

To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
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Subject: 04-374r0 SES-2 Define a SAS Expander element

Revision history

Revision 0 (7 November 2004) First revision

Related documents

ses2r09 - SCSI Enclosure Services - 2 revision 9

sas1r06 - Serial Attached SCSI - 1.1 revision 6

Overview

SAS expanders are not SCSI devices, although some might contain an embedded SCSI target port to provide access to an SES logical unit. This means they are not intended to be represented as Device elements or Array Device elements in SES. This leaves software unable to determine the enclosure in which each expander device (discovered with the SMP protocol) is located. If it determines that all the devices attached to an expander are in a certain enclosure, then it might assume that expander is also in that enclosure; however, that is not guaranteed (the expander could be outside in a separate box). The expander's embedded SES logical unit could be listed as a Device element (leading to its enclosure's identification) but not all expanders include SES logical units.

To determine which expanders are located in which enclosures, a new SAS Expander element is proposed. The Device Element Status diagnostic page is expanded to return the phy-by-phy SAS addresses (and other information) of the expander device represented by each SAS Expander element (in addition to returning that information about SAS devices represented by Device and Array Device elements).

In a dual-domain enclosure, the enclosure services process may or may not have access to information about expanders in the other domain. The RELATIVE ENCLOSURE SERVICE PROCESS IDENTIFIER and NUMBER OF ENCLOSURE SERVICE PROCESSES fields in the Configuration diagnostic page are the clues to decipher this and map the topology discovered via SMP to the information returned by the enclosure services process.

Suggested changes

6.1.13 Device Element Status diagnostic page

6.1.13.1 Device Element Status diagnostic page overview

The optional Device Element Status diagnostic page provides additional information about Device elements [and](#), Array Device elements, [and SAS Expander elements](#).

The Device Element Status diagnostic page returns a device information descriptor for each of the Device elements [and](#), Array Device elements, [and SAS Expander elements](#) that have been allowed for by the NUMBER OF POSSIBLE ELEMENTS field [in the correspondign type descriptor header](#) in the Configuration diagnostic page. The device information descriptors shall be in the same order as the ELEMENT STATUS fields in the Enclosure Status diagnostic page.

The Device Element Status diagnostic page is read by the RECEIVE DIAGNOSTIC RESULTS command with a PCV bit set to one and a PAGE CODE field set to 0Ah. If the parameter list for a SEND DIAGNOSTIC command contains a PAGE CODE field set to 0Ah, the command shall be treated as having an invalid field error (see 4.5).

Table 1 describes the Device Element Status diagnostic page.

Table 1 — Device Element Status diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (0Ah)							
1	Reserved							
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Device Element Status descriptor list								
8	Zero or more Device Element Status descriptors (see table 2)							
n								

The PAGE LENGTH field indicates the length in bytes of the diagnostic parameters that follow.

The format of the Device Element Status descriptor is shown in table 2.

Table 2 — Device Element Status descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved				PROTOCOL IDENTIFIER			
1	DEVICE ELEMENT STATUS DESCRIPTOR LENGTH (n - 1)							
2	Protocol-specific information							
n								

The PROTOCOL IDENTIFIER field is defined in SPC-3 and identifies the protocol of the device being described by the Device Element Status descriptor.

The DEVICE ELEMENT STATUS DESCRIPTOR LENGTH field indicates the length in bytes of the protocol-specific information.

6.1.13.2 Fibre Channel Device Element Status descriptor

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6.1.13.3 Serial Attached SCSI Device Element Status descriptor

Table 3 describes the Device Element Status descriptor for Serial Attached SCSI devices.

Table 3 — Serial Attached SCSI Device Element Status descriptor

Byte/Bit	7	6	5	4	3	2	1	0
0	Reserved				PROTOCOL IDENTIFIER (6h)			
1	DEVICE ELEMENT STATUS DESCRIPTOR LENGTH (n - 1)							
2	NUMBER OF PHY DESCRIPTORS							
3	Reserved							NOT ALL PHYS
One phy descriptor for each phy								
4	Reserved	DEVICE TYPE			Reserved			
5	Reserved							
6	Reserved				SSP INITIATOR PORT	STP INITIATOR PORT	SMP INITIATOR PORT	Reserved
7	Reserved				SSP TARGET PORT	STP TARGET PORT	SMP TARGET PORT	Reserved
8	ATTACHED SAS ADDRESS							
15	SAS ADDRESS							
16	SAS ADDRESS							
23	SAS ADDRESS							
24	PHY IDENTIFIER							
25	Reserved							
31	Reserved							
32 to n	...							

The PROTOCOL IDENTIFIER field of 6h indicates the descriptor is describing [a Serial Attached SCSI \(SAS\) ports device \(for Device elements and Array Device elements\)](#), or an [expander device \(for SAS Expander Device elements\)](#).

The DEVICE ELEMENT STATUS DESCRIPTOR LENGTH field indicates the length in bytes of the rest of the Device Element Status descriptor.

The NUMBER OF PHY DESCRIPTORS field indicates how many phy descriptors follow.

A NOT ALL PHYS bit set to one indicates that all phys in the SAS device [or expander device](#) are not described. A NOT ALL PHYS bit set to zero indicates that all phys in the SAS device [or expander device](#) are described.

NOTE 1 [The NOT ALL PHYS bit may be set to one for SAS devices with multiple ports, where the enclosure services process only has access to information about the phys in one of the ports \(e.g., in the same SAS domain as the enclosure services process\).](#)

The DEVICE TYPE field, SSP INITIATOR PORT bit, STP INITIATOR PORT bit, SMP INITIATOR PORT bit, SSP TARGET PORT bit, STP TARGET PORT bit, SMP TARGET PORT bit, SAS ADDRESS field, and PHY IDENTIFIER field contain the values of the fields in the IDENTIFY address frame transmitted by the phy (see SAS).

NOTE 2 - The phy transmits these fields in the IDENTIFY address frame to the attached phy (usually an [expander phy in an expander device](#)). The enclosure [services](#) process may retrieve the values from the attached phy (e.g., an enclosure process built into an expander device has direct access [to the values received by the expander phy](#)).

The ATTACHED SAS ADDRESS field contains the SAS address of the attached phy (e.g., [for Device Elements and Array Device elements, the SAS address of](#) the expander phy [to which the SAS device is attached](#))(see SAS).

NOTE 3 - All the fields are from the perspective of the SAS device associated with the Device element (e.g., the disk drive), not the device (e.g., the expander device) which receives the IDENTIFY address frame. The ATTACHED SAS ADDRESS fields [for multiple phys in the same SAS device](#) indicate if [the](#) SAS device is attached to more than one SAS domain.

7.1 Element definitions overview

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Table 4 lists the elements and their ELEMENT TYPE codes, and indicates which elements accept the DISABLE bit (see 7.2.2) in their control field, and which elements contain a value subject to comparison with a threshold.

Table 4 — Element type codes

Type code	Type of element	DISABLE bit reference	Threshold	Reference
00h	Unspecified	not defined	none	7.3.1
01h	Device	not defined	none	7.3.2
02h	Power Supply	not defined	none	7.3.4
03h	Cooling	not defined	none	7.3.5
04h	Temperature Sensor	7.3.6	temperature	7.3.6
05h	Door Lock	not defined	none	7.3.7
06h	Audible Alarm	not defined	none	7.3.8
07h	Enclosure Services Controller Electronics	not defined	none	7.3.9
08h	SCC Controller Electronics	not defined	none	0.0.1
09h	Nonvolatile Cache	not defined	none	7.3.11
0Ah	Invalid Operation Reason	not defined	none	7.3.12
0Bh	Uninterruptible Power Supply	not defined	battery status	7.3.13
0Ch	Display	not defined	none	7.3.14
0Dh	Key Pad Entry	not defined	none	7.3.15
0Eh	Enclosure	not defined	none	7.3.16
0Fh	SCSI Port/Transceiver	not defined	none	7.3.17
10h	Language	not defined	none	7.3.18
11h	Communication Port	not defined	none	7.3.19
12h	Voltage Sensor	7.3.20	% voltage	7.3.20
13h	Current Sensor	7.3.21	% current	7.3.21
14h	SCSI Target Port	not defined	none	7.3.22
15h	SCSI Initiator Port	not defined	none	7.3.23
16h	Simple Subenclosure	not defined	none	7.3.24
17h	Array Device	not defined	none	7.3.3
18h	SAS Expander	not defined	none	7.3.xx
18h 19h -7Fh	Reserved	reserved	reserved	
80h-FFh	Vendor-specific	vendor specific	vendor specific	

0.0.1 SAS Expander element

The format of the control field for a SAS Expander element is defined in table 5.

Table 5 — SAS Expander element for control type diagnostic pages

Byte\Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST IDENT	Reserved						
2	Reserved							
3	Reserved							

The COMMON CONTROL field is specified in 7.2.2.

The RQST IDENT (request identify) bit is set to request that the element be identified by a visual indication. When the RQST IDENT bit is set to zero, the visual indication is not present.

The format of the status field for a SAS Expander element is defined in table 6.

Table 6 — SAS Expander element for status type diagnostic pages

Byte\Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
1	IDENT	Reserved						
2	Reserved							
3	Reserved							

The COMMON STATUS field is specified in 7.2.3.

The IDENT (identify) bit is set to one to indicate that the RQST IDENT control bit has been set and that the element is providing a visual indication of its location. The IDENT bit is set to zero when the RQST IDENT control bit is set to zero or not implemented.