To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
Date: 21 November 2003
Subject: 04-010r0 SPC-3 SES-2 Diagnostic subpages

Revision history
Revision 0 (21 November 2003) First revision

Related documents
spc3r15 - SCSI Primary Commands - 3 revision 15
ses2r05 - SCSI Enclosure Services - 2 revision 5
sff-8067 - 40-pin SCA-2 Connector w/Bidirectional ESI revision 3.0 (24 March 2002) (see
http://www.sffcommittee.org)
04-007 SES-2 Generation codes for Help Text and String pages

Overview
SCSI enclosure services are only allowed 20h diagnostic pages, 10h of which are vendor specific. Pages up to 0Ch have been proposed, so the codes are nearly exhausted.

A "subpage" concept similar to that defined for mode pages and log pages needs to be introduced to allow for future expansion. It is up to the main page definition to define if subpages exist or not. Because of RECEIVE DIAGNOSTIC RESULTS restrictions, only 7 bits are available for subpage codes.

> Editor's Note 1: it might be better to only use 4 rather than all 7 of them, to leave room for other features in the CDB. Once all 7 remained bits are used, a RECEIVE DIAGNOSTICS (10 or higher) would have to be defined.

Subpages cannot be added to most of the existing pages, because there is no room for a subpage code field.

For SES-2, page code 0Fh will be the only page supporting subpages. For ESI-attached enclosure service processors, SFF-8067 will document a mapping from the page 0F subpages into ESI page codes 80h-FFh. This avoids needing to redefine the ESI data structures to support subpages.

Table 1 — Page code/subpage code to ESI page code translation

SCSI diagnostic page code	SCSI diagnostic subpage code	ESI page code	Description
00h - 0Eh	any	00h - 0Eh	Passed through ESI with the same page code
0Fh	00h	0Fh	Passed through ESI with the same page code
0Fh	01h - 7Fh	81h - FFh	Passed through ESI with a page code of 80h + the value of the SUBPAGE CODE field
10h - 1Fh	any	10h - 1Fh	Passed through ESI with the same page code
20h - 3Fh	any	none	Reserved for all device types (not passed through ESI)
40h - 7Fh	any	none	Device-specific (not passed through ESI)
80h - FFh	any	none	Vendor-specific (not passed through ESI)
none	none	20h - 7Fh	Reserved
none	none	80h	Reserved

Changes required are:

   a) add subpage support to page 00h (supported pages) in SPC-3
   b) add the mapping to SFF (so Fibre Channel disk drives start translating the page codes and passing them through ESI)

No subpages are actually proposed yet for SES-2.

Suggested changes to SPC-3

6.18 RECEIVE DIAGNOSTIC RESULTS command

The RECEIVE DIAGNOSTIC RESULTS command (see table 134) requests that data be sent to the application client after completion of a SEND DIAGNOSTIC command (see 6.26). If optional diagnostic page formats are supported and the PCV bit is set to one, the PAGE CODE field ~~specifies~~ and SUBPAGE CODE field specify the format of the returned data, and there is no relationship to a previous SEND DIAGNOSTIC command.

Table 2 — RECEIVE DIAGNOSTIC RESULTS command

Byte\Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (1Ch)							
1	~~Reserved~~SUBPAGE CODE							PCV
2	PAGE CODE							
3	(MSB)			ALLOCATION LENGTH				
4								(LSB)
5	CONTROL							

Editor's Note 2: it's unfortunate that SUBPAGE CODE is shifted left by one, but PCV is in the way

A page code valid (PCV) bit set to zero indicates that the most recent SEND DIAGNOSTIC command shall define the data returned by this command. Optionally, a PCV bit set to one indicates that the contents of the PAGE CODE field and the SUBPAGE CODE field shall define the data returned by this command. Page code and subpage code values are defined in 7.1 or in another command set standard (see 3.1.17).

   NOTES

   NOTE 1 To ensure that the diagnostic command information is not destroyed by a command sent from another initiator port the logical unit should be reserved.

   NOTE 2 Although diagnostic software is generally device-specific, this command and the SEND DIAGNOSTIC command provide a means to isolate the operating system software from the device-specific diagnostic software. The operating system may remain device-independent.

See 7.1 for RECEIVE DIAGNOSTIC RESULTS diagnostic page format definitions.

7.1 Diagnostic parameters

7.1.1 Diagnostic page format and page codes for all device types

This subclause describes the diagnostic page structure and the diagnostic pages that are applicable to all SCSI devices. Diagnostic pages specific to each device type are described in the command standard (see 3.1.17) that applies to that device type.

A SEND DIAGNOSTIC command with a PF bit set to one specifies that the SEND DIAGNOSTIC parameter list consists of zero or more diagnostic pages and that the data returned by the subsequent RECEIVE DIAGNOSTIC RESULTS command shall use the diagnostic page format defined in table 170. A RECEIVE

DIAGNOSTIC RESULTS command with a PCV bit set to one specifies that the device server return a diagnostic page using the format defined in table 170.

Table 3 — Diagnostic page format

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE							
1	~~Reserved~~Page code specific							
2	(MSB)			PAGE LENGTH (n - 3)				
3								(LSB)
4				Diagnostic parameters				
n								

Editor's Note 3: this was labeled wrong before. SES was already putting a variety of fields in byte 1.

Each diagnostic page defines a function or operation that the device server shall perform as a result of a SEND DIAGNOSTIC command or the information being returned as a result of a RECEIVE DIAGNOSTIC RESULTS with the PCV bit equal to one. The diagnostic page contains a page header followed by the data that is formatted according to the page code specified.

Device servers that implement diagnostic pages are only required to accept a single diagnostic page per command.

~~The PAGE CODE field identifies which diagnostic page is being sent as a result of a SEND DIAGNOSTIC command, requested as a result of a RECEIVE DIAGNOSTIC RESULTS command with the PCV bit equal to one, or returned as a result of a RECEIVE DIAGNOSTIC RESULTS parameter data. The page codes are defined in table 171.~~

The PAGE CODE field and SUBPAGE CODE field identify which diagnostic subpage is being sent as a result of a SEND DIAGNOSTIC command, requested as a result of a RECEIVE DIAGNOSTIC RESULTS command with

the PCV bit equal to one, or returned as a result of a RECEIVE DIAGNOSTIC RESULTS parameter data. The page codes and subpage codes are defined in table 171.

Table 4 — Diagnostic page codes

Page Code	Subpage Code	Diagnostic Page Name	Reference
00h	00h	Supported Diagnostic Pages	7.1.2
	01h	Supported Diagnostic Subpages	7.1.3
	02h - 7Fh	Reserved	
~~01h~~		~~Configuration~~	~~SES~~
~~02h~~		~~Enclosure Status/Control~~	~~SES~~
~~03h~~		~~Help Text~~	~~SES~~
~~04h~~		~~String In/Out~~	~~SES~~
~~05h~~		~~Threshold In/Out~~	~~SES~~
~~06h~~		~~Array Status/Control~~	~~SES~~
~~07h~~		~~Element Descriptor~~	~~SES~~
~~08h~~		~~Short Enclosure Status~~	~~SES~~
~~09h~~		~~Enclosure Busy~~	~~SES-2~~
~~0Ah~~		~~Device Element Status~~	~~SES-2~~
~~0Bh - 1Fh~~		~~Reserved for SES~~	~~SES-2~~
01h - 1Fh	any	Defined by SES-2 for: a) enclosure services devices (i.e., the PERIPHERAL DEVICE TYPE field set to 0Dh in standard INQUIRY data); and b) any device type if the ENCSERV bit is set to one in standard INQUIRY data	SES-2
20h - 3Fh	any	Reserved for p~~P~~ages that apply to all device types	
40h - 7Fh	any	See specific device type for definition	
80h - FFh	any	Vendor specific	

Editor's Note 4: Why keep bothering SPC-3 main text with page code assignments made by SES-2? SPC-3 probably should maintain a list in the numeric order codes informational annex.

The PAGE LENGTH field specifies the length in bytes of the diagnostic parameters that follow this field. If the application client sends a page length that results in the truncation of any parameter, the device server shall terminate the command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The diagnostic parameters are defined for each diagnostic page code. The diagnostic parameters within a diagnostic page may be defined differently in a SEND DIAGNOSTIC command than in a RECEIVE DIAGNOSTIC RESULTS command.

7.1.2 Supported diagnostic pages

The Supported Diagnostic Pages diagnostic page (see table 172) returns the list of diagnostic pages implemented by the device server. This diagnostic page shall be implemented if the device server implements

the diagnostic page format option of the SEND DIAGNOSTIC and RECEIVE DIAGNOSTIC RESULTS commands.

Table 5 — Supported diagnostic pages

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (00h)							
1	Reserved	~~Reserved~~SUBPAGE CODE (00h)						
2	(MSB)	PAGE LENGTH (n - 3)						
3								(LSB)
4	SUPPORTED PAGE LIST							
n								

The definition of this diagnostic page for the SEND DIAGNOSTIC command includes only the first four bytes. If the PAGE LENGTH field is not zero, the device server shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN PARAMETER LIST. This diagnostic page instructs the device server to make available the list of all supported diagnostic pages to be returned by a subsequent RECEIVE DIAGNOSTIC RESULTS command.

The definition of this diagnostic page for the RECEIVE DIAGNOSTIC RESULTS command includes the list of diagnostic pages supported by the device server.

The PAGE LENGTH field specifies the length in bytes of the following supported page list.

The SUPPORTED PAGE LIST field shall contain a list of all diagnostic page codes implemented by the device server in ascending order ~~beginning with~~ including and beginning with page code 00h.

7.1.2 Supported diagnostic subpages [this section is entirely new]

The Supported Diagnostic Subpages diagnostic page (see table 172) returns the list of diagnostic pages and subpages implemented by the device server. This diagnostic page shall be implemented if the device server implements the diagnostic page format option of the SEND DIAGNOSTIC and RECEIVE DIAGNOSTIC RESULTS commands and implements any subpages.

Table 6 — Supported diagnostic subpages

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (00h)							
1	Reserved	SUBPAGE CODE (01h)						
2	(MSB)	PAGE LENGTH (n - 3)						
3								(LSB)
4	Supported subpage descriptor(s)							
n								

The definition of this diagnostic page for the SEND DIAGNOSTIC command includes only the first four bytes. If the PAGE LENGTH field is not zero, the device server shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN PARAMETER LIST. This diagnostic page instructs the device server to make available the list of all supported diagnostic pages to be returned by a subsequent RECEIVE DIAGNOSTIC RESULTS command.

The definition of this diagnostic page for the RECEIVE DIAGNOSTIC RESULTS command includes the list of diagnostic pages and subpages supported by the device server.

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The PAGE LENGTH field specifies the length in bytes of the following supported subpage list.

The supported subpage descriptor format is described in table 7.

Table 7 — Supported subpage descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	SUPPORTED PAGE CODE (00h)							
1	SUPPORTED SUBPAGE CODE (1Fh - 7Fh)							

The SUPPORTED PAGE CODE field and SUPPORTED SUBPAGE CODE field page identify a supported page/subpage combination.

The supported subpage descriptors shall be sorted in ascending order by:

1) page code; and
2) subpage code.

[End of entirely new section]

Annex C Numeric order codes

Editor's Note 5: Create a list for diagnostic page codes.

Editor's Note 6: SES-2 defines all the pages mentioned in SPC-3 7.1.1. See 04-007 for two new pages being proposed.

Editor's Note 7: SBC-2 defines two diagnostic pages: 40h Translate Address, 41h Device Status. These are available to all three device types (direct access, optical memory, write-once)

Editor's Note 8: The following command sets define no special diagnostic pages: SSC-2, SMC-2, MMC-4, OSD, RBC, ADC, SCC-2, MSC. None of the obsolete SCSI-2 era device types had any either.

Suggested changes to SES-2

4.5 Invalid field errors

Any invalid fields included in the CDB or parameters of a SEND DIAGNOSTIC command and any invalid fields in the CDB of a RECEIVE DIAGNOSTIC RESULTS command shall be detected by the device server in an enclosure services device. An enclosure services device shall analyze these parameters before performing the requested operations and, if there is an error, the command shall be terminated with a CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code shall identify the location of the invalid fields, CDB, or parameter data.

The device server in a non-enclosure services device does not have the capability of analyzing the validity of the CDB and the parameters destined to an attached enclosure services process. Instead, the device server shall pass the parameters through to the attached enclosure services process without testing the validity of the parameters and shall return GOOD status. For errors in any diagnostic page other than the Threshold In diagnostic page, the INVOP (invalid operation requested) bit (see 6.1.4) shall be set in the next Enclosure Status diagnostic page returned to any initiator. For errors in the Threshold Out diagnostic page, the INVOP bit (see 6.1.9) shall be set in the next Threshold In diagnostic page returned to any initiator. An Invalid Operation

Reason element (see 7.3.12) may be included in the element list to indicate the reason for the error when returning a status page that has an INVOP bit (e.g., the Enclosure Status or Threshold In diagnostic page).

An attached enclosure services process shall process a RECEIVE DIAGNOSTIC RESULTS command requesting an unsupported page code or subpage code by returning no data. It shall process a SEND DIAGNOSTIC command requesting an unsupported page code or subpage code by setting INVOP to one in the next Enclosure Status diagnostic page returned to any initiator.

6 Parameters for enclosure services devices

6.1 Diagnostic parameters

6.1.1 Diagnostic parameters overview

This clause describes the diagnostic page structure and the diagnostic pages that are applicable to enclosure services devices and other device types that provide communications access to an enclosure services process. Each diagnostic page provides either control (outbound) or status (inbound) data transmission to or from the enclosure process.

The diagnostic page format is specified in SPC-3. All diagnostic pages have the diagnostic page header defined in SPC-3, including the PAGE CODE and PAGE LENGTH fields.

The PAGE CODE field identifies the diagnostic page being sent or requested. The page codes are defined in table 8.

Table 8 — Diagnostic page codes for enclosure service devices

Page code	Description	Control or status	Reference
00h	Supported Diagnostic Pages	Status	SPC-3
01h	Configuration diagnostic page	Status	6.1.2
02h	Enclosure Control diagnostic page	Control	6.1.3
	Enclosure Status diagnostic page	Status	6.1.4
03h	Help Text diagnostic page	Status	6.1.2
04h	String Out diagnostic page	Control	6.1.3
	String In diagnostic page	Status	6.1.4
05h	Threshold Out diagnostic page	Control	6.1.8
	Threshold In diagnostic page	Status	6.1.9
06h	Obsolete	N/A	
07h	Element Descriptor diagnostic page	Status	6.1.10
08h	Short Enclosure Status diagnostic page	Status	6.1.11
09h	Enclosure Busy diagnostic page	Status	6.1.12
0Ah	Device Element Status diagnostic page	Status	6.1.13
0Bh	Sub-enclosure Help Text diagnostic page	Status	6.1.2
0Ch	Sub-enclosure String Out diagnostic page	Control	6.1.3
	Sub-enclosure String In diagnostic page	Status	6.1.4
0Dh-0Eh	Reserved for ~~SES~~ this standard	N/A	6.1
0Fh	Reserved for this standard for diagnostic subpages	N/A	
10h-1Fh	Vendor-specific SES diagnostic pages	N/A	6.1
20h-3Fh	Reserved ~~(applies to all device type pages)~~for all device types	N/A	SPC-3
40h-7Fh	See specific device type for definition; reserved for the SES device type	N/A	SPC-3
80h-FFh	Vendor-specific pages	N/A	SPC-3

Suggested changes to SFF-8067

These changes are not to a T10 standard and are included here for reference.

Changes to expand the pass through range to 1Fh (from 0Fh) have already been proposed.

Add the following information to table 7-1 and make section 7.1 normative rather than informative.

Table 9 — Page code/subpage code to ESI page code translation

SCSI diagnostic page code	SCSI diagnostic subpage code	ESI page code	Description
00h - 0Eh	any	00h - 0Eh	Passed through ESI with the same page code
0Fh	00h	0Fh	Passed through ESI with the same page code
0Fh	01h - 7Fh	81h - FFh	Passed through ESI with a page code of 80h + the value of the SUBPAGE CODE field
10h - 1Fh	any	10h - 1Fh	Passed through ESI with the same page code
20h - 3Fh	any	none	Reserved for all device types (not passed through ESI)
40h - 7Fh	any	none	Device-specific (not passed through ESI)
80h - FFh	any	none	Vendor-specific (not passed through ESI)
none	none	20h - 7Fh	Reserved
none	none	80h	Reserved

7.2 Definition of command bytes for enclosure (normative)

If a SCSI device receives one of the SCSI diagnostic commands with a page code value between 01h and 1Fh, it prepares the proper information for transmission to the enclosure in a command phase. The command phase is composed of 4 bytes, as defined in Table 7-3. The command phase is always clocked with -DSK_WR.

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TABLE 7-3 ESI COMMAND PHASE INFORMATION
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The page code specifies the SES page that is to be transferred to or from the enclosure.

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7.3 Transmission of SEND DIAGNOSTIC pages to enclosure (normative)

When an SFF-8067 SCSI device receives a SEND DIAGNOSTIC command, it examines the CDB to determine the allocation length and to determine that the PF (Page Format) bit is set. If these conditions are met, it obtains at least 4 bytes of the parameters and examines the diagnostic page header. If the page code value is from 01h to 1Fh inclusive, the device prepares to communicate with the enclosure by executing a Discovery phase. SEND DIAGNOSTIC commands that do not involve enclosure activity are handled by the SCSI device according to the requirements of the SCSI SPC standard.

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The ESI Command transmits the page code extracted from the SCSI diagnostic page and subpage to the enclosure. The ESI command transmits the SEND bit with a 1 value to the enclosure. The ESI command transmits the SEND DIAGNOSTIC parameter length, which is set to 4 more than the page length in the diagnostic page.

...

The device then begins to execute the data transmission out to the enclosure. The entire diagnostic page is transferred to the enclosure ~~unchanged~~, including the header (page code modified per table 7-1, subpage code set to 0, reserved byte, and page length) and the ESI parameters.

...

7.4 Transmission of RECEIVE DIAGNOSTIC RESULTS from enclosure (normative)

When an SFF-8067 SCSI device receives a RECEIVE DIAGNOSTIC RESULTS command, it examines the CDB to determine the allocation length and the requested page code. If the page code is from 01 to 1Fh, inclusive, the device prepares to communicate with the enclosure by executing a Discovery phase.

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If the Discovery phase determines that the enclosure is an SFF-8045 compliant enclosure that supports Parallel ESI, the device returns the short enclosure status page (page code 08h) described in Table 7-4, regardless of the requested page. GOOD status is presented and the SCSI command is completed. The device negates -PARALLEL ESI to terminate the communication with the enclosure. Bit 7 of byte 1 indicates that the enclosure has been determined to be an 8045 enclosure supporting Parallel ESI.

If the Discovery phase determines that the enclosure is an SFF-8067 compliant enclosure and responding correctly, the device begins transmission of the ESI Command phase.

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TABLE 7-4 SPECIAL STATUS PAGE FORMAT FOR SFF-8045 PARALLEL ESI
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The ESI Command transmits the page code ~~extracted from~~ specifed by the SCSI CDB page code and subpage code fields to the enclosure (see table 7-1). The ESI command transmits the SEND bit with a 0 value to the enclosure.

For the RECEIVE DIAGNOSTIC RESULTS command, the parameter length field shall be 0.

If the time between the assertion of -DSK_WR by the device and the assertion of -ENCL_ACK by the enclosure exceeds the device's timeout value (minimum timeout = 100 usec), the device posts a CHECK CONDITION to the SCSI initiator with an ASC/ASCQ indication of Enclosure Transfer Failure. The device negates -PARALLEL ESI to terminate the communication with the enclosure.

The device then begins to execute the data transmission from the enclosure. The entire diagnostic page is transferred from the enclosure ~~unchanged~~, including the header (page code modified per table 7-1, subpage code set to 0, summary byte, and page length) and the enclosure service parameters. The device uses bytes 2 and 3 of the header to determine the total page length to be transferred. The device requests a number of bytes equal to the smaller of the total page length or the allocation length.

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8.3 Enclosure requested information

If the enclosure services interface transfer is initiated by the enclosure, the SCSI device sends ESI Command Phase information as defined in Table 7-3 to the enclosure following successful discovery. The page code in the ESI command is 00h. This page code is reserved for SCSI diagnostic commands between the host and the SCSI device and will not appear in ESI transfers initiated by SCSI commands. The ESI command is a read operation, SEND=0, with parameter length of 6h.