To: T10 Technical Committee
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Subject: 04-377r1 SES-2 Download Microcode diagnostic page

Revision history
Revision 0 (9 November 2004) First revision
Revision 1 (3 December 2004) Incorporated comments from November CAP WG.

Related documents
ses2r09 - SCSI Enclosure Services - 2 revision 9
spc3r21 - SCSI Primary Commands - 3 revision 21

Overview
Standalone SES logical units may use the WRITE BUFFER command for firmware (microcode) upgrades. For attached enclosure service processes, though, the WRITE BUFFER command only updates the firmware on the hosting logical unit (e.g. the disk drive).

A diagnostic page is proposed to allow enclosure services firmware upgrades whether standalone or attached. It is based on the two interoperable modes defined for the WRITE BUFFER command in SPC-3 - modes 6h (download microcode with offsets) and 7h (download microcode with offsets and save).

> Editor's Note 1: The offset modes (6h/7h) were chosen over the non-offset modes (4h/5h). The SEND DIAGNOSTIC 2-byte PARAMETER LIST LENGTH limits the transfer to 64 KB, which is probably too small for some ROM images. WRITE BUFFER has a 3 byte PARAMETER LIST LENGTH field limiting transfer to a more usable 16MB, and modes 4h and 5h define the PARAMETER LIST LENGTH field as vendor-specific so they can ignore that limit anyway. However, in the attached enclosure services case, the main logical unit (e.g. the disk drive) would probably not know to support a non-standard usage of the PARAMETER LIST LENGTH field for its parasite enclosure services process.

Suggested changes to SES-2

4.1.3 Attached enclosure services process

An application client may also be able to address the enclosure services using a logical unit with some other peripheral device type (e.g., a block device) as a transport for enclosure services information. Such peripheral devices have a communications connection to the attached enclosure services process defined outside this standard. The attached enclosure services device is not visible as its own logical unit; it transports the standard enclosure services information through the addressed logical unit.

Such devices shall use the same SEND DIAGNOSTIC and RECEIVE DIAGNOSTIC RESULTS commands and page formats used by a standalone enclosure services device, but otherwise support the device model specified by their peripheral device type value. Such a device server shall set the ENCSERV (enclosure services) bit to one in the standard INQUIRY data (see SPC-3) to indicate that it supports an attached enclosure services process, which may or may not be currently attached. An application client determines whether an enclosure services process is actually attached to the device by using the RECEIVE DIAGNOSTIC RESULTS command to request a Configuration diagnostic page (see 6.1.2). If the SCSI device is not able to communicate with an enclosure services process, the device server shall return CHECK CONDITION status as described in 4.8.

The Enclosure Services Management mode page (see 6.3.2) may be implemented by a ~~SCSI device~~ logical unit that allows access to an attached enclosure services process.

> NOTE 1 - One example using an attached enclosure services process is an enclosure of Fibre Channel disk drives with SCA-2 connectors defined in SFF-8067. The SCA-2 connector include pins for an Enclosure

Services Interface (ESI). The backplane connects selected disk drives' ESI interfaces to an enclosure management processor. providing the enclosure services process.

Figure 3 shows an example of an enclosure with an attached enclosure services process.

[figure 3]

The only SCSI device condition (see SAM-3) supported by an attached enclosure services process is power on. The logical unit does not communicate hard reset, logical unit reset, or I_T nexus loss to the attached enclosure services process.

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. Control pages are accessed with the SEND DIAGNOSTIC command; status pages are accessed with the RECEIVE DIAGNOSTIC RESULTS command.

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 1.

Table 1 — 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	6.1.5
04h	String Out diagnostic page	Control	6.1.6
	String In diagnostic page	Status	6.1.7
05h	Threshold Out diagnostic page	Control	6.1.8
	Threshold In diagnostic page	Status	6.1.9
06h	Obsolete		
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	Subenclosure Help Text diagnostic page	Status	6.1.14
0Ch	Subenclosure String Out diagnostic page	Control	6.1.15
	Subenclosure String In diagnostic page	Status	0.0.2
0Dh	Supported SES Diagnostic Pages diagnostic page	Status	6.1.17
0Eh	Download Microcode Control diagnostic page	Control	6.1.xx
	Download Microcode Status diagnostic page	Status	6.1.xx
0Eh 0Fh	Reserved for this standard		
10h-1Fh	Vendor-specific SES diagnostic pages		
20h-2Fh	Reserved for this standard		
30h-3Fh	Reserved for all device types		SPC-3
40h-7Fh	See specific device type for definition. Reserved for the SES device type		SPC-3
80h-FFh	Vendor-specific pages		SPC-3

0.0.1 Download Microcode Control diagnostic page [all new]

The Download Microcode Control diagnostic page transmits a vendor-specific microcode (i.e., firmware) image to the control memory space of the enclosure services process. The image may optionally be saved to non-volatile storage (e.g., a flash ROM).

The Download Microcode 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 0Eh is defined as the request to read the Download Microcode Status diagnostic page (see 0.0.2).

The microcode image may be sent using one or more SEND DIAGNOSTIC commands. If the complete set of SEND DIAGNOSTIC commands required to deliver the microcode image are not received before:

a) for attached enclosure services processes, power on; or
b) for standalone enclosure services processes, a logical unit reset, hard reset, power on, or I_T nexus loss,

the new microcode image shall be discarded and not used.

If an error is detected, the enclosure services process shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to the appropriate value in the Download Microcode Status diagnostic page.

Table 12 describes the Download Microcode Control diagnostic page.

Table 2 — Download Microcode Control diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (0Eh)							
1	SUBENCLOSURE IDENTIFIER							
2	(MSB)							
3	PAGE LENGTH (n - 3)							(LSB)
4	(MSB)							
7	GENERATION CODE							(LSB)
8	DOWNLOAD MICROCODE MODE							
9	Reserved							
10								
11	BUFFER ID							
12	(MSB)							
15	BUFFER OFFSET							(LSB)
16	(MSB)							
19	MICROCODE IMAGE LENGTH							(LSB)
20	(MSB)							
23	MICROCODE DATA LENGTH (m - 19)							(LSB)
24	MICROCODE DATA							
m								
m + 1	PAD (f needed)							
n								

The PAGE CODE field is set to 0Eh.

The SUBENCLOSURE IDENTIFIER field specifies the vendor-specific identifier for the subenclosure to which the application client is sending the microcode image. If the SUBENCLOSURE IDENTIFIER value does not match a SUBENCLOSURE IDENTIFIER value found in the Configuration diagnostic page, the enclosure services process shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.

The PAGE LENGTH field specifies the length in bytes of the remainder of the diagnostic page. If the PAGE LENGTH field value does not match the length of the page, the enclosure services process shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.

The GENERATION CODE field specifies 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 microcode data, 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 enclosure services process shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.

The DOWNLOAD MICROCODE MODE field is defined in table xx.

Table 3 — DOWNLOAD MICROCODE MODE field

Code	Name	Description
06h	Download microcode with offsets	After the last SEND DIAGNOSTIC command delivering a Download Microcode Control diagnostic page to the subenclosure completes, the enclosure services process shall: 1) verify the complete microcode image (e.g., perform a vendor-specific checksum); 2) provided there are no errors in the microcode image, set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 10h in the Download Microcode Status diagnostic page; 3) wait for a RECEIVE DIAGNOSTIC RESULTS command requesting the Download Microcode Status diagnostic page; and 4) begin using the new microcode image (i.e., reboot). The downloaded microcode shall be used until: a) it is supplanted by another download microcode operation; b) for attached enclosure services processes, power on; or c) for standalone enclosure services processes, hard reset or power on.
07h	Download microcode with offsets and save	After the last SEND DIAGNOSTIC command delivering a Download Microcode Control diagnostic page to the subenclosure completes, the enclosure services process shall verify the complete microcode image (e.g., perform a vendor-specific checksum) and save the new microcode image into non-volatile storage (e.g., flash ROM). Provided there are no errors in the microcode image or in the save operation, the enclosure services process shall: a) set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 10h in the Download Microcode Status diagnostic page and use the new microcode image after returning that diagnostic page; b) for standalone enclosure services processes, set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 11h in the Download Microcode Status diagnostic page and use the new microcode image after hard reset or power on; or c) for attached or standalone enclosure services processes, set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 12h in the Download Microcode Status diagnostic page and use the new microcode image after power on. The application client may determine the microcode revision level currently in use by retrieving the PRODUCT REVISION LEVEL field in the Enclosure descriptor in the Configuration diagnostic page.
All others	Reserved	Reserved. The enclosure services process shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.

Once a download microcode operation has begun, if the DOWNLOAD MICROCODE MODE field value changes while specifying the same buffer ID, the enclosure services process shall abort the download microcode

operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.

The BUFFER ID field specifies a specific buffer within the enclosure services process to receive the microcode image. The enclosure services process assigns vendor-specific buffer ID codes to buffers (e.g., the main firmware image may be stored in buffer 0 and a backup firmware image may be stored in buffer 1). The enclosure services process shall support a buffer ID value of zero. If more than one buffer is supported, then it shall assign additional buffer ID codes contiguously, beginning with 1. If it receives an unsupported buffer ID code, the enclosure services process shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.

The enclosure services process may require that only one subenclosure download microcode operation be processed at a time, and/or may require that only one buffer ID be used at a time. If the enclosure services process does not accept the specified combination of subenclosure identifier and buffer ID, it shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.

The BUFFER OFFSET field specifies the offset in bytes within the buffer to which the microcode data is written. The BUFFER OFFSET field shall be set to a multiple of 4. The enclosure services process may require that the BUFFER OFFSET field be contiguously increasing in consecutive SEND DIAGNOSTIC commands. If the enclosure services process does not accept the specified buffer offset, it shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.

The MICROCODE IMAGE LENGTH field specifies the total number of bytes in the microcode image the application intends to send to the specified buffer ID. The microcode image may be sent using one or more SEND DIAGNOSTIC commands.

The MICROCODE DATA LENGTH field specifies the number of bytes in the MICROCODE DATA field.

The MICROCODE DATA field contains part of the vendor-specific microcode image.

The PAD field contains zero, one, two, or three bytes set to 00h such that the total length of the diagnostic page is a multiple of four.

0.0.2 Download Microcode Status diagnostic page [all new]

The Download Microcode Status diagnostic page transmits information about the status of one or more download microcode operations to the application client.

The transmission of a page using the SEND DIAGNOSTIC command with a PAGE CODE field set to 0Eh is defined as the transmission of a Download Microcode Control diagnostic page (see 6.1.15).

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Table 4 describes the Download Microcode Status diagnostic page.

Table 4 — Download Microcode Status diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (0Eh)							
1	NUMBER OF SUBENCLOSURES							
2	(MSB)			PAGE LENGTH (z - 3)				
3								(LSB)
4	(MSB)			GENERATION CODE				
7								(LSB)
	Download microcode status descriptor list							
8	Download microcode status descriptor (primary subenclosure)							
m								
	...							
y +1	Download microcode status descriptor							
z								

The PAGE CODE field is set to 0Eh.

The NUMBER OF SUBENCLOSURES field indicates the number of separate subenclosure download microcode status descriptors that are included, not including the primary subenclosure. The NUMBER OF SUBENCLOSURES value shall be the same as the number of subenclosures value in the Configuration diagnostic page.

The PAGE LENGTH field indicates the length in bytes of the remainder of the diagnostic page.

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

Table 5 describes the format of each subenclosure's download microcode status descriptor. The first download microcode status descriptor shall be for the primary subenclosure; download microcode status descriptors for the remaining subenclosures may follow in any order.

Table 5 — Download microcode status descriptor format

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved							
1	SUBENCLOSURE IDENTIFIER							
2	SUBENCLOSURE DOWNLOAD MICROCODE STATUS							
3	SUBENCLOSURE DOWNLOAD MICROCODE ADDITIONAL STATUS							
4	(MSB)			SUBENCLOSURE DOWNLOAD MICROCODE MAXIMUM SIZE				
7								(LSB)
8				Reserved				
10								
11	SUBENCLOSURE DOWNLOAD MICROCODE EXPECTED BUFFER ID							
12	(MSB)			SUBENCLOSURE DOWNLOAD MICROCODE EXPECTED BUFFER OFFSET				
15								(LSB)

The SUBENCLOSURE IDENTIFIER field indicates the subenclosure identifier to which the download microcode status descriptor applies.

The SUBENCLOSURE DOWNLOAD MICROCODE STATUS field indicates the status of download microcode operations for the subenclosure and is defined in table 6. After reporting a non-zero value, the enclosure services process shall set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 00h and shall set the SUBENCLOSURE DOWNLOAD MICROCODE ADDITIONAL STATUS field to 00h

Table 6 — SUBENCLOSURE DOWNLOAD MICROCODE STATUS field

Code	Description
00h	No download microcode operation in progress.
01h	Download microcode operation in progress. The enclosure services process has received one or more Download Microcode Control diagnostic pages and is awaiting additional microcode data.
02h	Download microcode operation data transfer complete, currently updating non-volatile storage
03h - 0Fh	Reserved for codes indicating interim status
10h	Download microcode operation complete with no error. The enclosure services process begins using the new microcode after returning this status.
11h	Download microcode operation complete with no error. The enclosure services process (e.g., a standalone enclosure services process) begins using the new microcode after the next hard reset or power on.
12h	Download microcode operation complete with no error. The enclosure services process (e.g., an attached enclosure services process) begins using the new microcode after the next power on.
13h - 7Fh	Reserved for codes indicating no error
80h	Error in one or more of the Download Microcode Control diagnostic page fields, new microcode discarded. The SUBENCLOSURE DOWNLOAD MICROCODE ADDITIONAL STATUS field shall be set to the offset of the lowest byte of whichever field in the Download Microcode Control diagnostic page which is in error.
81h	Microcode image error (e.g., a problem detected from a vendor-specific check of the microcode image such as a checksum), new microcode discarded
82h	Download microcode timeout, new microcode discarded. The enclosure services process may discard microcode data after a vendor-specific amount of time if it does not receive the entire microcode image.
83h	Internal error in the download microcode operation; new microcode image is needed before a hard reset or power on (e.g., a flash ROM write failed and no backup ROM image is available).
84h	Internal error in the download microcode operation; hard reset and power on safe (e.g., the enclosure services process will use a backup ROM image on hard reset or power on).
05h - EFh	Reserved for code indicating errors
F0h - FFh	Vendor-specific error in the download microcode operation; microcode image status is vendor-specific.

The SUBENCLOSURE DOWNLOAD MICROCODE ADDITIONAL STATUS field provides additional status for certain values of the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field as described in table 6.

The SUBENCLOSURE DOWNLOAD MICROCODE MAXIMUM SIZE field indicates the maximum size in bytes of the microcode image that the enclosure services process accepts. The image may be delivered using one or more Download Microcode Control diagnostic pages.

The SUBENCLOSURE DOWNLOAD MICROCODE EXPECTED BUFFER ID field indicates the next value that the enclosure services process expects in the BUFFER ID field in the Download Microcode Control diagnostic page. If the enclosure services process accepts multiple BUFFER ID field values concurrently, it shall set the SUBENCLOSURE DOWNLOAD MICROCODE EXPECTED BUFFER ID field to FFh.

The SUBENCLOSURE DOWNLOAD MICROCODE EXPECTED BUFFER OFFSET field indicates the next value that the enclosure services process expects in the BUFFER OFFSET field in the Download Microcode Control diagnostic page. If the enclosure services process accepts arbitrary BUFFER OFFSET field values, it shall set the SUBENCLOSURE DOWNLOAD MICROCODE EXPECTED BUFFER OFFSET field to FFFFFFFFh.