StorageTek

StorageNet Fibre Channel Switch 4000 SES (SCSI-3 Enclosure Services)

User Guide

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Revision History

Tab Level/Date	Description
01 (08/98)	Initial release.
02 (03/99)	Manual release corresponding to Release 1.6a.

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About This Document

Introduction

Use this guide for monitoring, configuring, and maintaining a StorageNet Fibre Channel Switch 4000 through SCSI-3 Enclosure Services (SES). You should be knowledgeable about networking in general, routing and bridging in particular. A clearly defined network and security plan is necessary. Your security plan should assess the possible risks to your network and define access policies to deal with those risks.

How This Guide is Organized

This guide is divided into the following chapters:

- Chapter 1 “Product Overview”, provides an overview of SES and SES Management.
- Chapter 2 “SES Concepts”, describes the concepts associated with SES.
- Chapter 3 “SES Commands”, describes FC-PH constructs, FCP and SES commands, and diagnostics pages.
- Chapter 4 “Troubleshooting”, describes command error messages.

The following appendix is also included in this guide:

- Appendix A “Glossary”.

Reference Documents

The following documents contain information related to SES:

Fibre Channel Standards. For detailed information on the Fibre Channel standards, see the Fibre Channel Association web site at http://www.fibrechannel.com.

*StorageNet Fibre Channel Switch 4000 Installation and Reference Guide (*8946119902)

*StorageNet Fibre Channel Switch 4000 WEB TOOLS User Guide (*8946121602)

*StorageNet Fibre Channel Switch 4000 ZONING User Guide (*8946121502)

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Before calling StorageTek, please have your information from the Problem Reporting form ready. This form is located at the back of this manual.

If a problem cannot be resolved through Customer Support, a Return Material Authorization (RMA) is issued. Instructions are provided on where to return the part and how to receive a replacement part. If the product is installed by the customer, the customer is responsible for returning the product with freight paid to the nearest repair center.

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Chapter 1 Product Overview

Introduction

This chapter describes StorageTek's implementation of SES (SCSI-3 Enclosure Services) on the StorageNet Fibre Channel Switch 4000.

SES implementation in a SCSI-3-based Host Adapter is up to the adapter manufacturer and StorageTek cannot determine their implementation. Therefore, the focus of this guide is to discuss StorageTek's implementation of SES within the Fabric.

Note: Currently, the SES standard is in DRAFT status and is subject to change. See "Reference Documents" for a pointer to the SES Standards Committee's web site.

SES Management

SES is an in-band mechanism for managing devices, such as switches, within a Fabric or other enclosures. 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 (enclosure). The command set uses the SCSI `SEND DIAGNOSTIC` and `RECEIVE DIAGNOSTIC RESULTS` commands to obtain/set configuration information from the switch.

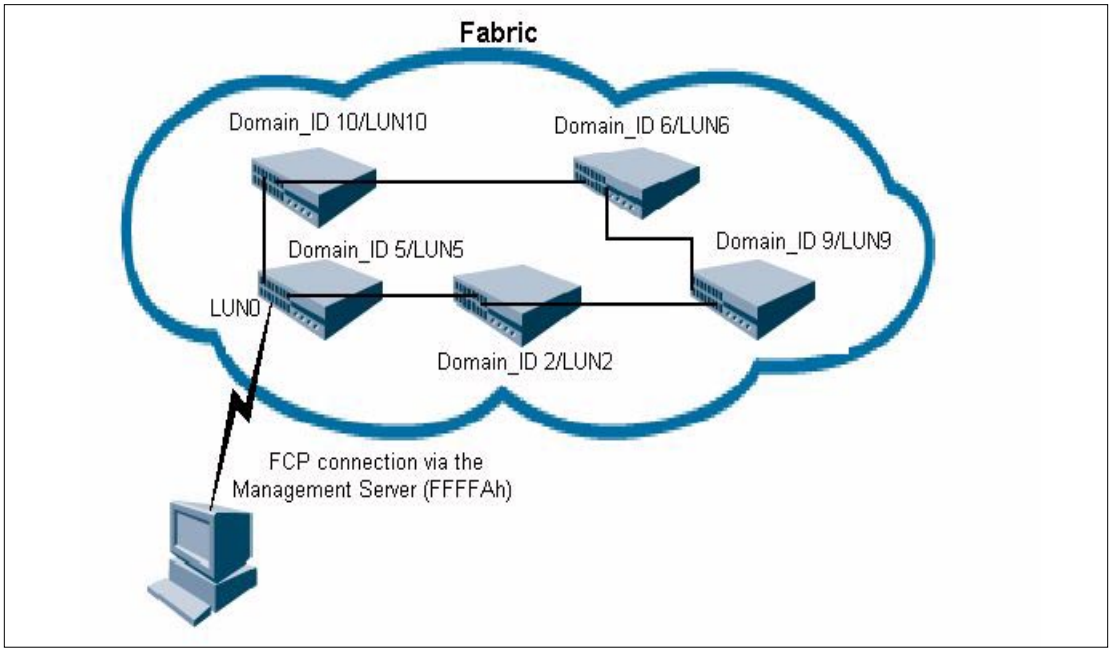
SES allows a SCSI entity (or initiator) to communicate with a switch through a standard Fiber Channel Protocol (FCP) connection into the Fabric. The benefits are:

- SES does not require supporting another protocol
- SES does not require an additional network link (such as Ethernet)

Figure 1-1 shows the Fabric SES view. The switch's `Domain_ID` is used as the Logical Unit Number (LUN) address to identify each switch including the switch used for access through SES. See the "SES Functional Model" section in Chapter 2 for more information.

Note: The connection to the Fabric is through the switch labeled LUN5 and which is also called LUN0. The connection to the well known management address (FFFFFAh) is always labeled LUN0 no matter which switch is used.

Figure 1-1 SES Overview



LUN addressing within the Fabric can be non-sequential because it is based on the switch's `Domain_ID`. Table 1-1 shows the sample LUN mapping used with Figure 1-1.

Table 1-1 Example LUN Mapping

Domain ID	Unique LUN Value (in Hex)
5	00000000 00000000 (Note that Domain ID 5 is used for both LUN 0 and 5)
2	01020000 00000000
5	01050000 00000000
6	01060000 00000000
9	01090000 00000000
10	010A0000 00000000

Figure 1-1 shows that the switch in the lower left hand corner is assigned both LUN5 and LUN0. (LUN5 because the switch's `Domain_ID` is 5 and LUN0 because the client is physically connected to that switch.) LUN values for the first byte, shown in Table 1-1, are:

- **00**000000 00000000 - the bold characters indicate the local switch
- **0X0X**0000 00000000 - the bold characters indicate the SCSI LUN address of the other switches in the Fabric

Therefore, if there are 5 switches in the Fabric SES reports 6 LUNs, one LUN value for each switch and LUN0 for the local client connection.

Other SCSI-3 enclosures can also run SES outside the Fabric, such as JBODs, 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.

Note: It is not this guide's intent to describe the environment outside of the Fabric.

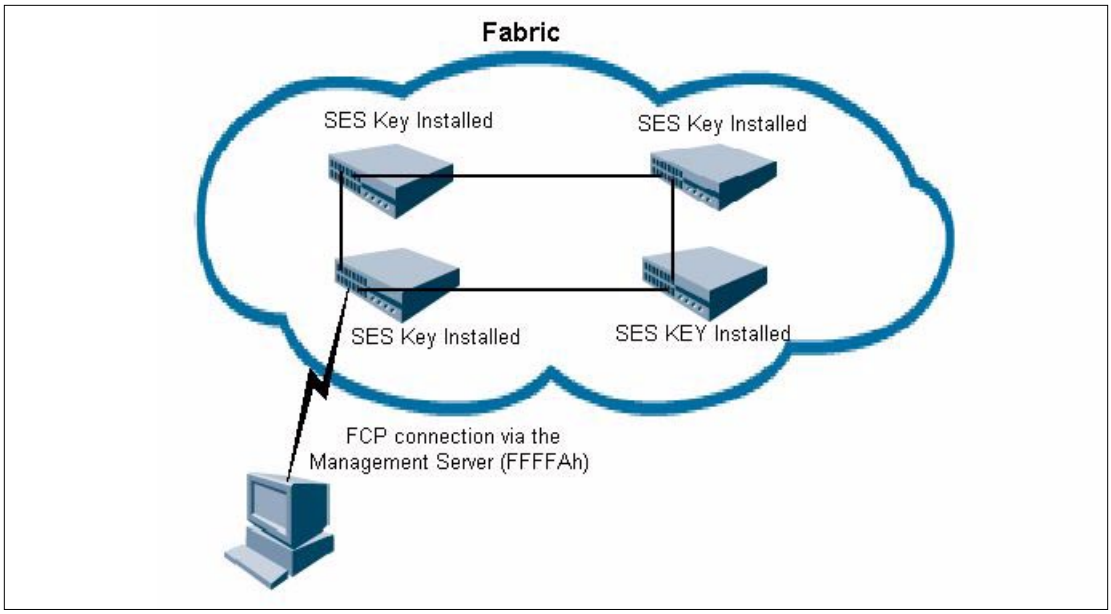
Chapter 2 SES Concepts

Introduction

This chapter uses generic terms to describe enclosure services and specific SES implementation. SES instances can be distributed inside and outside of the Fabric to any enclosure capable of supporting enclosure services through an SES device.

SES is distributed transparently throughout the Fabric, with an instance of a distributed SES Device (SESD) on each switch as shown in Figure 2-1.

Figure 2-1 SES Distribution

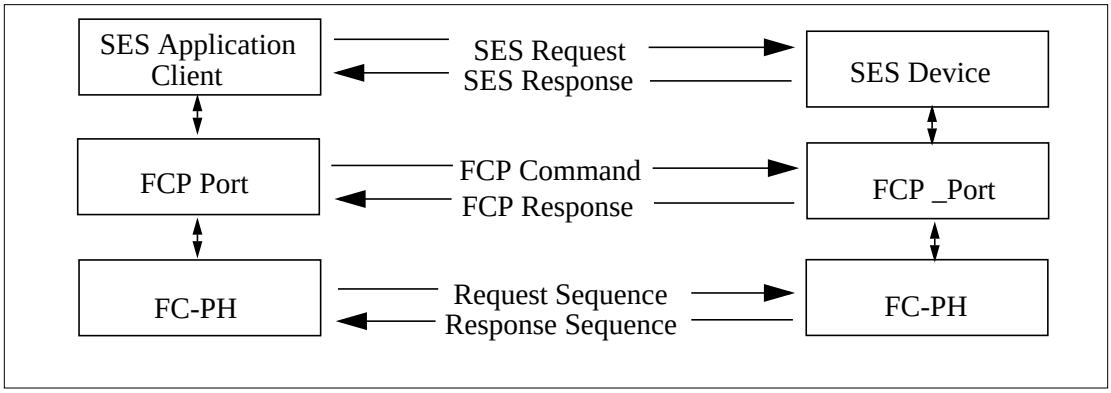


SES Functional Model

Each instance may be accessed by an SES Application Client by specifying the associated unique LUN. See Figure 2-2 for information on LUN addressing. SES implementation also provides an SES Application Client an in-band mechanism for managing any Fabric switch that it is attached to.

Figure 2-2 shows the SES functional model.

Figure 2-2 SES Functional Model



At the Fibre Channel level, each SESD is accessible through the Fibre Channel well known address, FFFFFAh (Management Server). At the SCSI-3 level, it 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.

The bus number for each switch is set to 010000b as shown in Table 2-1. The first byte of the Target/LUN is set using the Domain_ID of the switch. Bytes 2..7 are set to zero.

Table 2-1 Format of LUN recognized by SESD

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

Table 2-2 shows the LUN mapping.

Table 2-2 LUN Mapping

Domain ID		Unique LUN Value (in Hex)
0	0h	01000000 00000000
5	5h	01050000 00000000
12	Ch	010C0000 00000000
15	Eh	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 the "Report LUNs" section in Chapter 3 for more information.

Access to the Enclosure Services Process

An application client can monitor all enclosures capable of processing the enclosure services command set with SES instances distributed throughout a Storage Area Network (SAN). Enclosure services can monitor both devices inside and outside of the enclosure, such as an Uninterruptable Power Supply (UPS). However, SES pertains only to SES instances inside the Fabric.

An application client connects through Fiber Channel Protocol (FCP) using the Management Service address (`FFFFAh`) to any switch through its LUN. See Figure 1-1. The enclosure services command set uses the `RECEIVE DIAGNOSTIC RESULTS` and `SEND DIAGNOSTIC` commands to any device capable of supporting SES.

Access Through an Enclosure Services Device

The Application Client requests information from the SESD to examine status and warning information from the switch.

An Application Client through FCP calls the enclosure services process running on any switch as a LUN that has SES enabled. The SESD sets the enclosure services bit (`EncServ`) in the `INQUIRY` command to indicate that it can transport enclosure services information. See the "Inquiry" section in Chapter 3 for more information.

Indicators and Control Management

SESD is accessed through an application client that uses the `SEND DIAGNOSTIC` command to transport control information to 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 `PF` bit set to obtain enclosure status. The information returned indicates the actual enclosure state. See the "Receive Diagnostic Results" section in Chapter 3 for more information.

Note: 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.

Chapter 3 SES Commands

Introduction

This chapter contains information and examples on managing SES, including the following:

- FC-PH constructs
- FCP and SES commands
- Diagnostics pages

Note: SESD can be accessed from any Fabric switch licensed to run SES.

Constructs, Commands and Diagnostic Pages

Table 3-1 summarizes the FC-PH constructs, FCP commands, and SES commands.

Table 3-1 Constructs, Commands and Diagnostic Pages

Command	Description
FCP Information Unit	SCSI Command to be executed or a task management request.
FCP Transfer Ready Information Unit	Contains SCSI-3 data delivery service parameters.
FCP Data Information Unit	Transfers data.
FCP Response Information Unit	Contains status and sense information.
Supported Diagnostics Pages	Contains the diagnostic pages supported.
Switch Page	Contains status information about the switch, its operational state and firmware.
Sensor Table Page	Contains status information about the state of all sensors in the switch.
Fabric Page	Contains information about the Fabric, its neighbors and domain_ID.
Neighborhood Table Page	Contains information about the switch's neighbors in the Fabric.
Fibre Channel Port Table Page	Contains information about the switch's Fibre Channel ports.
Name Server Local Table Page	Contains information about the SESD.
Inquiry	Contains information about the devices and sensors in an enclosure.
Receive Diagnostics Results	Contains information returned by the SESD about an enclosure.

Table 3-1 Constructs, Commands and Diagnostic Pages (Continued)

Command	Description
Report LUNs	Contains information returned from SESD containing the LUNs attached to the SESD.
Request Sense	Used to sense information from the SESD.
Send Diagnostic	Used to configure/diagnose a logical unit.
Test Unit Ready	Used to test an LUNs operation state.
Reject	Contains information and status about a unit's failure.

FCP Constructs

Before initiating any FCP request, the Nx_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.

Note: The destination address in the PLOGI request must be set to `FFFFFAh`. The FCP Process Login (PRLI) is not required 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.*

Table 3-2 gives a brief description of the FCP Information Unit.

Table 3-2 FCP Information Unit Descriptions

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

FCP Command Information Unit

Table 3-3 shows the `FCP_CMND` Information Unit (IU) that carries either a SCSI command to be executed or a task management request to be performed. It contains the values and control fields defined in its payload.

Table 3-3 FCP_CMND IU Format

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

The FCP_LUN value format is described in Table 3-3 or the value is 0. The latter refers to the SESD on the local switch. The FCP_CNTL value is set to 1, 2 or 0 depending on whether *READ DATA*, *WRITE DATA* or neither is involved in the command. 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 IU.

Note: The SESD does not generate this optional Information Unit.

FCP Data Information Unit

The FCP_DATA Information Unit transfers the actual data.

FCP Response Information Unit

Table 3-4 shows the FCP_RSP that carries the response status and sense information associated with a particular FCP_CMND.

Table 3-4 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
n	FCP_SNS_INFO	SCSI Sense Information

Table 3-5 shows the FCP_STATUS field format.

Table 3-5 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 from the SCSI logical unit (not used)

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. See Table 3-4. This bit is not used by SESD. 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. See Table 3-3. This bit may be set by SESD.

FCP and SES Commands

Table 3-6 shows the commands supported by SESD.

Table 3-6 Supported Operation Codes

Command	Operation Code
Inquiry	12h
Receive Diagnostics Results	1Ch
Report LUNs	A0h
Request Sense	03h
Send Diagnostic	1Dh
Test Unit Ready	00h

The value of the FCP_LUN field in FCP_CMND specifies the logical unit for the request in each command. The value of FCP_DL field in FCP_CMND specifies whether there is any data parameter to be transferred to the SESD. The value should be 0 for command 1, 2, 3, 4 and 6. For command 5, the value may be 0 or the size of a diagnostic page whose page code is in the range of 80h through 85h.

Switch Diagnostics Pages

Before each SCSI command is discussed in detail, the diagnostics pages are defined in Table 3-7. They are particularly relevant to two commands: `Receive Diagnostic Results` and `Send Diagnostics`. The switch SESD supports 7 diagnostics pages.

Table 3-7 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

Table 3-8 shows the page codes 80h through 85h which are vendor specific pages and are roughly mapped from the switch Management Information Base (MIB) Definition for v1.6a firmware.

Table 3-8 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

Supported Diagnostics Pages

If requested using the `Send Diagnostic` or `Receive Diagnostic Result` command, the SESD returns the response shown in Table 3-9

Table 3-9 Page Code 0 Format – Supported Diagnostic Pages

Byte/Bit	7	6	5	4	3	2	1	0
0	Page Code = 00h							
1	Reserved							

Table 3-9 Page Code 0 Format – Supported Diagnostic Pages (Continued)

Byte/Bit	7	6	5	4	3	2	1	0
2	(MSB)							
3	Page Length = 7						(LSB)	
4	00h							
5	80h							
6	81h							
7	82h							
8	83h							
9	84h							
10	85h							

Switch Page

If requested using the `Send Diagnostic` or `Receive Diagnostic Result` command, the SESD returns the response shown in Table 3-10.

Table 3-10 Switch Page Format

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

The field `swValid` is bit mapped and indicates which subsequent fields within the page are valid. The bit position for subsequent fields starts from 0, as indicated in the Field # column of Table 3-10. For example, if the fields: `Current_Date`, `Boot_Date` and `Number_of_Sensors` are valid, it contains the hex value of 0003h.

Sensor Table Page

If requested using the *Send Diagnostic* or *Receive Diagnostic Result* command, the SESD returns the response shown in Table 3-11.

Table 3-11 Sensor Table Page Format

Byte/Bit	Field #	Access	7	6	5	4	3	2	1	0
0	na	na	Page Code = 81h							
1	na	na	Reserved							
2 .. 3	na	na	Page Length = *n* - 3							
4 .. 7	na	na	swNumEntries = *i* – specifies the number of entries received for bytes 8 -91, if the number is 5 there are 5 complete outputs for byte 8 - 91.							
8 .. 11	na	ro	swValidity[0]							
12 .. 15	0	ro	swSensorIndex[0]							
16 .. 19	1	ro	swSensorType[0]							
20 .. 23	2	ro	swSensorStatus[0]							
24 .. 27	3	ro	swSensorValue[0]							
28 .. 91	4	ro	swSensorInfo[0]							
..	... more instances of swSensorEntry (swValidity .. swSensorInfo) if applicable ...									
(*n-64*)..(*n-1*)	4	ro	swSensorInfo[*i-1*]							

Fabric Page

If requested using the `Send Diagnostic` or `Receive Diagnostic Result` command, the SESD returns the response shown in Table 3-12.

Table 3-12 Format of Fabric Page

Byte/Bit	Field #	Access	7	6	5	4	3	2	1	0
0	na	na	Page Code = 82h							
1	na	na	Reserved							
2 .. 3	na	na	Page Length = 20							
4 .. 7	na	na	swValid							
8 .. 11	0	ro	swDomainID							

Table 3-12 Format of Fabric Page (Continued)

Byte/Bit	Field #	Access	7	6	5	4	3	2	1	0
12 .. 15	1	ro	PrincipalSwitchFlag							
16 .. 19	2	ro	NumberOfImmediateNeighbor							
20 .. 23	3	ro	NumberOfFabricISL_Entries							

Neighborhood Table Page

If requested using the `Send Diagnostic` or `Receive Diagnostic Result` command, the SESD returns the response shown in Table 3-13.

Table 3-13 Neighborhood Table Page Format

Byte/Bit	Field #	Access	7	6	5	4	3	2	1	0
0	na	na	Page Code = 83h							
1	na	na	Reserved							
2 .. 3	na	na	Page Length = *n* - 3							
4 .. 7	na	na	swNumEntries = *i* – specifies the number of entries received for bytes 8. Note that each entry consists of swValidity[0] field through field 5.							
8 .. 11	na	rw	swValidity[0]							
12 .. 15	0	ro	swNbIndex[0]							
16 .. 19	1	ro	NswNbMyPort[0]							
20 .. 23	2	ro	swNbRemoteDomainID[0]							
24 .. 27	3	ro	swNbRemotePort[0]							
28 .. 31	4	ro	swNbBaudRate[0]							
32 .. 35	5	ro	swNbIslState[0]							
..	... more instances of swNbEntry (swValidity .. swNbIslState) if applicable ...									
(*n-4*)..(*n-1*)	0 - 5	ro	swNbIslState[*i-1*]							

Fibre Channel Port Table Page

If requested using the `Send Diagnostic` or `Receive Diagnostic Result` command, the SESD returns the response shown in Table 3-14.

Table 3-14 Fibre Channel Port Table Page Format

Byte/Bit	Field #	Access	7	6	5	4	3	2	1	0
0	na	na	Page Code = 84h							
1	na	na	Reserved							
2 .. 3	na	na	Page Length = *n* - 3							
4 .. 7	na	na	swNumEntries = *i* – specifies the number of entries received. **Note:** Each entry consists of swValidity[0] field through field 27.							
8 .. 11	na	rw	swValidity[0]							
12 .. 15	0	ro	swFCPortIndex[0]							
16 .. 19	1	ro	swFCPortType[0]							
20 .. 23	2	ro	swFCPortPhyStatus[0]							
24 .. 27	3	ro	swFCPortOpStatus[0]							
28 .. 31	4	rw	swFCPortAdmStatus[0]							
32 .. 35	5	ro	swFCPortTxWords[0]							
36 .. 39	6	ro	swFCPortRxWords[0]							
40 .. 43	7	ro	swFCPortTxFrames[0]							
44 .. 47	8	ro	swFCPortRxFrames[0]							
48 .. 51	9	ro	swFCPortTxC2Frames[0]							
52 .. 55	10	ro	swFCPortTxC3Frames[0]							
56 .. 59	11	ro	swFCPortRxLCs[0]							
60 .. 63	12	ro	swFCPortRxMcasts[0]							
64 .. 67	13	ro	swFCPortTooManyRdys[0]							
68 .. 71	14	ro	swFCPortNoTxCredits[0]							
72 .. 75	15	ro	swFCPortRxEncInFrs[0]							
76 .. 79	16	ro	swFCPortRxCrcs[0]							
80 .. 83	17	ro	swFCPortRxTruncs[0]							
84 .. 87	18	ro	swFCPortRxTooLongs[0]							
88 .. 91	19	ro	swFCPortRxBadEofs[0]							
92 .. 95	20	ro	swFCPortRxEncOutFrs[0]							
96 .. 99	21	ro	swFCPortRxBadOs[0]							
100 .. 103	22	ro	swFCPortRxC3Discards[0]							
104 .. 107	23	ro	swFCPortMcastTimedouts[0]							

Table 3-14 Fibre Channel Port Table Page Format (Continued)

Byte/Bit	Field #	Access	7	6	5	4	3	2	1	0
108 .. 111	24	ro	swFCPortTxMcasts[0]							
112 .. 115	25	ro	swFCPortLipIns							
116 .. 119	26	ro	swFCPortLipOuts							
120 .. 123	27	ro	swFCPortLipLastAlpa							
..	... more instances of swFCPortEntry (swValidity .. swFCPortTxMcasts) if applicable ...									
(*n-4*)..(*n-1*)	0 - 27	ro	swFCPortLipLastAlpa[*i-1*]							

Name Server Local Table Page

If requested using the `Send Diagnostic` or `Receive Diagnostic Result` command, the SESD returns the following response as shown in Table 3-15.

Table 3-15 Format of Name Server Local Table Page

Byte/Bit	Field #	Access	7	6	5	4	3	2	1	0
0	na	na	Page Code = 85h							
1	na	na	Reserved							
2 .. 3	na	na	Page Length = *n* - 3							
4 .. 7	na	na	swNumEntries = *i* – Note that each entry consists of swValidity[0] field through field 10.							
8 .. 11	na	ro	swValidity[0]							
12 .. 15	0	ro	swNsIndex[0]							
16 .. 19	1	ro	swNsPortType[0]							
20 .. 23	2	ro	swNsPortID[0]							
24 .. 31	3	ro	swNsPortName[0]							
32 .. 287	4	ro	swNsPortSymbolicName[0]							
288 .. 295	5	ro	swNsNodeName[0]							
296 .. 551	6	ro	swNsNodeSymbolicName[0]							
552 .. 559	7	ro	swNsInitialProcessInitiator[0]							
560 .. 575	8	ro	swNsClassOfServices[0]							
576 .. 579	9	ro	swNsClassOfServices[0]							
580 .. 643	10	ro	swNsFc4Types[0]							
...	... more instances of swNsLocalEntry (swValidity..swNsFc4Types) if applicable ...									
(*n-4*)..(*n-1*)	0 - 10	ro	swNsFc4Types[*i-1*]							

Inquiry

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 3-16.

Table 3-16 Inquiry Command Format

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

If the field, EVPD (Enable Vital Product Data) is set to 0 and the value of the page code is 0, the standard Inquiry Data is returned as shown in Table 3-17.

Table 3-17 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=1	Reserved=0	Response data format = 2			
4	Additional Length = 31 (1Fh)							
5	Reserved							
7	Reserved	EncServ=1Bh	VS = 0	MultiP=1Bh	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 = ”STORAGETEK”							
16. 31	Product identification = “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’s no patch. For example, v1.5a							

If the field, EVPD is set to 1, then the value of the page code may be set to one of the codes shown in Table 3-18.

Table 3-18 Page Codes

Page Code	Description
00h	Supported vital product data pages
80h	Unit Serial Number Page
83h	Device Identification Page

If the page code is set to 00h, the SESD will return codes shown in Table 3-19.

Table 3-19 SESD Return Codes for 00h

Byte/Bit	7	6	5	4	3	2	1	0
0	Peripheral qualifier = 0			Peripheral Device Type = 0Dh				
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 will return codes shown in Table 3-20.

Table 3-20 SESD Return Codes for 80h

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* E.g. “10:00:00:60:69:00:01:b4 ”							
...								
27								

If the page code is set to 83h, the SESD will return codes shown in Table 3-21.

Table 3-21 SESD Return Codes for 83h

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) See Table 3-17.							
...								
35								

Receive Diagnostic Results

An SES Application Client sends a `Receive Diagnostic Results` command to return diagnostic or management data. The `FCP_CDB` format is shown in Table 3-22.

Table 3-22 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 zero 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 the "Switch Diagnostics Pages" section.

Report LUNs

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 `CDB` format is shown in Table 3-23.

Table 3-23 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 SESD reports the LUNs of associated switches with the format shown in Table 3-24.

Table 3-24 Reported LUNs Format

Byte/Bit	7	6	5	4	3	2	1	0
0 .. 3	LUN list length (*n*-7)							
4 .. 7	Reserved							
8 .. 15	LUN							
..	..							
(*n*-7)..*n*	LUN							

Request Sense

An SES Application Client sends a `Request Sense` command to obtain sense data. The `CDB` format is shown in Table 3-25.

Table 3-25 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`.

Send Diagnostic

A SES Application Client can use a `Send Diagnostic` command to configure/diagnose a logical unit. After the command completion, the SES Application Client sends a `Receive Diagnostic Results` command. See Table 3-22. The `FCP_CDB` format is shown in Table 3-26.

Table 3-26 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							
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. At present, the SESD only supports the vendor-specific page structures as defined in the "Switch Diagnostics Pages" section.

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 shall be transferred from the SES Application client to the SESD.

Test Unit Ready

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 3-27.

Table 3-27 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` and `CHECK CONDITION` and a sense key of `NO SENSE` and an additional sense code of `NO ADDITIONAL SENSE INFORMATION`.

Reject

The SESD issues a `Reject` command to set status to `Check Condition` and the appropriate values for the Sense Key (SK) field. Additional Sense Code (ASC) and Additional Sense Code Qualifier (ASCQ) values are as shown in Table 3-28.

Table 3-28 Reject Command Format

SK	ASC	ASCQ	Explanation
2	04h	0	Logical Unit not ready
2	35h	0	Enclosure Service failed
2	35h	2	Enclosure Service unavailable (memory allocation problem)
5	1Ah	0	Parameter List length error (too small or too big)
5	20	0	Invalid command operation code
5	20	0	Logical Unit not supported (invalid LUN value in FCP_CDB)

Chapter 4 Troubleshooting

Introduction

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.

The following message is generated:

Probable cause: Invalid Field
Action: See the "Reject" section in Chapter 3 for more information.

CHECK CONDITION

`CHECK CONIDITION` 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.

Invalid Field Errors

`ILLEGAL REQUEST` is generated from any invalid fields in the CDB, from parameters of a `SEND DIAGNOSTIC` command and from the CDB of a `RECEIVE DIAGNOSTIC RESULTS` command. The sense code identifies the location of the invalid fields, parameter or CDB.

The following message is generated:

Probable cause: Invalid Field
Action: See the "Reject" section in Chapter 3 for more information.

Appendix A Glossary

Application Client: The source object of the SCSI commands and destination for the command responses.

Byte: A group of 8 bits.

Command Descriptor Block: The structure of up to 16 bytes in length used to communicate commands from the application client to a device server.

Critical Condition: An enclosure condition where one or more elements inside the enclosure have failed or are outside of operational parameters. The element failure makes normal operation of at least some elements in the enclosure impossible, although some of the elements inside the enclosure may be able to continue normal operation.

Device: A mechanical, electrical or electronic part in an enclosure.

Device Server: A logical unit object that executes SCSI tasks.

Device Service Request: A request from an application client of SCSI commands to a device server.

Device Slot: An insertion position in an enclosure for SCSI devices. The position provides power, signal and control connections for the SCSI device. The position may also provide protection, automatic insertion, device status LEDs, locking capability, and additional features to manage SCSI devices in the enclosure.

Device Type: The device type or device model implemented by the device server.

Domain_ID: The domain number uniquely identifies the switch in a Fabric. Normally the switch domain ID is automatically assigned by the principal switch and may be any value between 0 and 31. This number may also be assigned manually.

Enclosure: The box, rack or box set that provide power, mechanical protection, external interfaces and cooling for the SCSI device(s).

Enclosure Services: The services that establishes indictors and controls for the proper operation and maintenance of devices within the enclosure.

Enclosure Services Device: A SCSI device that monitors and controls enclosure services. The switches imbedded port.

Initiator: A SCSI device containing application clients that originate device service requests to be processed by the device servers.

Logical Unit: A target-resident entity that implements a device model and executes SCSI commands originated by an application client.

Logical Unit Number: A device or element known by an enclosure that identifies it to the application client.

Redundancy: The presence in an enclosure of one or more elements capable of automatically taking over the functions of a failed element.

SCSI: Small Computer Systems Interface.

SCSI Device: A device that is connected to a service delivery subsystem and supports the SCSI application protocol.

Target: A SCSI device that receives SCSI commands and directs such commands to one or more logical units for execution.

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