

## 9 March 2007 07-098r0 SES-2 Additional Element Status for Enclosure Services Controller Electronics

To: T10 Technical Committee  
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### **Revision history**

Revision 0 (9 March 2007) First revision

### **Related documents**

ses2r15 - SCSI Enclosure Services - 2 (SES-2) revision 15  
07-087 - SAS-2 SES-2 Enclosure Connector Information (Brad Besmer, LSI Logic)  
07-092 - SES-2 Additional Element Status Bay Number for Fibre Channel (Rob Elliott, HP)

### **Overview**

In an enclosure, a standalone enclosure services process is represented by the Enclosure Services Controller Electronics element and is accessible by its own SCSI target port. This SCSI target port could be represented by a SCSI Target Port element, but that element provides no hint that the SCSI target port leads to enclosure services rather than something like RAID controller logic.

In SAS, the enclosure services process is often part of a SAS expander (which is represented as a SAS Expander element). The port through which it is accessed is a virtual phy inside the SAS expander.

For SAS, Additional Element Status is defined for the SCSI Target Port element indicating information about the element (its SAS address) and the other to which it is attached (SAS Connectors, SAS Expanders).

The same information should be defined for Fibre Channel.

To isolate SCSI target ports that are unrelated to enclosure services, for both SAS and Fibre Channel, the Enclosure Services Controller Electronics element should also have Additional Element Status defined to report the same information that is provided for a SCSI Target Port.

This proposal:

- a) adds Additional Element Status descriptors for SCSI Initiator Port and SCSI Target Port elements for FC
- b) adds Additional Element Status descriptors for Enclosure Services Controller Electronics elements for both FC and SAS

### **Suggested changes to SES-2 (as modified by 07-092)**

#### **6.1.13 Additional Element Status diagnostic page**

##### **6.1.13.1 Additional Element Status diagnostic page overview**

The optional Additional Element Status diagnostic page provides additional information about:

- a) Device elements (see 7.3.2);<sub>i</sub>
- b) Array Device elements (see 7.3.3);<sub>i</sub>
- c) SAS Expander elements (see 7.3.25);<sub>i</sub>
- d) SCSI Initiator Port elements (see 7.3.23) containing SAS phys;<sub>i</sub> and
- e) SCSI Target Port elements (see 7.3.22) containing SAS phys;<sub>i</sub> and
- f) [Enclosure Services Controller Electronics elements \(see 7.3.25\)](#).

The Additional Element Status diagnostic page returns an Additional Element Status descriptor for each of the [following elements](#) that have been allowed for by the NUMBER OF POSSIBLE ELEMENTS field in the corresponding type descriptor header in the Configuration diagnostic page (see 6.1.2):

- a) Device elements;<sub>i</sub>
- b) Array Device elements;<sub>i</sub> and
- c) SAS Expander elements.

It may include Additional Element Status descriptors for:

- a) SCSI Initiator Port elements [containing SAS phys;](#) and
- b) SCSI Target Port elements [containing SAS phys; and](#)
- c) [Enclosure Services Controller Electronics elements;](#)

The Additional Element Status descriptors shall be in the same order as the ELEMENT STATUS fields in the Enclosure Status diagnostic page (see 6.1.4).

The Additional 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 defines the Additional Element Status diagnostic page.

**Table 1 — Additional 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								
Additional Element Status descriptor list								
8	Additional Element Status descriptor (first)(see table 2 and table 3)							
...								
n	Additional Element Status descriptor (last)(see table 2 and table 3)							

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

The format of the Additional Element Status descriptor with the EIP bit set to one is shown in table 2.

**Table 2 — Additional Element Status descriptor with the EIP bit set to one**

Byte\Bit	7	6	5	4	3	2	1	0
0	INVALID	Reserved		EIP (1b)	PROTOCOL IDENTIFIER			
1	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (x - 1)							
2	Reserved							
3	ELEMENT INDEX							
4	Protocol-specific information							
x								

The format of the Additional Element Status descriptor with the EIP bit set to zero is shown in table 3.

**Table 3 — Additional Element Status descriptor with the EIP bit set to zero**

Byte\Bit	7	6	5	4	3	2	1	0
0	INVALID	Reserved		EIP (0b)	PROTOCOL IDENTIFIER			
1	ADDITIONAL ELEMENT STATUS DESCRIPTOR LENGTH (x - 1)							
2	Protocol-specific information							
x								

An INVALID bit set to one indicates that the contents of the protocol-specific information are invalid. An INVALID bit set to zero indicates that the contents of the protocol-specific information are valid. The enclosure services process may set the INVALID bit to one when the ELEMENT STATUS CODE field in the element status for the associated element (see table 60 in 7.2.3) is set to 5h (i.e., not installed), 6h (i.e., unknown), or 7h (not available).

An EIP (element index present) bit set to one indicates that the Additional Element Status descriptor has the format described in table 2. An EIP bit set to zero indicates that the Additional Element Status descriptor has the format described in table 3 (i.e., does not include the two extra bytes including the ELEMENT INDEX field that are defined in table 2). The EIP bit should be set to one.

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

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

The ELEMENT INDEX field indicates the index of the element that this descriptor is describing. The index is based on the position of the ELEMENT STATUS field in the Enclosure Status diagnostic pages (see 6.1.4) relative to all other ELEMENT STATUS fields. It does not include the OVERALL STATUS fields.

The protocol-specific information bytes contain information defined based on the PROTOCOL IDENTIFIER field. If the PROTOCOL IDENTIFIER field is set to 0h (i.e., Fibre Channel), the protocol-specific information is defined in table 27 (see 6.1.13.2). If the PROTOCOL IDENTIFIER field is set to 6h (i.e., SAS), the protocol-specific information is defined in table 30 (see 6.1.13.3).

**6.1.13.2 Additional Element Status descriptor protocol-specific information for Fibre Channel**

The Additional Element Status descriptor is used to describe a Device element ~~or~~ an Array Device element that may contain a Fibre Channel device [or a SCSI Initiator Port, SCSI Target Port, or Enclosure Services Controller Electronics element that is a Fibre Channel device.](#)

Table 27 defines the Additional Element Status descriptor protocol-specific information for Fibre Channel devices (see FCP-3) with the EIP bit set to one.

**Table 27 — Additional Element Status descriptor protocol-specific information for ~~Device and Array Device elements~~ for Fibre Channel with the EIP bit set to one**

Byte\Bit	7	6	5	4	3	2	1	0
0	NUMBER OF PORTS							
1	Reserved							
2	BAY NUMBER							
3	(MSB)							
4	NODE NAME							
11	(LSB)							
Port descriptor list								
12	Port descriptor (first)(see table 29)							
27	...							
y - 15	Port descriptor (last)(see table 29)							
y								

Table 28 defines the Additional Element Status descriptor protocol-specific information for Fibre Channel devices (see FCP-3) with the EIP bit set to zero.

Fibre Channel device. This format does not include the two extra bytes that are in table 27

**Table 28 — Additional Element Status descriptor protocol-specific information for ~~Device and Array Device elements~~ for Fibre Channel with the EIP bit set to zero**

Byte\Bit	7	6	5	4	3	2	1	0
0	NUMBER OF PORTS							
1	Reserved							
2	(MSB)							
9	NODE NAME							
	(LSB)							
Port descriptor list								
10	Port descriptor (first)(see table 29)							
25	...							
y - 15	Port descriptor (last)(see table 29)							
y								

The NUMBER OF PORTS field indicates how many Fibre Channel ports are in the port descriptor list. There is one port descriptor for each port.

The BAY NUMBER field, if any, indicates the number of the bay represented by the ~~Device element or Array Device element~~.

The NODE NAME field contains the node Name\_Identifier of the corresponding Fibre Channel node.

Table 29 defines the port descriptor.

**Table 29 — Port descriptor**

Byte\Bit	7	6	5	4	3	2	1	0
0	PORT LOOP POSITION							
1	Reserved							
3								
4	PORT REQUESTED HARD ADDRESS							
5	(MSB)	N_PORT IDENTIFIER						(LSB)
7								
8	(MSB)	N_PORT_NAME						(LSB)
15								

The PORT LOOP POSITION field indicates the position of the corresponding Fibre Channel port on a Fibre Channel Arbitrated Loop.

The PORT REQUESTED HARD ADDRESS field contains the Fibre Channel Arbitrated Loop requested hard address of the corresponding Fibre Channel port.

The N\_PORT IDENTIFIER field contains the address identifier of the corresponding Fibre Channel port. Applications may compare the lower 8 bits of this field with the PORT REQUESTED HARD ADDRESS field to determine whether the port was assigned its requested address.

The N\_PORT\_NAME field contains the Name\_Identifier of the corresponding Fibre Channel port.

**6.1.13.3 Additional Element Status descriptor protocol-specific information for SAS**

**6.1.13.3.1 Additional Element Status descriptor protocol-specific information for SAS overview**

Table 30 defines the Additional Element Status descriptor for SAS devices and expander devices (see SAS-1.1). This is used to describe a Device element or an Array Device element that may contain a SAS device or a SATA device, describe a SAS Expander element, or describe a SCSI Initiator Port element or SCSI Target Port element [or an Enclosure Services Controller Electronics element](#) containing SAS phys.

**Table 30 — Additional Element Status descriptor protocol-specific information for SAS**

Byte\Bit	7	6	5	4	3	2	1	0
0	Descriptor-type specific							
1	DESCRIPTOR TYPE	Descriptor-type specific						
2	Descriptor-type specific							
y	Descriptor-type specific							

The DESCRIPTOR TYPE field is defined in table 31.

**Table 31 — DESCRIPTOR TYPE field**

Code	Description
00b	<a href="#">Used for</a> Device element <del>or</del> , Array Device element (see 6.1.13.3.2)
01b	<a href="#">Used for:</a> a) SAS Expander element (see 6.1.13.3.3); b) SCSI Initiator Port element (see 6.1.13.3.4); c) SCSI Target Port element (see 6.1.13.3.4); <a href="#">and</a> d) <a href="#">Enclosure Services Controller Electronics element (see 6.1.13.3.4)</a>
All others	Reserved

**6.1.13.3.2 Additional Element Status descriptor protocol-specific information for Device and Array Device elements for SAS**

Table 32 defines the Additional Element Status descriptor protocol-specific information for Device elements ~~and~~, Array Device elements with the EIP bit (see 6.1.13.1) set to one.

**Table 32 — Additional Element Status descriptor protocol-specific information for Device and Array Device elements for SAS with the EIP bit set to one**

Byte\Bit	7	6	5	4	3	2	1	0
0	NUMBER OF PHY DESCRIPTORS							
1	DESCRIPTOR TYPE (00b)		Reserved					NOT ALL PHYS
2	Reserved							
3	BAY NUMBER							
Phy descriptor list								
4	Phy descriptor (first)(see table 34)							
31	...							
z - 27	Phy descriptor (last)(see table 34)							
z								

Table 33 defines the Additional Element Status descriptor protocol-specific information for Device elements and Array Device elements with the EIP bit (see 6.1.13.1) set to zero. This format does not include the two extra bytes including the BAY NUMBER field that are in table 32.

**Table 33 — Additional Element Status descriptor protocol-specific information for Device and Array Device elements for SAS with the EIP bit set to zero**

Byte\Bit	7	6	5	4	3	2	1	0
0	NUMBER OF PHY DESCRIPTORS							
1	DESCRIPTOR TYPE (00b)		Reserved					NOT ALL PHYS
Phy descriptor list								
2	Phy descriptor (first)(see table 34)							
29	...							
z - 27	Phy descriptor (last)(see table 34)							
z								

The DESCRIPTOR TYPE field is set to 00b.

The NUMBER OF PHY DESCRIPTORS field indicates how many phy descriptors are in the phy descriptor list.

A NOT ALL PHYS bit set to one indicates that all phys in the SAS device or SATA device may or may not be described. A NOT ALL PHYS bit set to zero indicates that all phys in the SAS device or SATA 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 BAY NUMBER field, if any, indicates the number of the bay represented by the ~~Device element or Array Device~~ element.

Table 34 defines the phy descriptor.

**Table 34 — Phy descriptor**

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved	DEVICE TYPE			Reserved			
1	Reserved							
2	Reserved				SSP INITIATOR PORT	STP INITIATOR PORT	SMP INITIATOR PORT	Reserved
3	SATA PORT SELECTOR	Reserved			SSP TARGET PORT	STP TARGET PORT	SMP TARGET PORT	SATA DEVICE
4	_____							
	ATTACHED SAS ADDRESS							
11	_____							
12	_____							
	SAS ADDRESS							
19	_____							
20	PHY IDENTIFIER							
21	_____							
	Reserved							
27	_____							

If the device currently associated with the ~~Device element or Array Device~~ element is a SAS device:

- a) 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;
- b) the SATA PORT SELECTOR bit shall be set to zero; and
- c) the SATA DEVICE bit shall be set to zero.

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).

NOTE 3 - A virtual phy (e.g., for an Enclosure Services Controller Electronics element representing an enclosure services process contained inside an expander device) does not actually transmit an IDENTIFY address frame.

If the device currently associated with the ~~Device element or Array Device~~ element is a SATA device:

- a) the DEVICE TYPE field shall be set to 000b;
- b) the SSP INITIATOR PORT bit shall be set to zero;
- c) the STP INITIATOR PORT bit shall be set to zero;
- d) the SMP INITIATOR PORT bit shall be set to zero;
- e) the SSP TARGET PORT bit shall be set to zero;
- f) the STP TARGET PORT bit shall be set to zero;
- g) the SMP TARGET PORT bit shall be set to zero;
- h) the SATA PORT SELECTOR bit shall be set to one if the SATA device is attached to a SATA port selector and the SATA PORT SELECTOR bit shall be set to zero if it is not;
- i) the SATA DEVICE bit shall be set to one;
- j) the SAS ADDRESS field shall be set to the SAS address of the STP target port of the STP/SATA bridge, and
- k) the PHY IDENTIFIER field shall be set to 00h.

The ATTACHED SAS ADDRESS field contains the SAS address of the attached phy (e.g., the SAS address of the expander phy to which the SAS device or SATA device is attached).

NOTE 4 - All the fields are from the perspective of the SAS device or SATA device associated with the ~~Device element or Array 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 or SATA device differ if it is attached to more than one SAS domain.

NOTE 5 - A SATA device may be attached to more than one SAS domain using a SATA port selector.

**6.1.13.3.3 Additional Element Status descriptor protocol-specific information for SAS Expander elements**

Table 35 defines the Additional Element Status descriptor protocol-specific information for SAS Expander elements (see SAS-1.1).

**Table 35 — Additional Element Status descriptor protocol-specific information for SAS Expander elements**

Byte\Bit	7	6	5	4	3	2	1	0
0	NUMBER OF EXPANDER PHY DESCRIPTORS							
1	DESCRIPTOR TYPE (01b)		Reserved					
2	Reserved							
3	Reserved							
4	Reserved							
11	SAS ADDRESS							
Expander phy descriptor list								
12	Expander phy descriptor (first)(see table 36)							
13	Expander phy descriptor (first)(see table 36)							
	...							
y - 1	Expander phy descriptor (last)(see table 36)							
y	Expander phy descriptor (last)(see table 36)							

The DESCRIPTOR TYPE field is set to 01b.

The NUMBER OF EXPANDER PHY DESCRIPTORS field indicates how many expander phy descriptors are in the expander phy descriptor list.

The SAS ADDRESS field indicates the SAS address of the expander device.

Table 36 defines the expander phy descriptor.

**Table 36 — Expander phy descriptor**

Byte\Bit	7	6	5	4	3	2	1	0
0	CONNECTOR ELEMENT INDEX							
1	OTHER ELEMENT INDEX							

The CONNECTOR ELEMENT INDEX field indicates the index of a SAS Connector element (see 7.3.26) to which the expander phy is attached. If the expander phy is not attached to a connector represented by a SAS Connector element, this field shall be set to FFh.

The OTHER ELEMENT INDEX field indicates the index of a Device element (see 7.3.2), Array Device element (see 7.3.3), SAS Expander element (see 7.3.25), SCSI Initiator Port element (see 7.3.23), ~~or~~ SCSI Target Port element (see 7.3.22) or Enclosure Services Controller Electronics element (see 7.3.xx) to which the expander phy is attached. If the expander phy is not attached to one of those elements, this field shall be set to FFh.

**6.1.13.3.4 Additional Element Status descriptor protocol-specific information for SCSI Initiator Port and SCSI Target Port, and Enclosure Services Controller Electronics elements for SAS**

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Editor's Note 1: The difference between this and the SAS Expander descriptor is that the SAS address is not provided here. The enclosure services process might not know the SAS address of an arbitrary initiator port or target port in the system. It does likely know the SAS address of an expander.

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Table 37 defines the Additional Element Status descriptor protocol-specific information for SCSI Initiator Port ~~and~~ SCSI Target Port elements, and Enclosure Services Controller Electronics elements representing SCSI initiator ports and SCSI target ports with SAS phys.

**Table 37 — Additional Element Status descriptor protocol-specific information for SCSI Initiator Port ~~and~~ SCSI Target Port, and Enclosure Services Controller Electronics elements for SAS**

Byte\Bit	7	6	5	4	3	2	1	0
0	NUMBER OF PHY DESCRIPTORS							
1	DESCRIPTOR TYPE (01b)		Reserved					
2	Reserved							
3	Reserved							
Phy descriptor list								
4	Phy descriptor (first)(see table 38)							
15	...							
y - 1	Phy descriptor (last)(see table 38)							
y								

The DESCRIPTOR TYPE field is set to 01b.

The NUMBER OF PHY DESCRIPTORS field indicates how many phy descriptors are in the phy descriptor list.

Table 38 defines the phy descriptor.

**Table 38 — Phy descriptor**

Byte\Bit	7	6	5	4	3	2	1	0
0	PHY IDENTIFIER							
1	Reserved							
2	CONNECTOR ELEMENT INDEX							
3	OTHER ELEMENT INDEX							
4	SAS ADDRESS							
11								

The PHY IDENTIFIER field indicates the phy identifier (see SAS-1.1) of the phy.

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The CONNECTOR ELEMENT INDEX field indicates the index of a SAS Connector element (see 7.3.26) to which the phy is attached. If the phy is not attached to a connector represented by a SAS Connector element, this field shall be set to FFh.

The OTHER ELEMENT INDEX field indicates the index of a Device element (see 7.3.2), Array Device element (see 7.3.3), [Enclosure Services Controller Electronics element \(see 7.3.xx\)](#), SAS Expander element (see 7.3.25), SCSI Initiator Port element (see 7.3.23), or SCSI Target Port element (see 7.3.22) to which the phy is attached. If the phy is not attached to one of those elements, this field shall be set to FFh.

The SAS ADDRESS field indicates the SAS address of the phy. If the enclosure services process does not know the SAS address (e.g., the enclosure services process is in an expander on the back-side of an SCC controller, and this is a phy in a SCSI target port on the front-side of the SCC controller), this field shall be set to zero.