To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com) and Dennis Spicher, HP (dennis.spicher@hp.com)
Date: 3 March 2007
Subject: 07-097r0 SES-2 Add failure indicator support to most elements

Revision history
Revision 0 (3 March 2007) First revision

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

Overview
Several elements have failure indicators that let the application client turn on a failure indicator:

a) Device
   A) Control element: RQST FAULT byte 3 bit 5
   B) Status element: FAULT SENSED byte 3 bit 5, FAULT REQSTD byte 3 bit 5
   C) The enclosure services process can report failures itself, and also lets the application client control the failure
b) Array Device
   A) Control element: RQST FAULT byte 3 bit 5
   B) Status element: FAULT SENSED byte 3 bit 5, FAULT REQSTD byte 3 bit 5
   C) The enclosure services process can report failures itself, and also lets the application client control the failure
c) Power Supply
   A) Control element: RQST FAIL byte 3 bit 6
   B) Status element: FAIL byte 3 bit 6
d) Cooling
   A) Control element: RQST FAIL byte 3 bit 6
   B) Status element: FAIL byte 3 bit 6
e) Enclosure
   A) Control element: REQUEST FAILURE byte 3 bit 1
   B) Status element: FAILURE INDICATION byte 2 bit 1, FAILURE REQUESTED byte 3 bit 1
   C) The enclosure services process can report failures itself, and also lets the application client control the failure

Additional element types should also include a failure indicator status control, with a RQST FAIL bit added to the control element and a FAIL bit added to the status element:

Table 1 — Elements to gain failure indicator control/status bits

Element	Location
Device	As-is
Array Device	As-is
Power Supply	As-is
Cooling	As-is
Temperature Sensor	**byte 1 bit 6** OK, byte 3 bit 6 OK
Door Lock	**byte 1 bit 6** OK, byte 3 bit 6 OK
Audible Alarm	**byte 1 bit 6** OK byte 3 bit 6 is used by SET MUTE bit
Enclosure Services Controller Electronics	**byte 1 bit 6** OK, byte 3 bit 6 OK
SCC Controller Electronics	**byte 1 bit 6** OK, byte 3 bit 6 OK
Nonvolatile Cache	**byte 1 bit 6** OK byte 3 used in status element
Invalid Operation Reason	**none** - not a physical element
Uninterruptible Power Supply	byte 1 bit 6 used by BATTERY STATUS field **byte 3 bit 6** OK (and adjacted to IDENT bit)
Display	**byte 1 bit 6** OK byte 3 used in both control and status
Key Pad Entry	**byte 1 bit 6** OK, byte 3 bit 6 OK
Enclosure	As-is
SCSI Port/Transceiver	**byte 1 bit 6** OK, byte 3 bit 6 OK
Language	**none** - not a physical element
Communication Port	**byte 1 bit 6** OK, byte 3 bit 6 OK
Voltage Sensor	**byte 1 bit 6** OK byte 3 used in status element
Current Sensor	**byte 1 bit 6** OK byte 3 used in status element
SCSI Target Port	**byte 1 bit 6** OK, byte 3 bit 6 OK
SCSI Initiator Port	**byte 1 bit 6** OK, byte 3 bit 6 OK
Simple Subenclosure	**none** - not appropriate, this represents an element that doesn't really support SES
SAS Expander	**byte 1 bit 6** OK, byte 3 bit 6 OK
SAS Connector	**byte 1 bit 6** OK, byte 3 bit 6 OK

Suggested changes to SES-2

Editor's Note 1: Included excerpts from Device, Array Device, Power Supply, and Cooling, which already have fault/failure bits

7.3.2 Device element

The Device element manages a SCSI device (e.g., a disk drive) in the enclosure.

Additional information about a Device element may be reported in the Additional Element Status diagnostic page (see 6.1.13).

The format of the control field for a Device element in the Enclosure Control diagnostic page (see 6.1.3) is defined in table 2.

Table 2 — Device element for the Enclosure Control diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	Reserved							
2	RQST ACTIVE	DO NOT REMOVE	Reserved	RQST MISSING	RQST INSERT	RQST REMOVE	RQST IDENT	Rsvd
3	Reserved		RQST FAULT	DEVICE OFF	ENABLE BYP A	ENABLE BYP B	Reserved	

The RQST ACTIVE (request device activity indication) bit has no effect if the enclosure provides no visual activity indication. The RQST ACTIVE bit may be set to one by the application client to cause a visual indication that the device is active. The enclosure services process shall sustain the active condition of the visual indicator for at least 0,5 seconds.

NOTE 1 - To maintain the active indication asserted (if present), the application client sets the bit to one at least once every 0,5 seconds.

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A RQST IDENT (request identify) bit set to one specifies that the enclosure services process identify the element (i.e., the device slot) by a visual indication. A RQST IDENT bit set to zero specifies that the enclosure services process not identify the element by a visual indication.

A RQST FAULT (request fault indication) bit set to one specifies that the device slot be identified by a visual indication that a fault is present in the device. A RQST FAULT bit set to zero specifies that the fault indication shall be cleared if the indication is not also being set by the device or the enclosure services process.

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The format of the status field for a Device element in the Enclosure Status diagnostic page (see 6.1.4) is defined in table 3.

Table 3 — Device element for the Enclosure Status diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
1	SLOT ADDRESS							
2	APP CLIENT BYPASSED A	DO NOT REMOVE	ENCLOSURE BYPASSED A	ENCLOSURE BYPASSED B	READY TO INSERT	RMV	IDENT	REPORT
3	APP CLIENT BYPASSED B	FAULT SENSED	FAULT REQSTD	DEVICE OFF	BYPASSED A	BYPASSED B	DEVICE BYPASSED A	DEVICE BYPASSED B

The COMMON STATUS field is specified in 7.2.3.

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An IDENT (identify) bit set to one indicates that the enclosure services process is currently identifying the element by a visual indication because the RQST IDENT bit was set to one in the control-type diagnostic page. An IDENT bit set to zero indicates that the enclosure services process is not currently identifying the element by a visual indication based on the RQST IDENT bit in the control-type diagnostic page, or a visual indication is not implemented.

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A FAULT SENSED bit set to one indicates that the enclosure or device has detected a fault condition and may be displaying a visual indication of the fault condition. A FAULT SENSED bit set to zero indicates that there is no fault condition detected by the device or enclosure.

A FAULT REQSTD (fault requested) bit set to one indicates that the RQST FAULT control bit has set to one, specifying that the device slot be identified by a visual fault indication. A FAULT REQSTD bit set to zero indicates that the RQST FAULT control bit has been set to zero or that the RQST FAULT control bit is not implemented.

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7.3.3 Array Device element

The Array Device element manages a SCSI device (e.g., a disk drive) in an enclosure that is being used in a storage array (e.g., a RAID controller). The mapping between the visual indicators associated with the Array Device element and the requests to set those indicators is vendor specific.

Additional information about an Array Device element may be reported in the Additional Element Status diagnostic page (see 6.1.13).

The format of the control field for an Array Device element in the Enclosure Control diagnostic page (see 6.1.3) is defined in table 4.

Table 4 — Array Device element for the Enclosure Control diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	COMMON CONTROL							
1	RQST OK	RQST RSVD DEVICE	RQST HOT SPARE	RQST CONS CHECK	RQST IN CRIT ARRAY	RQST IN FAILED ARRAY	RQST REBUILD/ REMAP	RQST R/R ABORT
2	RQST ACTIVE	DO NOT REMOVE	Reserved	RQST MISSING	RQST INSERT	RQST REMOVE	RQST IDENT	Rsvd
3	Reserved		RQST FAULT	DEVICE OFF	ENABLE BYP A	ENABLE BYP B	Reserved	

The COMMON CONTROL field is specified in 7.2.2.

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The RQST ACTIVE (request device activity indication) bit, DO NOT REMOVE bit, RQST INSERT (request insert) bit, RQST REMOVE (request removal) bit, RQST MISSING (request device missing indication) bit, RQST IDENT (request identify) bit, RQST FAULT (request fault indication) bit, DEVICE OFF bit, ENABLE BYP A (enable bypass A) bit, and ENABLE BYP B (enable bypass B) bit are defined in the Device element for the Enclosure Control diagnostic page (see 7.3.2).

The format of the status field for an Array Device element in the Enclosure Status diagnostic page (see 6.1.4) is defined in table 5.

Table 5 — Array Device element for the Enclosure Status diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
1	OK	RSVD DEVICE	HOT SPARE	CONS CHK	IN CRIT ARRAY	IN FAILED ARRAY	REBUILD/ REMAP	R/R ABORT
2	APP CLIENT BYPASSED A	DO NOT REMOVE	ENCLOSURE BYPASSED A	ENCLOSURE BYPASSED B	READY TO INSERT	RMV	IDENT	REPORT
3	APP CLIENT BYPASSED B	FAULT SENSED	FAULT REQSTD	DEVICE OFF	BYPASSED A	BYPASSED B	DEVICE BYPASSED A	DEVICE BYPASSED B

The COMMON STATUS field is specified in 7.2.3.

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The DO NOT REMOVE bit, READY TO INSERT bit, RMV (remove) bit, IDENT (identify) bit, and REPORT bit are defined in the Device element for the Enclosure Status diagnostic page (see 7.3.2).

The FAULT SENSED bit, FAULT REQSTD bit, and DEVICE OFF bit are defined in the Device element for the Enclosure Status diagnostic page (see 7.3.2).

The APP CLIENT BYPASSED A bit, APP CLIENT BYPASSED B bit, ENCLOSURE BYPASSED A bit, ENCLOSURE BYPASSED B bit, BYPASSED A bit, BYPASSED B bit, DEVICE BYPASSED A bit, and DEVICE BYPASSED B bit are defined in the Device element for the Enclosure Status diagnostic page (see 7.3.2).

7.3.4 Power Supply element

The Power Supply element manages a power supply (e.g., providing power to devices (see 7.3.2), array devices (see 7.3.3), enclosure services process electronics (see 7.3.9), and/or SCC controller electronics (see 7.3.10)).

The format of the control field for a Power Supply element is defined in table 6.

Table 6 — Power Supply 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	Rsvd	RQST FAIL	RQST ON	Reserved				

The COMMON CONTROL field is specified in 7.2.2.

A RQST IDENT (request identify) bit set to one specifies that the enclosure services process identify the element by a visual indication. A RQST IDENT bit set to zero specifies that the enclosure services process not identify the element by a visual indication.

A RQST FAIL (request failure indication) bit set to one specifies that the power supply be identified by a visual indication that a failure is present. A RQST FAIL bit set to zero specifies that the failure indication may be turned off if the indication is not also being set by the power supply or the enclosure services process. Some failure indications in the STATUS INFORMATION field are latched. Setting the RQST FAIL bit to one and then setting it to zero shall reset any latched failure indications.

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The format of the status field for a Power Supply element is defined in table 7.

Table 7 — Power Supply element for status-type diagnostic pages

Byte\Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
1	IDENT	Reserved						
2	Reserved				DC OVER VOLTAGE	DC UNDER VOLTAGE	DC OVER CURRENT	Rsvd
3	Rsvd	FAIL	RQSTED ON	OFF	OVRTMP FAIL	TEMP WARN	AC FAIL	DC FAIL

The COMMON STATUS field is specified in 7.2.3.

An IDENT (identify) bit set to one indicates that the enclosure services process is currently identifying the element by a visual indication because the RQST IDENT bit was set to one in the control-type diagnostic page. An IDENT bit set to zero indicates that the enclosure services process is not currently identifying the element by a visual indication based on the RQST IDENT bit in the control-type diagnostic page, or a visual indication is not implemented.

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A FAIL bit set to one indicates that the failure indication is on or has been set on. If there are no additional failures detected by the enclosure, setting the RQST FAIL control bit to zero shall cause the FAIL bit to be set to zero.

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7.3.5 Cooling element

The Cooling element manages a fan, blower, or other cooling mechanism.

The format of the control field for a Cooling element is defined in table 8.

Table 8 — Cooling 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	Rsvd	RQST FAIL	RQST ON	Reserved		REQUESTED SPEED CODE		

The COMMON CONTROL field is specified in 7.2.2.

A RQST IDENT (request identify) bit set to one specifies that the enclosure services process identify the element by a visual indication. A RQST IDENT bit set to zero specifies that the enclosure services process not identify the element by a visual indication.

A RQST FAIL (request failure indication) bit set to one specifies that that the Cooling element be identified by a visual indication that a failure is present. When the RQST FAIL bit is set to zero, the failure indication may be turned off if the indication is not also being set by the enclosure services process.

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The format of the status field for a cooling element is defined in table 9.

Table 9 — Cooling element for status-type diagnostic pages

Byte\Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
1	IDENT	Reserved				(MSB)		
2	ACTUAL FAN SPEED							(LSB)
3	Rsvd	FAIL	RQSTED ON	OFF	Rsvd	ACTUAL SPEED CODE		

The COMMON STATUS field is specified in 7.2.3.

An IDENT (identify) bit set to one indicates that the enclosure services process is currently identifying the element by a visual indication because the RQST IDENT bit was set to one in the control-type diagnostic page. An IDENT bit set to zero indicates that the enclosure services process is not currently identifying the element by a visual indication based on the RQST IDENT bit in the control-type diagnostic page, or a visual indication is not implemented.

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A FAIL bit set to one indicates that the failure indication is on or has been turned on. If there are no additional failures detected by the enclosure, setting the RQST FAIL control bit to zero shall cause the FAIL bit to be set to zero.

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7.3.6 Temperature Sensor element

Editor's Note 2: Add changes similar to this to each element gaining the new bits.

The Temperature Sensor element provides temperature indications to the application client. The temperature values may be compared with values that correspond to over temperature and under temperature failures and warnings.

If variable threshold values are implemented, the optional Threshold Out diagnostic page (see 6.1.8) may be used to override default temperature threshold values. The threshold field for Temperature Sensor elements shall have the same format and units as the TEMPERATURE field.

When the DISABLE bit (see 7.2.2) is set to one, the temperature sensor's output is not tested against any threshold values and no noncritical, critical, or unrecoverable conditions are indicated because of the temperature values sensed. When the DISABLE bit is set to zero, the temperature sensor's output is accepted normally by the enclosure services process.

The format of the control field for a Temperature Sensor element is defined in table 10.

Table 10 — Temperature Sensor element for control-type diagnostic pages

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

The COMMON CONTROL field is specified in 7.2.2.

A RQST IDENT (request identify) bit set to one specifies that the enclosure services process identify the element by a visual indication. A RQST IDENT bit set to zero specifies that the enclosure services process not identify the element by a visual indication.

A RQST FAIL (request failure indication) bit set to one specifies that that the enclosure services process shall enable a visual indication that a failure is present in the element. A RQST FAIL bit set to zero specifies that the enclosure services process shall not enable a visual indication that a failure is present in the element.

The format of the status field for a Temperature Sensor element is defined in table 11.

Table 11 — Temperature Sensor element for status-type diagnostic pages

Byte\Bit	7	6	5	4	3	2	1	0
0	COMMON STATUS							
1	IDENT	~~Reserved~~ FAIL	Reserved					
2	TEMPERATURE							
3	Reserved				OT FAILURE	OT WARNING	UT FAILURE	UT WARNING

The COMMON STATUS field is specified in 7.2.3.

An IDENT (identify) bit set to one indicates that the enclosure services process is currently identifying the element by a visual indication because the RQST IDENT bit was set to one in the control-type diagnostic page.

An IDENT bit set to zero indicates that the enclosure services process is not currently identifying the element by a visual indication based on the RQST IDENT bit in the control-type diagnostic page, or a visual indication is not implemented.

A FAIL bit set to one indicates that a visual indication that a failure is present in the element is enabled. A FAIL bit set to zero indicates that a visual indication that a failure is present in the element is disabled.

The value in the TEMPERATURE field shall indicate the temperature at the sensor in degrees Celsius, offset by +20 degrees. The range of the value expresses a temperature between -19 and +235 degrees Celsius. The value of 0 is reserved. Thresholds may be set for the temperature element. The threshold value uses the same units and format.

An OT FAILURE (overtemperature failure) bit set to one indicates that the enclosure services process has detected a temperature higher than a safe operating temperature or higher than the value indicated by the HIGH CRITICAL THRESHOLD field in the Threshold In diagnostic page (see 6.1.9). An OT FAILURE bit set to zero indicates that the temperature has fallen to a safe operating temperature or below the value specified by the HIGH CRITICAL THRESHOLD field.

An OT WARNING (overtemperature warning) bit set to one indicates that the enclosure services process has detected a temperature higher than a normal operating temperature or higher than the value indicated by the HIGH WARNING THRESHOLD field in the Threshold In diagnostic page. An OT WARNING bit set to zero indicates that the temperature has fallen within the normal operating limits or below the value specified by the HIGH WARNING THRESHOLD field.

A UT FAILURE (undertemperature failure) bit set to one indicates that the enclosure services process has detected a temperature lower than a safe operating temperature or lower than the value indicated by the LOW CRITICAL THRESHOLD field in the Threshold In diagnostic page. A UT FAILURE bit set to zero indicates that the temperature has risen to a safe operating temperature or the above the value specified by the LOW CRITICAL THRESHOLD field.

A UT WARNING (undertemperature warning) bit set to one indicates that the enclosure services process has detected a temperature lower than a normal operating temperature or lower than the value indicated by the LOW WARNING THRESHOLD field in the Threshold In diagnostic page. A UT WARNING bit set to zero indicates that the temperature has risen within the normal operating limits or above the value specified by the LOW WARNING THRESHOLD field.