Table 4-24.

**Table 4-24** Write Buffer Command

| Byte/ Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 0 | Operation Code = 3Bh | | | | | | | |
| 1 | Reserved | | | | Mode | | | |
| 2 | Buffer ID | | | | | | | |

**Table 4-24** Write Buffer Command (Continued)

| Byte/ Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| 3 .. 5 | Buffer Offset | | | | | | | |
| 6 .. 8 | Parameter List Length | | | | | | | |
| 9 | Control = 0 | | | | | | | |

The Buffer IDs are defined as follows:

'0x00'h - Downloads firmware, equivalent to the telnet firmwareDownload command.

'0x01'h - Downloads configuration data, equivalent to the telnet configDownload command.

The `Write Buffer` command is not distributed throughout a fabric. The SESD only responses to the locally attached SES clients with respect to firmware/configuration data download. If the command is addressed to one of the remote switches, a “check condition” status is returned to the client (KEY/ASC = 05/25, ILLEGAL REQUEST with LOGICAL UNIT NOT SUPPORTED).

Only one SES client can download at a time. An SES client with multiple FC HBAs is considered to be multiple clients as each HBA will have its own S_ID in the FC frame headers. An SES client can initiate only one instance of download.

The `Write Buffer` command can be issued at any time to initiate downloading firmware or configuration data. There is no required state of the SESD before downloading starts.

## *Download Firmware*

The download firmware Buffer ID ('0x00'h) is equivalent to the firmwareDownload telnet command. For detailed information about the command, refer to the *Brocade Fabric OS Reference*.

In multiple `Write Buffer` commands to download firmware, the Mode field is always '0110'b except in the last command. The Mode field in the last command is '0111'b.

The Buffer Offset starts at 0 in the first command in multiple `Write Buffer` commands and the subsequent value of the Buffer Offset field is the previous Buffer Offset plus the previous Parameter List Length. The current Parameter List Length for all transfers except the last frame is 32768 Bytes (32K).

For example, the first transfer contains Buffer Offset = 0 with Parameter List Length = 32K and the second transfer contains Buffer Offset = 32K with Parameter List Length = 32K. In last transfer the Mode should be '0111'b and the Parameter List Length could be less than 32K.

In multiple Write Buffer transfers, if the subsequent `Write Buffer` commands contain illegal or invalid fields in the command block, any data received up to that point will be discarded by the SESD and a “check condition” status is returned to the client (KEY/ASC=05/24, ILLEGAL REQUEST with INVALID FIELD IN CDB). The client then should restart transferring data from the beginning.

A time-out value of 10 seconds (R_A_TOV: Resource Allocation Time Out Value) is used between each data transfer. If the next data is not received within R_A_TOV, all the previously received data is discarded and the client must re-transfer the firmware.

The SESD allocates a flash block size of volatile memory buffer (currently 128K) at a time to save the received data from the SES client. When this buffer becomes full, the SESD writes the buffer content to the corresponding block of flash memory and then the buffer becomes re-initialized. After writing the last block, the SESD immediately reads back the entire firmware from the first flash in order to verify the checksum. Upon the successful checksum verification, the SESD continues to write the same firmware image to the second flash, if the flash exists.

If the checksum is not valid, the firmware download process fails and the client will receive a "reject" message with a sense key of `'OB'h,Aborted` command. If the second flash does not exist and the checksum verification fails, the flash image remains damaged and will not be rebootable until a good image of the firmware is successfully downloaded.

During the last `FCP_CMND` sequence, the client will receive a "good" status `FCP_RSP` before the SESD completes writing to the flash memory in order to avoid any unnecessary timeouts at the FCP driver level due to a lengthy operation of writing to flash.

You can reboot either by a power cycle or by the "Switch_Administrative_Status" field of the Switch Page(80h) in the Send Diagnostic command (1Dh).

**Note:** It is recommended that the SESD be quiescent before starting reboot.

## *Download Configuration Data*

The Download Configuration Data Buffer ID ('0x01'h) is intended to download configuration data, which is equivalent to the `configDownload` telnet command. For detailed information about the command, refer to the *Brocade Fabric OS Reference*.

One `Write buffer` command with max Parameter List Length of 32768 Bytes (32K) is sufficient to download configuration data to the SESD, so the Mode and Buffer Offset fields are ignored.

The Parameter List Length must be less than or equal to 32K. If the command contains illegal or invalid fields in the command block, a "check condition" status is returned to the client (KEY/ ASC=05/24, ILLEGAL REQUEST with INVALID FIELD IN CDB). The client then should re-send the command with valid fields.

As soon as the SESD receives data successfully, it returns a "good" status to the client and immediately disables itself so that it can parse the received data and write valid configuration changes to the configuration database in the switch. If data is invalid, the switch's configuration database remains unchanged. When the client receives a "good" Status from the SESD, the client must login to the SESD again (that is, FLOGI and/or PLOGI) to communicate with effective parameters and continue its operations. When the client logs in again, it is especially important that fabric settings such as E_D_TOV or BB Credit are changed. The client may use the Read Buffer command to read the configuration back to the database for a verification of changes.

The configuration data is in ASCII text file format and may have been generated using the telnet configUpload command or the SES Read Buffer command with Buffer ID = '0x01'h. A user can also create the file if specific configuration data needs to be changed. In this case, exercise extreme care because inadvertent changes to configuration data may cause malfunctioning of the SESD during the next re-boot. It is strongly advised that you consult with Brocade Support before making any changes to the saved configuration data. For detailed information about contents of the file, refer to the *Brocade Fabric OS Reference*.

# Diagnostic Pages

Table 4-25 shows a list of supported vendor specific diagnostic pages. They are particularly relevant to two commands:

- `Receive Diagnostic Results`
- `Send Diagnostics`

**Table 4-25** Switch Diagnostics Pages

| Page Code | Description |
|---|---|
| 00h | Supported Diagnostics Pages |
| 80h | Switch Page |
| 81h | Sensor Table Page |
| 82h | Fabric Page |
| 83h | Neighborhood Table Page |
| 84h | Fibre Channel Port Table Page |
| 85h | Name Server Local Table Page |
| 86h | Event Table Page |
| 87h | Port Error and Interrupt Statistics Table Page |
| 8Ah | Fabric Inquiry Data Page |
| 90h | MIB-II System Group Page |
| B0h | Portlog Dump Page |
| B1h | Unicast Route Table Page |

Table 4-26 shows the Page Codes 80h through 86h, which are Brocade Vendor Specific Pages and are roughly mapped from the switch Management Information Base (MIB) Definition for v3.0 Fabric OS.

**Table 4-26** Switch MIB Groups

| Page Code | Switch MIB Group |
|---|---|
| 80h | System Group, variables 1..8, 20, 21 |
| 81h | System Group, Sensor Table |
| 82h | Fabric Group, variables 1, 2, and 8 |
| 83h | Fabric Group, Neighborhood Table |
| 84h | Fibre Channel Port Table |
| 85h | Name Server Local Table |
| 86h | Event Table Page |

The Diagnostics Pages generally contain the first four bytes the Page Code, Reserved byte and a two byte Page Length, and the field called `swValidity` (or `swValidity[i]` in cases where there are multiple entries to a table. The field is used to indicate which subsequent data fields are valid. Each subsequent data field has an associated field number. If the data field is valid, its associated bit in `swValidity` is set. In most cases, all data fields are valid in the response to `Receive Diagnostic Result` command. For example, if data fields 0, 1 and 2 are valid, then the related `swValidity` field contains the value 7. This is also a flexible mechanism for the `Send Diagnostic` command to indicate which data fields the client wishes to *write* into.

# Supported Diagnostics Pages

The following structure is used for the Supported Diagnostics Pages of `Receive Diagnostic Result`. If requested using the `Receive Diagnostic Result` command, the SESD returns the response shown in Table 4-27.

**Table 4-27** Page Code 0 Format

| Byte | Description |
|---|---|
| 0 | Page Code = 00h |
| 1 | Reserved |
| 2 | (MSB) |
| 3 | Page Length = 13 bytes (LSB) |
| 4 | 00h |
| 5 | 80h |
| 6 | 81h |
| 7 | 82h |
| 8 | 83h |
| 9 | 84h |
| 10 | 85h |
| 11 | 86h |
| 12 | 87h |
| 13 | 8Ah |
| 14 | 90h |
| 15 | B0h |
| 16 | B1h |

# Switch Page

The structure in Table 4-28 applies to the Switch Page of `Send Diagnostic` or `Receive Diagnostic Result` command.

**Table 4-28** Switch Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = 80h | 1 |
| 1 | na | na | Reserved = 0 | 1 |
| 2 .. 3 | na | rw | Page Length = 404 | 2 |
| 4 .. 7 | na | rw | swValidity = 3FFh | 4 |
| 8 .. 71 | 0 | ro | Current_Date (in ASCII text) | 64 |
| 72 .. 135 | 1 | ro | Boot_Date (in ASCII text) | 64 |
| 136 .. 199 | 2 | ro | Firmware_Last_Updated_Date (in ASCII text) | 64 |
| 200 .. 263 | 3 | ro | FLASH_Last_Updated_Date (in ASCII text) | 64 |
| 264 .. 327 | 4 | ro | Boot_PROM_Last_Updated_Date (in ASCII text) | 64 |
| 328 .. 391 | 5 | ro | Firmware_Version_Information (in ASCII text) | 64 |
| 392 .. 395 | 6 | ro | Switch_Operational_Status | 4 |
| 396 .. 399 | 7 | rw | Switch_Administrative_Status | 4 |
| 400 .. 403 | 8 | ro | Diagnostics_Result | 4 |
| 404 .. 407 | 9 | ro | Number_of_Sensors | 4 |
| **Legend:** na = not available, ro = read only, and rw = read/write. | | | | |

Switch Page field descriptions:

`Current_Date` The current date and time. For example, `Wed Feb 10 15:04:28 1999`.

`Boot_Date` The boot date and time.

`Firmware_Last_Updated_Date`
The last date and time the FOS was updated.

`FLASH_Last_Updated`
The last date and time the flash memory was updated.

`Boot_PROM_Last_Updated_Date`
The last date and time the boot PROM was updated.

`Firmware_Version_Information`
Fabric OS version information. For example, `v3.0`.

`Switch_Operational_Status`

The switch's current operational status to an external fibre channel port, as follows:
1 – Online - the switch is accessible.
2 – Offline - the switch is not accessible.
3 – Testing - the switch is in testing, is not accessible, and SESD is not available.
4 – Faulty - the switch is faulty, is not accessible, and SESD is not available.

`Switch_Administrative_Status`

The switch's desired administrative status. An SES client may place the switch in a desired state by setting this field, as follows:
1 – Online - the switch is accessible.
2 – Offline - the switch is not accessible (and SESD is not available).
3 – Testing - the switch not accessible and SESD is not available.
4 – Faulty - the switch not accessible and SESD is not available.
5 – Reboot - the switch reboots.
6 – Fastboot - the switch performs a warm boot (skipping POST).

`Diagnostics_Result`

POST result and is one of the following integer values:
1 – OK
2 – Central memory fault
3 – Embedded port fault

`Number_of_Sensors`

Number of sensors in the switch.

# Sensor Table Page

If requested using the `Receive Diagnostic Result` command, the SESD returns the response shown in Table 4-29.

**Table 4-29** Sensor Table Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = 81h | 1 |
| 1 | na | na | Reserved = 0 | 1 |
| 2 .. 3 | na | ro | Page Length = *n* - 3 | 2 |
| 4 .. 7 | na | ro | swNumEntries = *i* – specifies the number of set entries received for bytes 8 -91, if the number is 5 there are 5 sets of outputs for bytes 8 - 91. | 4 |
| 8 .. 11 | na | ro | swValidity[0] = 1Fh | 4 |
| 12 .. 15 | 0 | ro | swSensorIndex[0] | 4 |

**Table 4-29** Sensor Table Page (Continued)

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 16 .. 19 | 1 | ro | swSensorType[0] | 4 |
| 20 .. 23 | 2 | ro | swSensorStatus[0] | 4 |
| 24 .. 27 | 3 | ro | swSensorValue[0] | 4 |
| 28 .. 91 | 4 | ro | swSensorInfo[0] | 64 |
| .. | ... more instances of swSensorEntry (swValidity..swSensorInfo) if applicable | | | ... |
| (*n-63*).. *n* | 4 | ro | swSensorInfo[*i-1*] | 64 |
| **Legend:** na = not available, ro = read only, and rw = read/write. | | | | |

Sensor Table Page field descriptions:

`swSensorIndex` Identifies the sensor

`swSensorType` Identifies the sensor type:
1 = temperature
2 = fan
3 = power supply

`swSensorStatus` Current sensor status:
1 = unknown
2 = faulty
3 = below-min
4 = nominal
5 = above-max
6 = absent

`swSensorValue` Current value (reading) of the sensor. Value “-2147483648” represents an unknown quantity indicating that the sensor does not have the capability to measure the actual value. The temperature sensor value is in Celsius, the fan value is in RPM (revolution per minute). The power supply sensor reading is a value of -2147483648 (unknown).

`swSensorInfo` Additional information on sensor. It contains sensor type and number in textual format. For example, “Temp 3”, or “Fan 6”.

# Fabric Page

The structure in Table 4-30 applies to the Fabric page of `Send Diagnostic` or `Receive Diagnostic Result` command.

**Table 4-30** Fabric Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = 82h | 1 |
| 1 | na | na | Reserved | 1 |
| 2 .. 3 | na | rw | Page Length = 20 | 2 |
| 4 .. 7 | na | rw | swValidity = 7 | 4 |
| 8 .. 11 | 0 | rw | swDomainID | 4 |
| 12 .. 15 | 1 | ro | PrincipalSwitchFlag | 4 |
| 16 .. 19 | 2 | ro | NumberOfImmediateNeighbor | 4 |
| 20 .. 23 | 3 | ro | reserved | 4 |
| **Legend:** na = not available, ro = read only, and rw = read/write. | | | | |

Fabric Page Field Descriptions:

`swDomainID` Current fibre channel domain ID of the switch.

`PrincipalSwitchFlag`
Indicates whether the switch is the Principal switch as per FC-SW:
1 = yes
2 = no

`NumberOfImmediateNeighbor`
The number of Inter-Switch Links in the (immediate) neighborhood.

# Neighborhood Table Page

The structure in Table 4-31 applies to the Neighborhood Table page of `Receive Diagnostic Result` command.

**Table 4-31** Neighborhood Table Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = 83h | 1 |
| 1 | na | na | Reserved | 1 |
| 2 .. 3 | na | na | Page Length = *n* - 3 | 2 |
| 4 .. 7 | na | na | swNumEntries = *i* – specifies the number of set entries received for bytes 8. Note that each entry consists of swValidity[0] field through swNbIslState[0] field. | 4 |
| 8 .. 11 | na | ro | swValidity[0] = 3Fh | 4 |
| 12 .. 15 | 0 | ro | swNbIndex[0] = 1 | 4 |
| 16 .. 19 | 1 | ro | swNbMyPort[0] | 4 |
| 20 .. 23 | 2 | ro | swNbRemoteDomain[0] | 4 |
| 24 .. 27 | 3 | ro | swNbRemotePort[0] | 4 |
| 28 .. 31 | 4 | ro | swNbBaudRate[0] | 4 |
| 32 .. 35 | 5 | ro | swNbIslState[0] | 4 |
| .. | ... more instances of swNbEntry (swValidity .. swNbIslState) if applicable ..... | | | ... |
| (*n-3*)..*n* | 0 - 5 | ro | swNbIslState[*i-1*] | 4 |
| **Legend:** na = not available, ro = read only, and rw = read/write. | | | | |

**Note:** The fabric wide ISL table is not supported.

Neighborhood Table Page Field Descriptions:

`swNbIndex` Identifies the neighbor ISL entry.

`swNbMyPort` The port index that has an ISL to another switch.

`swNbRemDomain` Fibre channel domain on the other end of the ISL.

`swNbRemPort` Port index on the other end of the ISL.

`swNbBaudRate` The baud rate of the ISL which should be 16 for 1 gigabit.

`swNbIslState` The current state of the ISL which should be 5 for active.

# Fibre Channel Port Table Page

The structure in Table 4-32 applies to the fibre channel Port Table Page for the `Send Diagnostic` or `Receive Diagnostic Result` command.

**Table 4-32** Fibre Channel Port Table Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = 84h | 1 |
| 1 | na | na | Reserved | 1 |
| 2 .. 3 | na | rw | Page Length = *n* - 3 | 2 |
| 4 .. 7 | na | rw | `swNumEntries` = *i* – specifies the number of set entries received. Note that each entry consists of `swValidity[0]` field through `swFCPortLipLastAlpa` field. | 4 |
| 8 .. 11 | na | rw | swValidity[0] = FFFFFFFh | 4 |
| 12 .. 15 | 0 | ro | swFCPortIndex[0] | 4 |
| 16 .. 19 | 1 | ro | swFCPortType[0] | 4 |
| 20 .. 23 | 2 | ro | swFCPortPhyState[0] | 4 |
| 24 .. 27 | 3 | ro | swFCPortOpStatus[0] | 4 |
| 28 .. 31 | 4 | rw | swFCPortAdmStatus[0] | 4 |
| 32 .. 35 | 5 | ro | swFCPortTxWords[0] | 4 |
| 36 .. 39 | 6 | ro | swFCPortRxWords[0] | 4 |
| 40 .. 43 | 7 | ro | swFCPortTxFrames[0] | 4 |
| 44 .. 47 | 8 | ro | swFCPortRxFrames[0] | 4 |
| 48 .. 51 | 9 | ro | swFCPortRxC2Frames[0] | 4 |
| 52 .. 55 | 10 | ro | swFCPortRxC3Frames[0] | 4 |
| 56 .. 59 | 11 | ro | swFCPortRxLCs[0] | 4 |
| 60 .. 63 | 12 | ro | swFCPortRxMcasts[0] | 4 |
| 64 .. 67 | 13 | ro | swFCPortTooManyRdys[0] | 4 |
| 68 .. 71 | 14 | ro | swFCPortNoTxCredits[0] | 4 |
| 72 .. 75 | 15 | ro | swFCPortRxEncInFrs[0] | 4 |
| 76 .. 79 | 16 | ro | swFCPortRxCrcs[0] | 4 |
| 80 .. 83 | 17 | ro | swFCPortRxTruncs[0] | 4 |
| 84 .. 87 | 18 | ro | swFCPortRxTooLongs[0] | 4 |

**Table 4-32** Fibre Channel Port Table Page (Continued)

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 88 .. 91 | 19 | ro | swFCPortRxBadEofs[0] | 4 |
| 92 .. 95 | 20 | ro | swFCPortRxEncOutFrs[0] | 4 |
| 96 .. 99 | 21 | ro | swFCPortRxBadOs[0] | 4 |
| 100 .. 103 | 22 | ro | swFCPortRxC3Discards[0] | 4 |
| 104 .. 107 | 23 | ro | swFCPortMcastTimedouts[0] | 4 |
| 108 .. 111 | 24 | ro | swFCPortTxMcasts[0] | 4 |
| 112 .. 115 | 25 | ro | swFCPortLipIns[0] | 4 |
| 116 .. 119 | 26 | ro | swFCPortLipOuts[0] | 4 |
| 120 .. 123 | 27 | ro | swFCPortLipLastAlpa[0] | 4 |
| ... | ... more instances of `swFCPortEntry` (`swValidity` ..`swFCPortLipLastAlpa`) if applicable ... | | | ... |
| (*n-3*)..*n* | 0 - 27 | ro | swFCPortLipLastAlpa[*i-1*] | 4 |
| **Legend:** na = not available, ro = read only, and rw = read/write. | | | | |

Fibre channel Port Table Page field descriptions:

swFCPortIndex — Identifies the switch port index. Note that the value of a port index is always one higher than the port number labeled on the front panel. For example, port index 1 correspond to port number 0.

swFCPortType — Identifies the type of switch port. It may be of type `stitch(1)`, `flannel(2),loom(3), or bloom(4).`

swFCPortPhyState — Identifies the physical state of the port, as follows:

`noCard(1)` – no card present in this switch slot

`noGbic(2)` – no GBIC module in this port

`laserFault(3)` – the module is signaling a laser fault (defective GBIC)

`noLight(4)` – the module is not receiving light

`noSync(5)` – the module is receiving light but is out of sync

`inSync(6)` – the module is receiving light and is in sync

`portFault(7)` – the port is marked faulty (defective GBIC, cable or device)

`diagFault(8)` – the port failed diagnostics: defective G_Port or FL_Port card or motherboard

`lockRef(9)` – the port is locking to the reference signal

swFCPortOpStatus — Identifies the port's operational status. The `online(1)` state indicates that user frames can be passed. The `unknown(0)` state indicates that likely the port module is physically absent (see `swFCPortPhyState`).

| | |
|---|---|
| swFCPortAdmStatus | The port's desired state. A management station may place the port in a desired state by setting this object accordingly. The `testing(3)` state indicates that no user frames can be passed. As the result of either explicit management action or per configuration information accessible by the switch, `swFCPortAdmStatus` is then changed to either the `online(1)` state, `testing(3)` state, or remains in the `offline(2)` state. |
| swFCPortTxWords | Counts the number of fibre channel words that the port has transmitted. |
| swFCPortRxWords | Counts the number of fibre channel words that the port has received. |
| swFCPortTxFrames | Counts the number of (fibre channel) frames that the port has transmitted. |
| swFCPortRxFrames | Counts the number of (fibre channel) frames that the port has received. |
| swFCPortRxC2Frames | Counts the number of Class 2 frames that the port has received. |
| swFCPortRxC3Frames | Counts the number of Class 3 frames that the port has received. |
| swFCPortRxLCs | Counts the number of Link Control frames that the port has received. |
| swFCPortRxMcasts | Counts the number of Multicast frames that the port has received. |
| swFCPortTooManyRdys | Counts the number of times when RDYs exceeds the frames received. |
| swFCPortNoTxCredits | Counts the number of times when the transmit credit has reached zero. |
| swFCPortRxEncInFrs | Counts the number of encoding error or disparity error inside frames received. |
| swFCPortRxCrcs | Counts the number of CRC errors detected for frames received. |
| swFCPortRxTruncs | Counts the number of truncated frames that the port has received. |
| swFCPortRxTooLongs | Counts the number of received frames that are too long. |
| swFCPortRxBadEofs | Counts the number of received frames that have bad EOF delimiter. |
| swFCPortRxEncOutFrs | Counts the number of encoding error or disparity error outside frames received. |
| swFCPortRxBadOs | Counts the number of invalid Ordered Sets received. |
| swFCPortC3Discards | Counts the number of Class 3 frames that the port has discarded. |
| swFCPortMcastTimedOuts | Counts the number of Multicast frames that have been timed out. |
| swFCPortTxMcasts | Counts the number of Multicast frames that have been transmitted. |
| swFCPortLipIns | Counts the number of Loop Initializations that have been initiated by loop devices attached. |
| swFCPortLipOuts | Counts the number of Loop Initializations that have been initiated by the port. |
| swFCPortLipLastAlpa | Indicates the Physical Address (AL_PA) of the loop device that initiated the last Loop Initialization. |

An example of the fibre channel Port Table Page with Send Diagnostic:

If you are changing the `swFCPortAdmstatus` command of port #6(counting from 0, so the 7th port) only, then `swFCPortIndex[0]` = 7(one higher than port#, see *Diagnostic Pages* on page 4-19) with bit#4 of `swValidity[0]`=on for the `swFCPortAdmStatus` field. And `swNumEntries` = 1.

# Name Server Local Table Page

If requested using the `Receive Diagnostic Result` command, the SESD returns the response as shown in Table 4-33.

**Table 4-33** Name Server Local Table Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = 85h | 1 |
| 1 | na | na | Reserved | 1 |
| 2 .. 3 | na | na | Page Length = *n* - 3 | 2 |
| 4 .. 7 | na | na | `swNumEntries` = *i* – specifies the number of set entries received. Note that each entry consists of `swValidity[0]` field through `swNsFc4Types[0]` field. | 4 |
| 8 .. 11 | na | ro | swValidity[0] = 7FFh | 4 |
| 12 .. 15 | 0 | ro | swNsEntryIndex[0] | 4 |
| 16 .. 19 | 1 | ro | swNsPortType[0] | 4 |
| 20 .. 23 | 2 | ro | swNsPortID[0] | 4 |
| 24 .. 31 | 3 | ro | swNsPortName[0] | 8 |
| 32 .. 287 | 4 | ro | swNsPortSymb[0] | 256 |
| 288 .. 295 | 5 | ro | swNsNodeName[0] | 8 |
| 296 .. 551 | 6 | ro | swNsNodeSymb[0] | 256 |
| 552 .. 559 | 7 | ro | swNsIPA[0] | 8 |
| 560 .. 575 | 8 | ro | swNsIpAddress[0] | 16 |
| 576 .. 579 | 9 | ro | swNsCos[0] | 4 |
| 580 .. 611 | 10 | ro | swNsFc4[0] | 32 |
| 612 .. 615 | na | ro | swValidity[1] - if applicable (n > 612) | 4 |
| ..... | ... more instances of `swNsEntry` as applicable... | | | ... |
| **Legend:** na = not available, ro = read only, and rw = read/write. | | | | |

Name Server Local Table Page field descriptions:

| | |
|---|---|
| `swNsEntryIndex` | Identifies the Name Server database entry:<br>`0 = unknown`<br>`1 = nPort`<br>`2 = nlPort` |
| `swNsPortType` | Identifies the port type: N_Port, NL_Port, etc., for this entry. The type is defined in FC-GS-2. |
| `swNsPortID` | Identifies the fibre channel port address ID of the entry. |
| `swNsPortName` | Identifies the fibre channel WWN of the port entry. |
| `swNsPortSymb` | Identifies the Symbolic Name contents of the port entry. In FC-GS-2, a Symbolic Name consists of a byte array of 1 through 256 bytes and the first byte of the array specifies the length of its *contents*. |
| `swNsNodeName` | Identifies the fibre channel WWN of the associated node as defined in FC-GS-2. |
| `swNsNodeSymb` | Identifies the Symbolic Name contents of the node associated with the entry. In FC-GS-2, a Symbolic Name consists of a byte array of 1 through 256 bytes and the first byte of the array specifies the length of its *contents*. |
| `swNsIPA` | Identifies the Initial Process Associator of the node for the entry as defined in FC-GS-2. |
| `swNsIpAddress` | Identifies the IP address of the node for the entry as defined in FC-GS-2. The address format is in IPv6. |
| `swNsCos` | Identifies the class of services supported by the port. The value is a bit-map defined as follows:<br>bit 0 is class F<br>bit 1 is class 1<br>bit 2 is class 2<br>bit 3 is class 3<br>bit 4 is class 4 |
| `swNsFc4` | Identifies the FC-4s supported by the port as defined in FC-GS-2. |

# Event Table Page

If requested using the `Receive Diagnostic Result` command, the SESD returns the response as shown in Table 4-34.

**Table 4-34** Event Table Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = 86h | 1 |
| 1 | na | na | Reserved | 1 |
| 2 .. 3 | na | na | Page Length = n -3 | 2 |
| 4 .. 7 | na | na | swNumEntries = i | 4 |
| 8 .. 11 | na | ro | swValidity[0] = 1Fh | 4 |
| 12 .. 15 | 0 | ro | swEventIndex[0] | 4 |
| 16 .. 47 | 1 | ro | swEventTimeInfo[0] | 32 |
| 48 .. 51 | 2 | ro | swEventLevel[0] | 4 |
| 52 .. 55 | 3 | ro | swEventRepeatCount[0] | 4 |
| 56 .. 311 | 4 | ro | swEventDescr[0] | 256 |
| ... | more instances of (`swValidity` .. `swEventDescr`) if applicable | | | |

Event Table Page field descriptions:

`swEventIndex` Identifies the event entry in the table.

`swEventTimeInfo` Identifies the date and time when this particular event occurred, in text format.

`swEventLevel` The level of severity associated with the event:

- 1 = critical
- 2 = error
- 3 = warning
- 4 = informational
- 5 = debug

`swEventRepeatCount` Identifies how many times this particular event has occurred.

`swEventDescr` Additional description of the event, in text format.

# Port Error and Interrupt Statistics Table Page

If requested using the `Receive Diagnostic Result` command, the SESD responds as shown in Table 4-35. The fields are described from the telnet `portShow` command.

**Table 4-35** Port Error and Interrupt Statistics Table Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = 87h | 1 |
| 1 | na | na | Reserved | 1 |
| 2 .. 3 | na | na | Page Length = *n* -3 | 2 |
| 4 .. 7 | na | na | swNumEntries = *i* | 4 |
| 8 .. 11 | na | ro | swValidity[0] = 7FF1FFFh | 4 |
| 12 .. 15 | 0 | ro | swFCPortIndex[0] | 4 |
| 16 .. 19 | 1 | ro | swFCPortLinkFailures[0] | 4 |
| 20 .. 23 | 2 | ro | swFCPortSyncLosses[0] | 4 |
| 24..27 | 3 | ro | swFCPortSignalLosses[0] | 4 |
| 28..31 | 4 | ro | swFCPortPrimSeqProtoErrors[0] | 4 |
| 32..35 | 5 | ro | swFCPortInvalidTxWords[0] | 4 |
| 36..39 | 6 | ro | swFCPortInvalidCrcs[0] | 4 |
| 40..43 | 7 | ro | swFCPortDelimiterErrors[0] | 4 |
| 44..47 | 8 | ro | swFCPortAddressIdErrors[0] | 4 |
| 48..51 | 9 | ro | swFCPortLinkResetIns[0] | 4 |
| 52..55 | 10 | ro | swFCPortLinkResetOuts[0] | 4 |
| 56..59 | 11 | ro | swFCPortOlsIns[0] | 4 |
| 60..63 | 12 | ro | swFCPortOlsOuts[0] | 4 |
| 64..67 | 13 | ro | reserved | 4 |
| 68..71 | 14 | ro | reserved | 4 |
| 72..75 | 15 | ro | reserved | 4 |
| 76..79 | 16 | ro | TotalNumberOfInterrupts (sum of subsequent interrupts below) | 4 |
| 80..83 | 17 | ro | UnknownInterrupts | 4 |
| 84..87 | 18 | ro | LinkLevelInterrupts | 4 |
| 88..91 | 19 | ro | ProcessingRequiredInterrupts | 4 |
| 92..95 | 20 | ro | TimedoutInterrupts | 4 |
| 96..99 | 21 | ro | RxFlushedInterrupts | 4 |

**Table 4-35** Port Error and Interrupt Statistics Table Page (Continued)

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 100..103 | 22 | ro | TxUnavailableInterrupts | 4 |
| 104..107 | 23 | ro | FreeBufferInterrupts | 4 |
| 108..111 | 24 | ro | OverrunInterrupts | 4 |
| 112..115 | 25 | ro | Suspended_Interrupts | 4 |
| 116..119 | 26 | ro | ParityErrorInterrupts | 4 |
| 120..123 | 27 | ro | Reserved_last | 4 |
| ... | more instances of (swValidity..reserved_last) if applicable | | | |

## *Error Statistics*

Port Error and Interrupt Statistics Table Page command field descriptions:

swFCPortLinkFailures Number of link failures.

swFCPortSyncLosses Loss of synchronization.

swFCPortSignalLosses Loss of signal (no light).

swFCPortPrimSeqProtoErrors
Protocol error.

swFCPortInvalidTxWords
Invalid word (encoding errors inside of frames).

swFCPortInvalidCrcs Invalid CRC in a frame.

swFCPortDelimiterErrors Delimeter error (order set).

swFCPortAddressIdErrors
Address id error (S_ID D_ID).

swFCPortLinkResetIns Link reset in (primitive sequence). Does not apply to FL_Port.

swFCPortLinkResetOuts Link reset out (primitive sequence). Does not apply to FL_Port.

swFCPortOlsIns Offline resent in (primitive sequence). Does not apply to FL_Port.

swFCPortOlsOuts Offline resent in (primitive sequence). Does not apply to FL_Port.

## *Interrupt Statistics*

TotalNumberOfInterrupts Total number of interrupts.

UnknownInterrupts Number of interrupts not counted in all other categories.

LinkLevelInterrupts Number of low level interface (LLI) interrupts.

ProcessingRequiredInterrupts
Number of interrupts with processing (CPU) required.

TimedoutInterrupts Number of timed out interrupts.

RxFlushedInterrupts Number of flushed transmissions.

| | |
|---|---|
| TxUnavailableInterrupts | Number of interrupted transmissions. |
| FreeBufferInterrupts | Number of buffer interrupts. |
| OverrunInterrupts | Number of buffer overruns. |
| Suspended_Interrupts | Number of suspended interrupts. |
| ParityErrorInterrupts | Number of parity errors. |

# Fabric Inquiry Data Page

If requested using the `Receive Diagnostic Result` command the SESD returns the response shown in Table 4-36.

**Table 4-36** Fabric Inquiry Data Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = 8Ah | 1 |
| 1 | na | na | Reserved | 1 |
| 2..3 | na | na | Page Length =*n - 3* | 2 |
| 4..7 | na | ro | swValidity = FEFh | 4 |
| 8..15 | 0 | ro | switchWorld_wide_name | 8 |
| 16..47 | 1 | ro | switchName | 32 |
| 48..51 | 2 | ro | switchModelInfo | 4 |
| 52..55 | 3 | ro | firmwareVersion | 4 |
| 56..119 | 4 | ro | Reserved | 64 |
| 120..123 | 5 | ro | numberOfIpInterfaces = *i* | 4 |
| 124..127 | 6 | ro | interfaceType[0] | 4 |
| 128..143 | 7 | ro | interfaceName[0] - in ASCII format | 16 |
| 144..159 | 8 | ro | ipAddress[0] in IPv6 format | 16 |
| ... | | | ... | ... |
| (n-15)..n | 0 - 8 | ro | ipAddress[i-1] in IPv6 format | 16 |

Fabric Inquiry Data Page field descriptions are as follows:

`switchWorld_wide_Name`
: The switch's worldwide name. The format is as defined in the fibre channel standards.

`switchName`
: The switch name in ASCII text and terminated with a null character; this name is the same as the one displayed by the telnet command `switchName` or the MIB-II variable `sysName`.

`switchModelInfo` The first two bytes (byte 48 and 49) are reserved. The third byte (byte 50) represents the product model:
1 = SilkWorm 1000 series
2 = SilkWorm 2800
3 = SilkWorm 2400
4 = SilkWorm 2010, 2040, 2050
The fourth byte (byte 51) represents the revision of the motherboard.

`firmwareVersion` A 4 byte ASCII string of the format `v{N}{m}{p}`, as follows:
`{N}` is a single number designating the major firmware release number.
`{m}` is a single number designating the minor release number.
`{p}` is a single alpha character designating a patch; `{p}` may be a space indicating that there is no patch.
An example of this value is `v20`. See the product revision level in the `Inquiry Data Page`.

`numberOfIpInterfaces`
This is an integer indicating the number of IP interfaces supported by the switch. This number is likely to be 2. This also indicates how many interface entries follow. Each interface entry contains the interface type, interface name and its IP address.

`interfaceType` This value designates the type of network (IP) interface type as defined in RFC1213 - MIB-II. Note that the following enumerated values would apply:
`ethernetCsmacd(6)` – for the Ethernet interface.
`fibreChannel(56)` – for the fibre channel interface.

`interfaceName` A 16 byte ASCII text representing the name of the interface.

`ipAddress` The IP address of the interface in IPv6 format.

# MIB-II System Group Page

If requested using the `Receive Diagnostic Result` command the SESD returns the response shown in Table 4-37. This page contains the System Group, SNMP MIB-II, as defined in the Internet Engineering Task Force (IETF) standard document, RFC 1213. SNMP is a popular network management protocol that is based on TCP/IP protocol suite.

**Table 4-37** MIB-II System Group Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = 90h | 1 |
| 1 | na | na | Reserved | 1 |
| 2..3 | na | na | Page Length =1200 | 2 |
| 4..7 | na | ro | swValidity = 7Dh | 4 |
| 8..263 | 0 | ro | sysDescr | 256 |

**Table 4-37** MIB-II System Group Page (Continued)

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 264..427 | 1 | na | **reserved** for sysObjectID - it seems pointless to map this variable at present; note that bit 1 in validity is set to 0. | 164 |
| 428..431 | 2 | ro | sysUpTime | 4 |
| 432..687 | 3 | ro | sysContact | 256 |
| 688..943 | 4 | ro | sysName | 256 |
| 944..1199 | 5 | ro | sysLocation | 256 |
| 1200..1203 | 6 | ro | sysServices | 4 |

MIB-II System Group Page field descriptions:

`sysDescr` — System (switch) description is also available as the `Product Identification` field of the standard `Inquiry Data` (see Figure 14-1 on page 4-9). If `sysDescr` is more than 16 bytes long, then only the first 16 bytes are mapped to the Product Identification field. This information may be set with the telnet command, `agtcfgSet` or the SNMP-SET request. The factory default value is `Fibre Channel Switch`.

`sysUpTime` — The time, in hundredths of a second, since the SNMP agent was started (at boot time).

`sysContact` — The textual identification of the contact person for this managed switch, together with information on how to contact this person. This information may be set with the telnet command, `agtcfgSet` or the SNMP-SET request. The factory default value is `Field Support`.

`sysName` — An administratively assigned name for this switch. This information may be set with the telnet command, `switchName` or the SNMP-SET request.

`sysLocation` — The physical location of this switch. This information may be set with the telnet command, `agtcfgSet`, or the SNMP-SET request. The factory default value is `End User Premise`.

`sysServices` — A value which indicates the set of (network) services that this switch firmware offers. Initially, the sum value is zero. For each (network) layer, L, in the range 1 through 7, that the Fabric Operating System (FOS) performs a transaction for, 2 raised to (L-1) is added to the sum. In the context of the Internet suite of protocols, values should be calculated accordingly:

**layer** – **functionality**
1 = physical
2 = datalink / subnetwork
3 = internet
4 = end-to-end
7 = applications

This value is set to 79. That is, layers 1, 2, 3, 4, and 7 are supported.

# Port Log Table Page

If requested using the `Receive Diagnostic Result` command the SESD returns the response shown in Table 4-38. To interpret the contents of this page, a UNIX utility, `portlogDump`, is provided.

**Table 4-38** Port Log Table Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page Code = B0h | 1 |
| 1 | na | na | Reserved | 1 |
| 2..3 | na | na | Page Length = *n* - 3 | 2 |
| An array of port log entries to follow, as applicable, where p = (n-3)/40 | | | | |
| 4 | 0 | ro | reserved[0] | 1 |
| 5 | 1 | ro | duplicate_count[0] | 1 |
| 6 | 2 | ro | portNumber[0] | 1 |
| 7 | 3 | ro | logType[0] | 1 |
| 8..11 | 4 | ro | argument0[0] | 4 |
| 12..15 | 5 | ro | argument1[0] | 4 |
| 15..19 | 6 | ro | argument2[0] | 4 |
| 20..23 | 7 | ro | argument3[0] | 4 |
| 24..27 | 8 | ro | argument4[0] | 4 |
| 28..31 | 9 | ro | argument5[0] | 4 |
| 32..35 | 10 | ro | taskID | 4 |
| 36..39 | 11 | ro | timeStamp_sec[0] | 4 |
| 40..43 | 12 | ro | timeStamp_nanoSec[0] | 4 |
| ... | ... more instances of the above as applicable. | | | |

# Unicast Route Table Page

If requested using the `Receive Diagnostic Result` command, the SESD returns the response shown in Table 4-39.

**Table 4-39** Unicast Route Table Page

| Byte | Field # | Access | Description | Size |
|---|---|---|---|---|
| 0 | na | rw | Page code = B1h | 1 |
| 1 | na | na | Reserved | 1 |
| 2 .. 3 | na | na | Page length = n-3 | 2 |
| 4 .. 7 | na | na | swNumEntries = i | 4 |
| 8 .. 11 | na | ro | swValidity[0] = 1FFh | 4 |
| 12 .. 15 | 0 | ro | swEntryIndex[0] | 4 |
| 16 .. 19 | 1 | ro | swInPortNum[0] | 4 |
| 20 .. 23 | 2 | ro | swDestinationDomainID[0] | 4 |
| 24 .. 27 | 3 | ro | swOutPortNum[0] | 4 |
| 28 .. 31 | 4 | ro | swMetricCount[0] | 4 |
| 32 .. 35 | 5 | ro | swHopCount[0] | 4 |
| 36 .. 39 | 6 | ro | swFlags | 4 |
| 40 .. 43 | 7 | ro | swNextDomainID | 4 |
| 44 .. 47 | 8 | ro | swNextOutPortNum | 4 |
| ... | more instances of (swValidity .. swNextOutPortNum) if applicable | | | |

Unicast Route Table Page field descriptions:

`swEntryIndex` Identifies the event entry in the table.

`swInPortNum` Identifies the (incoming) port number of the frame.

`swDestinationDomainID`
Destination domain of an incoming frame.

`swOutPortNum` Identifies the (out going) port to which the frame is forwarded in order to reach the destination domain.

`swMetricCount` Cost of reaching the destination domain.

`swHopCount` Number of hops required to reach the destination domain.

`swFlags` Indicates whether the route is dynamic (0) or static (1). A dynamic route is discovered automatically by FSFP path selection protocol; a static route is assigned using the `uRouteConfig` command. A non-zero value when static indicates the bit position of the swInPortNum. For example, if swInPortNum =3, for a static route, swFlags = 0x00 00 00 08.

`swNextDomainID` Domain of the next hop connected to the out-going port.

`swNextOutPortNum` Port number of the next hop connected to the out-going port.

# Troubleshooting

# 5

This chapter discusses the `SEND DIAGNOSTIC` command error messages.

## License Reject

A license reject is generated when the SES license key is improperly entered or is not installed.

**Note:** The license key when installed must be in double quotes (“key”).

The following message is generated:

**Probable cause:** Invalid Field

**Action:** See *Reject* on page 4-9 for more information.

## Check Condition

The `CHECK CONIDITION` command is generated when the SES Device (SESD) terminates an operation because an error was encountered. These error conditions can be from invalid operations, warning indications and failure conditions. The sense key and sense code describe the error. Refer to Table 4-8 on page 4-6 for more information.

# 5 Troubleshooting

# Glossary

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

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

**AL_PA** — Arbitrated loop physical address. A unique 8-bit value assigned during loop initialization to a port in an arbitrated loop.

**alias** — An alternate name for an element or group of elements in the fabric. Aliases can be used to simplify the entry of port numbers and WWNs when creating zones.

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

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

**alias server** — A fabric software facility that supports multicast group management.

**ANSI** — American National Standards Institute. The governing body for fibre channel standards in the U.S.A.

**API** — Application programming interface. A defined protocol that allows applications to interface with a set of services.

**arbitrated loop** — A shared 100 MBps fibre channel transport structured as a loop. Can support up to 126 devices and one fabric attachment. See also *topology.*

**ASIC** — Application specific integrated circuit.

**ATM** — Asynchronous transfer mode. A transport used for transmitting data over LANs or WANs that transmit fixed-length units of data. Provides any-to-any connectivity, and allows nodes to transmit simultaneously.

**authentication** — The process of verifying that an entity (such as a switch) in a fabric is what it claims to be. See also *digital certificate, switch-to-switch authentication.*

**AW_TOV** — Arbitration wait time-out value. The minimum time an arbitrating L_Port waits for a response before beginning loop initialization.

**backup FCS switch** — Backup fabric configuration server switch. The switch or switches assigned as backup in case the primary FCS switch fails. See also *FCS switch, primary FCS switch.*

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

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

**beacon** When all the port LEDs on a switch are set to flash from one side of the switch to the other, to enable identification of an individual switch in a large fabric. A switch can be set to beacon by telnet command or through Brocade Web Tools.

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

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

**block** As applies to fibre channel, upper-level application data that is transferred in a single sequence.

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

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

**CA** Certificate authority. A trusted organization that issues digital certificates. See also *digital certificate.*

**cascade** Two or more interconnected fibre channel switches. SilkWorm 2000 and later switches can be cascaded up to 239 switches, with a recommended maximum of seven interswitch links (no path longer than eight switches). See also *fabric, ISL*.

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

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

**Class 1** The class of frame switching service for a dedicated connection between two communicating ports (also called connection-oriented service), with acknowledgement of delivery or nondelivery of frames.

**Class 2** A connectionless class of frame switching service that includes acknowledgement of delivery or nondelivery of frames.

**Class 3** A connectionless class of frame switching service that does not include acknowledgement of delivery or nondelivery of frames. Can be used to provide a multicast connection between the frame originator and recipients, with acknowledgement of delivery or nondelivery of frames.

**Class F** The class of frame switching service for a direct connection between two switches, allowing communication of control traffic between the E_Ports, with notification of delivery or nondelivery of data.

**class of service** A specified set of delivery characteristics and attributes for frame delivery.

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

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

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

**CRC** Cyclic redundancy check. A check for transmission errors that is included in every data frame.

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

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

**data word** A type of transmission word that occurs within frames. The frame header, data field, and CRC all consist of data words. See also *frame, ordered set, transmission word.*

**defined zone configuration** The set of all zone objects defined in the fabric. May include multiple zone configurations. See also *enabled zone configuration, zone configuration.*

**digital certificate** An electronic document issued by a CA (certificate authority) to an entity, and containing the public key and identity of the entity. Entities in a secure fabric are authenticated based on these certificates. See also *authentication, CA, public key*.

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

**DLS** Dynamic load sharing. Dynamic distribution of traffic over available paths. Allows for recomputing of routes when an Fx_Port or E_Port changes status.

**domain ID** Unique identifier for all switches in a fabric, used in routing frames. Usually automatically assigned by the principal switch, but can be assigned manually. The domain ID for a SilkWorm switch can be any integer between| 1 and 239.

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

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

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

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

**enabled zone configuration** The currently enabled configuration of zones. Only one configuration can be enabled at a time. See also *defined zone configuration, zone configuration.*

**end-to-end flow control** Governs flow of class 1 and 2 frames between N_Ports. See also *EE_Credit.*

**error** As applies to fibre channel, a missing or corrupted frame, time-out, loss of synchronization, or loss of signal (link errors). See also *loop failure.*

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

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

**fabric** A fibre channel network containing two or more switches in addition to hosts and devices. May also be referred to as a switched fabric. See also *cascade, SAN, topology*.

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

**FC-AL-3** The Fibre Channel Arbitrated Loop standard defined by ANSI. Defined on top of the FC-PH standards.

**FC-FLA** The Fibre Channel Fabric Loop Attach standard defined by ANSI.

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

**FCP** Fibre channel protocol. Mapping of protocols onto the fibre channel standard protocols. For example, SCSI FCP maps SCSI-3 onto fibre channel.

**FC-PH-1, 2, 3** The Fibre Channel Physical and Signalling Interface standards defined by ANSI.

**FC-PI** The Fibre Channel Physical Interface standard defined by ANSI.

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

**FCS switch** Fabric configuration server switch. One or more designated SilkWorm switches that store and manage the configuration and security parameters for all switches in the fabric. FCS switches are designated by WWN, and the list of designated switches is communicated fabric-wide. See also *backup FCS switch, primary FCS switch.*

**FC-SW-2** The second generation of the Fibre Channel Switch Fabric standard defined by ANSI. Specifies tools and algorithms for the interconnection and initialization of fibre channel switches in order to create a multi-switch fibre channel fabric.

**fibre channel transport** A protocol service that supports communication between fibre channel service providers. See also *FSP*.

**Fill Word** An IDLE or ARB ordered set that is transmitted during breaks between data frames to keep the fibre channel link active.

**firmware** The basic operating system provided with the hardware.

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

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

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

**FRU** Field-replaceable unit. A component that can be replaced on site.

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| **FS** | Fibre channel service. A service that is defined by fibre channel standards and exists at a well-known address. For example, the Simple Name Server is a fibre channel service. See also *FSP*. |
| **FSP** | Fibre channel service protocol. The common protocol for all fabric services, transparent to the fabric type or topology. See also *FS*. |
| **FSPF** | Fabric shortest path first. Brocade's routing protocol for fibre channel switches. |
| **full-duplex** | A mode of communication that allows the same port to simultaneously transmit and receive frames. See also *half-duplex*. |
| **Fx_Port** | A fabric port that can operate as either an F_Port or FL_Port. See also *F_Port, FL_Port*. |
| **G_Port** | Generic port. A port that can operate as either an E_Port or F_Port. A port is defined as a G_Port when it is not yet connected or has not yet assumed a specific function in the fabric. |
| **GBIC** | Gigabit interface converter. A removable serial transceiver module that allows gigabaud physical-level transport for fibre channel and gigabit ethernet. |
| **Gbps** | Gigabits per second (1,062,500,000 bits/second). |
| **GBps** | GigaBytes per second (1,062,500,000 bytes/second). |
| **half-duplex** | A mode of communication that allows a port to either transmit or receive frames at any time, but not simultaneously (with the exception of link control frames, which can be transmitted at any time). See also *full-duplex*. |
| **hard address** | The AL_PA that an NL_Port attempts to acquire during loop initialization. |
| **hardware translative mode** | A method for achieving address translation. The following two hardware translative modes are available to a QuickLoop enabled switch:<br>• Standard translative mode: Allows public devices to communicate with private devices that are directly connected to the fabric.<br>• QuickLoop mode: Allows initiator devices to communicate with private or public devices that are not in the same loop. |
| **HBA** | Host bus adapter. The interface card between a server or workstation bus and the fibre channel network. |
| **hub** | A fibre channel wiring concentrator that collapses a loop topology into a physical star topology. Nodes are automatically added to the loop when active and removed when inactive. |
| **idle** | Continuous transmission of an ordered set over a fibre channel link when no data is being transmitted, to keep the link active and maintain bit, byte, and word synchronization. |
| **initiator** | A server or workstation on a fibre channel network that initiates communications with storage devices. See also *target*. |
| **Integrated Fabric** | The fabric created by a SilkWorm 6400, consisting of six SilkWorm 2250 switches cabled together and configured to handle traffic as a seamless group. |
| **IOD** | In-order delivery. A parameter that, when set, guarantees that frames are either delivered in order or dropped. |
| **ISL** | Interswitch link. A fibre channel link from the E_Port of one switch to the E_Port of another. See also *cascade, E_Port*. |

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

**IU** — Information unit. A set of information as defined by either upper-level process protocol definition or upper-level protocol mapping.

**JBOD** — Just a bunch of disks. Indicates a number of disks connected in a single chassis to one or more controllers. See also *RAID.*

**K28.5** — A special 10-bit character used to indicate the beginning of a transmission word that performs fibre channel control and signaling functions. The first seven bits of the character are the comma pattern. See also *comma*.

**key** — A string of data (usually a number) shared between two entities and used to control a cryptographic algorithm. Usually selected from a large pool of possible keys to make unauthorized identification of the key difficult. See also *key pair.*

**key pair** — In public key cryptography, a pair of keys consisting of an entity's public and private key. The public key can be publicized, but the private key must be kept secret. See also *public key cryptography*.

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

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

See also *non-participating mode, participating mode.*

**latency** — The period of time required to transmit a frame, from the time it is sent until it arrives. Together, latency and bandwidth define the speed and capacity of a link or system.

**LED** — Light emitting diode. Used to indicate status of elements on switch.

**link** — As applies to fibre channel, a physical connection between two ports, consisting of both transmit and receive fibres. See also *circuit.*

**link services** — A protocol for link-related actions.

**LIP** — Loop initialization primitive. The signal used to begin initialization in a loop. Indicates either loop failure or resetting of a node.

**LM_TOV** — Loop master time-out value. The minimum time that the loop master waits for a loop initialization sequence to return.

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

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

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

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

**LPSM** — Loop port state machine. The logical entity that performs arbitrated loop protocols and defines the behavior of L_Ports when they require access to an arbitrated loop.

**LWL** Long wavelength. A type of fiber optic cabling that is based on 1300mm lasers and supports link speeds of 1.0625 Gbps. May also refer to the type of GBIC or SFP. See also *SWL*.

**MIB** Management information base. An SNMP structure to help with device management, providing configuration and device information.

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

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

**N_Port** Node port. A port on a node that can connect to a fibre channel port or to another N_Port in a point-to-point connection. See also *NL_Port, Nx_Port.*

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

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

**node** A fibre channel device that contains an N_Port or NL_Port.

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

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

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

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

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

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

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

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

**path selection** The selection of a transmission path through the fabric. Brocade switches use the FSPF protocol. See also *FSPF*.

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

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

**PKI** Public key infrastructure. An infrastructure that is based on public key cryptography and CA (certificate authority), and uses digital certificates. See also *CA, digital certificate, public key cryptography*.

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| **PKI certification utility** | Public key infrastructure certification utility. A utility that makes it possible to collect certificate requests from switches and load certificates to switches. See also *digital certificate, PKI.* |
| **PLOGI** | Port login. The port-to-port login process by which initiators establish sessions with targets. See also *FLOGI.* |
| **point-to-point** | A fibre channel topology that employs direct links between each pair of communicating entities. See also *topology.* |
| **Port_Name** | The unique identifier assigned to a fibre channel port. Communicated during login and port discovery. |
| **POST** | Power on self-test. A series of tests run by a switch after it is turned on. |
| **primary FCS switch** | Primary fabric configuration server switch. The switch that actively manages the configuration and security parameters for all switches in the fabric. See also *backup FCS switch, FCS switch.* |
| **private device** | A device that supports arbitrated loop protocol and can interpret 8-bit addresses, but cannot log into the fabric. |
| **private key** | The secret half of a key pair. See also *key, key pair.* |
| **private loop** | An arbitrated loop that does not include a participating FL_Port. |
| **private NL_Port** | An NL_Port that communicates only with other private NL_Ports in the same loop and does not log into the fabric. |
| **protocol** | A defined method and set of standards for communication. |
| **public device** | A device that supports arbitrated loop protocol, can interpret 8-bit addresses, and can log into the fabric. |
| **public key** | The public half of a key pair. See also *key, key pair.* |
| **public key cryptography** | A type of cryptography which uses a key pair, with the two keys in the pair called at different points in the algorithm. The sender uses the recipient's public key to encrypt the message, and the recipient uses the recipient’s private key to decrypt it. See also *key pair, PKI.* |
| **public loop** | An arbitrated loop that includes a participating FL_Port, and may contain both public and private NL_Ports. |
| **public NL_Port** | An NL_Port that logs into the fabric, can function within either a public or a private loop, and can communicate with either private or public NL_Ports. |
| **quad** | A group of four adjacent ports that share a common pool of frame buffers. |
| **R_A_TOV** | Resource allocation time-out value. The maximum time a frame can be delayed in the fabric and still be delivered. See also *E_D_TOV, RR_TOV.* |
| **RAID** | Redundant array of independent disks. A collection of disk drives that appear as a single volume to the server and are fault tolerant through mirroring or parity checking. See also *JBOD.* |
| **request rate** | The rate at which requests arrive at a servicing entity. See also *service rate.* |
| **route** | As applies to a fabric, the communication path between two switches. May also apply to the specific path taken by an individual frame, from source to destination. See also *FSPF.* |

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| **routing** | The assignment of frames to specific switch ports, according to frame destination. |
| **RR_TOV** | Resource recovery time-out value. The minimum time a target device in a loop waits after a LIP before logging out a SCSI initiator. See also *E_D_TOV, R_A_TOV.* |
| **RSCN** | Registered state change notification. A switch function that allows notification of fabric changes to be sent from the switch to specified nodes. |
| **SAN** | Storage area network. A network of systems and storage devices that communicate using fibre channel protocols. See also *fabric*. |
| **sectelnet** | A protocol similar to Telnet but with encrypted passwords for increased security. |
| **security policy** | A set of rules that determine how security is implemented in a fabric. Security policies can be customized. |
| **sequence** | A group of related frames transmitted in the same direction between two N_Ports. |
| **service rate** | The rate at which an entity can service requests. See also *request rate*. |
| **SI** | Sequence initiative. |
| **SilkWorm** | The brand name for the Brocade family of switches. |
| **single mode** | The fiber optic cabling standard that corresponds to distances of up to 10 km between devices. |
| **SNMP** | Simple network management protocol. An internet management protocol that uses either IP for network-level functions and UDP for transport-level functions, or TCP/IP for both. Can be made available over other protocols, such as UDP/IP, because it does not rely on the underlying communication protocols. See also *community (SNMP).* |
| **SNS** | Simple name server. A switch service that stores names, addresses, and attributes for up to 15 minutes, and provides them as required to other devices in the fabric. SNS is defined by fibre channel standards and exists at a well-known address. May also be referred to as directory service. See also *FS.* |
| **switch** | Hardware that routes frames according to fibre channel protocol and is controlled by software. |
| **switch name** | The arbitrary name assigned to a switch. |
| **switch port** | A port on a switch. Switch ports can be E_Ports, F_Ports, or FL_Ports. |
| **switch-to-switch authentication** | The process of authenticating both switches in a switch-to-switch connection using digital certificates. See also *authentication, digital certificate.* |
| **SWL** | Short wavelength. A type of fiber optic cabling that is based on 850mm lasers and supports 1.0625 Gbps link speeds. May also refer to the type of GBIC or SFP. See also *LWL.* |
| **target** | A storage device on a fibre channel network. See also *initiator.* |
| **tenancy** | The time from when a port wins arbitration in a loop until the same port returns to the monitoring state. Also referred to as loop tenancy. |
| **throughput** | The rate of data flow achieved within a cable, link, or system. Usually measured in bps (bits per second). See also *bandwidth.* |

**topology** As applies to fibre channel, the configuration of the fibre channel network and the resulting communication paths allowed. There are three possible topologies:

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

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

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

**transmission word** A group of four transmission characters.

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

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

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

**UDP** User datagram protocol. A protocol that runs on top of IP and provides port multiplexing for upper-level protocols.

**ULP** Upper-level protocol. The protocol that runs on top of fibre channel. Typical upper-level protocols are SCSI, IP, HIPPI, and IPI.

**ULP_TOV** Upper-level time-out value. The minimum time that a SCSI ULP process waits for SCSI status before initiating ULP recovery.

**unicast** The transmission of data from a single source to a single destination. See also *broadcast, multicast.*

**well-known address** As pertaining to fibre channel, a logical address defined by the fibre channel standards as assigned to a specific function, and stored on the switch.

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

**WWN** Worldwide name. An identifier that is unique worldwide. Each entity in a fabric has a separate WWN.

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

**zone configuration** A specified set of zones. Enabling a configuration enables all zones in that configuration. See also *defined zone configuration, enabled zone configuration.*

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