

To: T10 Technical Committee  
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Subject: 07-096r1 SES-2 Overall element handling

### **Revision history**

Revision 0 (7 March 2007) First revision  
Revision 1 (22 March 2007) Incorporated comments from March 2007 CAP WG

### **Related documents**

ses2r15 - SCSI Enclosure Services - 2 (SES-2) revision 15

### **Overview**

The enclosure services process categorizes elements by type descriptor header. In the Enclosure Control diagnostic page, each type descriptor header correlates to one OVERALL CONTROL field plus a list of individual ELEMENT CONTROL fields. In the Enclosure Status diagnostic page, they are called the OVERALL STATUS field and the ELEMENT STATUS fields. For example, a fan module containing two fans can be given its own type descriptor header, so the OVERALL CONTROL/STATUS field represents the module itself and two ELEMENT CONTROL/STATUS fields represent the fans.

SES-2 currently prohibits the enclosure services process from setting the ELEMENT STATUS CODE field to a value other than 0h Unsupported in an OVERALL STATUS field (non-zero values indicate that the element is OK, Critical, Noncritical, Unrecoverable, Not Installed, Unknown, or Not Available). It would be useful to report non-zero values when they apply to the collection of elements corresponding to that type descriptor header.

Also, the rule that certain values of the ELEMENT STATUS CODE field are mandatory should be removed. Currently, 5h (i.e., not installed) and 1h (i.e., OK) are mandatory. If an element represents something that is soldered down, the enclosure services process will never report 5h. If the overall status is used rather than the element status, then 1h will never be returned.

### **Suggested changes to SES-2**

#### **6.1.3 Enclosure Control diagnostic page**

The Enclosure Control diagnostic page provides control information to each of the elements identified by the Configuration diagnostic page. In addition, a separate control field is provided for the collection of elements of the same type as defined by each type descriptor header. The data allows the application client to control many functions within the addressed enclosure.

The Enclosure Control diagnostic page contains an OVERALL CONTROL field for each element type described by a type descriptor header in the Configuration diagnostic page (see 6.1.2), and an ELEMENT CONTROL field for each of the elements of that type that have been allowed for by the NUMBER OF POSSIBLE ELEMENTS field of the Configuration diagnostic page. The list of fields shall be in the order defined by the Configuration diagnostic page. The relationship between the order of the ELEMENT CONTROL fields and the physical location of the element within the enclosure is vendor specific. The relationship may be described by the descriptor fields of the Configuration diagnostic page, by the descriptors in the Element Descriptor diagnostic page (see 6.1.10), or by external references. The relationship shall not change unless the generation code is incremented (see 6.1.2).

The Enclosure Control diagnostic page shall be implemented if the device supports enclosure services and does not use the Short Enclosure Status diagnostic page (see 6.1.11). The Enclosure Control diagnostic page is written by the SEND DIAGNOSTIC command. A RECEIVE DIAGNOSTIC RESULTS command with a PCV bit set to one and a page code field set to 02h is defined as the request to read the Enclosure Status diagnostic page (see 6.1.4).

Table 1 defines the Enclosure Control diagnostic page.

**Table 1 — Enclosure Control diagnostic page**

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (02h)							
1	Reserved			INFO	NON-CRIT	CRIT	UNRECOV	
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Overall and element control by type list								
8	OVERALL CONTROL (first element type)							
11								
12	ELEMENT CONTROL (first element of first element type)							
15								
...								
(4 bytes)	ELEMENT CONTROL (last element of first element type)							
(4 bytes)								
(4 bytes)	OVERALL CONTROL (second element type)							
(4 bytes)								
(4 bytes)	ELEMENT CONTROL (first element of second element type)							
...								
n - 3	ELEMENT CONTROL (last element of last element type)							
n								

The PAGE CODE field is set to 02h.

The INFO, NON-CRIT, CRIT, and UNRECOV bits are mandatory and may be set to one in the enclosure by the application client when the application client has detected that one or more of the elements in the enclosure are not operating normally.

An INFO (informational condition) bit set to one specifies that the application client is detecting an informational condition (see 3.1.16). An INFO bit set to zero has no effect.

A NON-CRIT (noncritical condition) bit set to one specifies that the application client is detecting a noncritical condition (see 3.1.20). A NON-CRIT bit set to zero specifies that the application client is not detecting a noncritical condition. If the enclosure services process has independently determined that a noncritical condition is present, a request from the application client to set the NON-CRIT bit to zero shall be ignored by the enclosure services process.

A CRIT (critical condition) bit set to one specifies that the application client is detecting a critical condition (see 3.1.6). A CRIT bit set to zero specifies that the application client is not detecting a critical condition. If the enclosure services process has independently determined that a critical condition is present, a request from the application client to set the CRIT bit to zero shall be ignored by the enclosure services process.

An UNRECOV (unrecoverable condition) bit set to one specifies that the application client is detecting an unrecoverable condition (see 3.1.31). An UNRECOV bit set to zero specifies that the application client is not detecting an unrecoverable condition. If the enclosure services process has independently determined that an

unrecoverable condition is present, a request from the application client to set the UNRECOV bit to zero shall be ignored by the enclosure services process.

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

The GENERATION CODE field shall have the value expected to be found in the GENERATION CODE field of the Configuration diagnostic page (see 6.1.2). To prevent the misinterpretation of the OVERALL CONTROL and ELEMENT CONTROL fields, the enclosure services process shall verify that the value of the GENERATION CODE field matches the generation code value known by the enclosure services process. If there is a mismatch, the application client shall be notified of an invalid field error (see 4.5) and the enclosure services process shall ignore the remainder of the Enclosure Control diagnostic page.

The OVERALL CONTROL field for each element type has the same format as the corresponding ELEMENT CONTROL field. There is exactly one OVERALL CONTROL field for each type descriptor header in the Configuration diagnostic page (see table 7). The OVERALL CONTROL field provides control for all elements described in the ELEMENT CONTROL fields. Control values may be applied using either the OVERALL CONTROL field or the ELEMENT CONTROL field. ~~Except as required by the enclosure services process, requests in the ELEMENT CONTROL field shall override requests in the OVERALL CONTROL field.~~

Following the OVERALL CONTROL field, there shall be one ELEMENT CONTROL field for each of the possible elements identified by the NUMBER OF POSSIBLE ELEMENTS field in the corresponding TYPE DESCRIPTOR HEADER. Each ELEMENT CONTROL field optionally contains control information for the element. Each element type has a standard fixed format for its control field. The general format for an ELEMENT CONTROL field is defined by table 58 of 7.2.1.

[The ELEMENT CONTROL fields override the OVERALL CONTROL field as defined in table 2.](#)

**Table 2 — ELEMENT CONTROL and OVERALL CONTROL field processing**

<a href="#">ELEMENT CONTROL field SELECT bit</a>	<a href="#">OVERALL CONTROL field SELECT bit</a>	<a href="#">Description</a>
<a href="#">0</a>	<a href="#">0</a>	<a href="#">The enclosure services process shall not change the element based on this SEND DIAGNOSTIC command</a>
	<a href="#">1</a>	<a href="#">The enclosure services process should change the element based on the OVERALL CONTROL field</a>
<a href="#">1</a>	<a href="#">0 or 1</a>	<a href="#">The enclosure services process should change the element based on the ELEMENT CONTROL field</a>

#### 6.1.4 Enclosure Status diagnostic page

The Enclosure Status diagnostic page returns status information for each of the elements identified by the Configuration diagnostic page (see 6.1.2). In addition, an OVERALL STATUS field is provided to collect information about the collection of elements of the same type defined by each TYPE DESCRIPTOR HEADER. The information provides the status about many functions within the addressed enclosure.

The Enclosure Status diagnostic page returns an OVERALL STATUS field for each element type described by a TYPE DESCRIPTOR HEADER in the Configuration diagnostic page and an ELEMENT STATUS field for each of the elements of that type that have been allowed for by the NUMBER OF POSSIBLE ELEMENTS field in the Configuration diagnostic page. The fields shall be in the order defined by the Configuration diagnostic page. The relationship between the order of the ELEMENT STATUS fields and the physical location of the element within the enclosure is vendor specific. The relationship may be described by the descriptor fields of the Configuration diagnostic page, by the descriptors in the Element Descriptor diagnostic page, or by external references. The relationship shall not change unless the GENERATION CODE field is incremented.

This page shall be implemented if the device supports enclosure services and does not use the Short Enclosure Status diagnostic page (see 6.1.11). The Enclosure 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 02h. The

transmission of a page using the SEND DIAGNOSTIC command with a page code field set to 02h is defined as the transmission of an Enclosure Control diagnostic page (see 6.1.3).

Table 3 defines the Enclosure Status diagnostic page.

**Table 3 — Enclosure Status diagnostic page**

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (02h)							
1	Reserved			INVOP	INFO	NON-CRIT	CRIT	UNRECOV
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Overall and element status by type list								
8	OVERALL STATUS (first element type)							
11								
12	ELEMENT STATUS (first element of first element type)							
15								
...								
(4 bytes)	ELEMENT STATUS (last element of first element type)							
(4 bytes)								
(4 bytes)	OVERALL STATUS (second element type)							
(4 bytes)	ELEMENT STATUS (first element of second element type)							
...								
n - 3	ELEMENT STATUS (last element of last element type)							
n								

The PAGE CODE field is set to 02h.

The INVOP, INFO, NON-CRIT, CRIT, and UNRECOV bits are mandatory. The bits may be read with an allocation length greater than 1 and may be examined by an enclosure polling procedure to determine if events have occurred that require reading the complete page. The bits are set independently and may be set in any combination. The bits may be set by either the enclosure services process or with the Enclosure Control diagnostic page.

The INVOP (Invalid operation requested) bit shall be set to one if an invalid field error has occurred (e.g., an Enclosure Control diagnostic page with an invalid format has previously been transmitted to the enclosure services process and an application client has not already been informed of the error) and the SEND DIAGNOSTIC command was not terminated with CHECK CONDITION status to notify the application client of the error.

Each time the INVOP bit is set to one:

- a) standalone enclosure service processes shall set the INVOP bit to one the first time they return the Enclosure Status diagnostic page to the same I\_T nexus that transmitted the invalid control page and shall set the INVOP bit to zero for subsequent requests; and

- b) attached enclosure services processes shall set the INVOP bit to one the first time they return the Enclosure Status diagnostic page to any application client and shall set the INVOP bit to zero for subsequent requests.

An Invalid Operation Reason element may be included in the element list. If the INVOP bit is set to zero and an Invalid Operation Reason element (see 7.3.12) is included, the Invalid Operation Reason element shall be ignored.

An INFO (information) bit set to one indicates that one or more information conditions (see 3.1.16) have been detected by the enclosure services process or specified by an application client with the Enclosure Control diagnostic page. Each time the INFO bit is set to one by any mechanism:

- a) standalone enclosure services processes (see 4.1.2) shall set the INFO bit set to one the first time they return the Enclosure Status diagnostic page to each I\_T nexus and shall set the INFO bit to zero for subsequent requests; and
- b) attached enclosure services processes (see 4.1.3) shall set the INFO bit set to one the first time they return the Enclosure Status diagnostic page to any application client and may set the INFO bit to zero for subsequent requests.

An INFO bit shall be set to one once as an indication to the application client that an information condition is available and not set to one again until a new information condition occurs.

A NON-CRIT (noncritical condition) bit set to one indicates that one or more noncritical conditions (see 3.1.20) have been detected by the enclosure services process or specified by an application client with the Enclosure Control diagnostic page. A NON-CRIT bit set to zero indicates that both the following conditions are met:

- a) all noncritical conditions have been corrected in the enclosure; and
- b) an application client has set the NON-CRIT bit to zero in the Enclosure Control diagnostic page.

A CRIT (critical condition) bit set to one indicates that one or more critical conditions (see 3.1.6) have been detected by the enclosure services process or specified by an application client with the Enclosure Control diagnostic page. A CRIT bit set to zero indicates that both the following conditions are met:

- a) all critical conditions have been corrected in the enclosure; and
- b) an application client has set the CRIT bit to zero in the Enclosure Control diagnostic page.

An UNRECOV (unrecoverable condition) bit set to one indicates that one or more unrecoverable conditions (see 3.1.31) have been detected by the enclosure services process or specified by an application client with the Enclosure Control diagnostic page. An UNRECOV bit set to zero indicates that both the following conditions are met:

- a) all unrecoverable conditions have been corrected in the enclosure; and
- b) an application client has set the UNRECOV bit to zero in the Enclosure Control diagnostic page.

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

The GENERATION CODE field contains the same value as the GENERATION CODE field in the Configuration diagnostic page (see 6.1.2).

The OVERALL STATUS field for each element type has the same format as the corresponding ELEMENT STATUS field. There is exactly one OVERALL STATUS field for each TYPE DESCRIPTOR HEADER in the Configuration diagnostic page. The OVERALL STATUS optionally indicates a summary of the status for all of the elements of that type [and may provide status for elements that do not report individual status](#). The OVERALL STATUS also may be used to indicate the status of those elements whose individual status is not available, but that do have a measurable overall status.

An example of an enclosure that uses the OVERALL STATUS field is an enclosure with three temperature sensors. If the enclosure only reports the average of the three sensors, the OVERALL STATUS field contains the temperature information. If the enclosure reports the output of each sensor separately, the ELEMENT STATUS fields contain the information. Both the OVERALL STATUS field and the ELEMENT STATUS field may contain information.

Zero or more ELEMENT STATUS fields are provided immediately after the OVERALL STATUS field for that element type. The number of ELEMENT STATUS fields shall be equal to the NUMBER OF POSSIBLE ELEMENTS specified by

the corresponding TYPE DESCRIPTOR HEADER in the Configuration diagnostic page. Each ELEMENT STATUS field optionally indicates the status for the particular element. The general format for an ELEMENT STATUS field is defined by table 59 and by 7.3.

## 7 Element definitions

### 7.1 Element definitions overview

### 7.2 Formats for status and control fields

#### 7.2.1 Formats for status and control fields overview

7.2.2 and 7.2.2 specify the general format for the ELEMENT CONTROL and OVERALL CONTROL fields (i.e., control in the Enclosure Control diagnostic page (see 6.1.3) and for the ELEMENT CONTROL and OVERALL CONTROL fields (i.e., status fields) in the Enclosure Status diagnostic page (see 6.1.4).

Unless otherwise specified, all status and control bits are optional. The enclosure is not required to return any optional status bit to the application client. The enclosure is not required to act on any optional control bit. All control bits are advisory and may be ignored or overridden to maintain a proper operating environment in the enclosure.

#### 7.2.2 Format for all status fields

The format for the ELEMENT STATUS and OVERALL STATUS fields (i.e., status fields) for all element types is shown in table 4..

**Table 4 — ELEMENT STATUS and OVERALL STATUS fields**

Byte\Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
	Rsvd	PRDFAIL	DISABLED	SWAP	ELEMENT STATUS CODE			
1	Element-type-specific status information							
3	Element-type-specific status information							

...

The ELEMENT STATUS CODE field is defined in table 5. ~~The ELEMENT STATUS CODE values apply to ELEMENT STATUS fields. The OVERALL STATUS fields shall have an ELEMENT STATUS CODE of 0h (i.e., unsupported).~~

**Table 5 — ELEMENT STATUS CODE field**

Code	Name	Condition	Mandatory or optional
0h	Unsupported	Status detection is not implemented for this element <del>(e.g., this is an overall status).</del>	Optional
1h	OK	Element is installed and no error conditions are known.	Mandatory
2h	Critical	Critical condition is detected.	Optional
3h	Noncritical	Noncritical condition is detected.	Optional
4h	Unrecoverable	Unrecoverable condition is detected.	Optional
5h	Not Installed	Element is not installed in enclosure.	Mandatory
6h	Unknown	Sensor has failed or element status is not available.	Optional
7h	Not Available	Element installed, no known errors, but the element has not been turned on or set into operation.	Optional
8h-Fh	Reserved		

In an OVERALL STATUS field, the enclosure services process shall set the ELEMENT STATUS CODE field to 0h if it does not implement overall status detection, or it shall set the ELEMENT STATUS CODE field to:

- a) if there are no ELEMENT STATUS fields, any value representing the overall status;
- b) if there are one or more ELEMENT STATUS fields and, in each of them, the ELEMENT STATUS CODE field is set to 0h (i.e., Unsupported), any value representing the overall status; and
- c) if there are one or more ELEMENT STATUS fields and, in each of them, the ELEMENT STATUS CODE field is not set to 0h (i.e., Unsupported), 0h (i.e., Unsupported) or any value representing the overall status.

The element-type-specific status information is defined separately for each element type in 7.3.