To: T10 Technical Committee
From: Rob Elliott, Compaq Computer Corporation (Robert.Elliott@compaq.com)
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Subject: T10/01-199r1 SPC-3 SPI-4 SBC-2 SSC-2 sense data changes

Revision History

Revision 0 (17 July 2001) first revision
Revision 1 (5 November 2001) included maximum sense data length fix from July SRP WG and picked a solution. Incorporated comments from September CAP WG.

Related Documents

spc2r19 - SCSI Primary Commands - 2 revision 19
ssc2r06 – SCSI Stream Commands – 2 revision 6
sbc2r03 – SCSI Block Commands – 2 revision 4
spi4r06 - SCSI Parallel Interface - 4 revision 6

Overview

1. The sense data format can be 263 bytes. REQUEST SENSE can only return 255 bytes. Autosense support by various protocols can also impose limits: SPI-4 has a 32-bit field and requires even and less than or equal to 252 bytes, SRP has a 32-bit field and requires multiples of 4, FCP-2 has a 32-bit field, and iSCSI has a 16 bit field. The sense data should be limited to the smallest of these. The September CAP WG recommended imposing a 4 byte alignment on the length, thus making it 252 bytes. Protocol specifications should remain silent on any limits; SPC-2's sense data format should be the sole place this is enforced.

2. SPC-2 includes a long list of device-type specific behavior that more properly belongs in the device command set standards.

~~2~~3. Sense data includes a 4 byte INFORMATION field that can contain values like an LBA or a residual based on the device types and/or command. This field is not big enough for commands using 8 byte LBAs, commands with 8 byte residuals, or bidirectional commands with multiple residuals.

SBC-2 includes that access > 2 TB like READ(16) and WRITE(16). The LBAs for these commands are 8 bytes long and don't fit in the INFORMATION field. A temporary workaround was added to SPC-2 declaring that if the LBA does not fit in 4 bytes, the VALID bit for the INFORMATION field is set to 0. A complete solution needs to be provided.

SBC-2 includes a bidirectional command that can result in two residuals, one for each direction. Future command sets may define more bidirectional commands with similar properties. The residual size is limited by the size of the transfer length field, which is currently 4 bytes in SBC-2. A pair of these residuals does not fit in the INFORMATION field.

SSC-2 includes a set of commands for an explicit model that use 8 byte LBAs like SBC-2. The definition of INFORMATION is yet to be defined for all these commands, but it might be needed to carry the LBA like in SBC-2 or a long residual reflecting distance from a long LBA.

SSC-2 include a SPACE(16) command, used in both explicit and implicit models, that uses an 8 byte COUNT field. This means an 8 byte residual must be stored in the sense data.

Possible solutions:

a) For each command requiring more than 4 bytes of INFORMATION data, use the 4-byte COMMAND-SPECIFIC INFORMATION field to hold the additional data. Each new command definition would define its use of the field. This solution leaves the sense data format unchanged. Unfortunately, some commands use COMMAND-SPECIFIC INFORMATION for a 2nd LBA.
b) Define a new sense data format (e.g. 72h). This would be incompatible with all existing software.

c) Claim some bytes in the additional sense data (byte 19+). Many vendors use this as vendor-specific data, even though it is marked reserved for definition by commands.
d) Use the INFORMATION field to point to a location in the additional sense data where the long LBA (or whatever) is located – this avoids interfering with any vendor-specific data.

Solution d) is proposed.

Open issue: should another bit in the sense data be used to indicate that INFORMATION contains a pointer rather than real data? Use another bit for COMMAND SPECIFIC INFORMATION or use one bit to cover both?

Specific usage of INFORMATION and COMMAND SPECIFIC INFORMATION fields where they store LBAs or residuals:

Today only EXTENDED COPY (SPC-2), REASSIGN BLOCKS (SBC-2), and certain XOR commands (SBC-2) use the COMMAND SPECIFIC INFORMATION field. Many commands use the INFORMATION field.

SPC-3:

a) EXTENDED COPY (7.2.3) stores either a 2 byte segment number (in the "third and fourth" bytes) or a pointer into the sense data in this field in the first or second bytes. It stores a residual in the INFORMATION field. When EXTENDED COPY is expanded to support SBC-2 and SSC-2, none of these fields should grow so no additional work looks necessary.

SBC-2:

b) REASSIGN BLOCKS (5.1.14) stores the first LBA of the first defect descriptor that was not reassigned. The current description discusses storing FFFFFFFF FFFFFFFFh into it if LONGLBA is one, which is not possible. (Editor's note: this section uses "COMMAND-SPECIFIC" rather than "COMMAND SPECIFIC" making searching difficult)

c) In the MEDIUM SCAN description (5.2.3), a REQUEST SENSE following the MEDIUM SCAN is supposed to return an LBA in the "information bytes" and a number of contiguous logical blocks in the "command specific information bytes". (Editor's note: this section uses lower case making searching difficult)

d) in a third party command REBUILD, REGENERATE or XPWRITE EXTENDED (4.2.3.6.4) where a secondary command fails without a CHECK CONDITION from the target, the first byte of the COMMAND SPECIFIC INFORMATION field contains a pointer to the first byte in the sense data where the primary target's sense data in response to the secondary command is stored. (Note: this means the sense data for the primary command plus the secondary command must combine to be less than 252 bytes)

e) in a third party command REBUILD, REGENERATE or XPWRITE EXTENDED (4.2.3.6.4) where a secondary command fails with a CHECK CONDITION from the target, the second byte of the COMMAND SPECIFIC INFORMATION field contains a pointer to the first byte in the sense data that points to the status byte, followed by sense data, of the secondary target. . (Note: this means the sense data for the primary command plus a status byte and sense data for the secondary command must combine to be less than 252 bytes)

f) in a REBUILD or REGENERATE command (4.2.3.6.4), the third byte of the COMMAND SPECIFIC INFORMATION field contains an index pointing to the source descriptor of the failing target for the secondary command.

g) SPC-2 mentions that EXTENDED COPY and REASSIGN BLOCKS use the COMMAND SPECIFIC INFORMATION field (7.20.2). 7.20.3 mentions it in a segment descriptor definition.

SSC-2:

h) SPACE(16) returns a residual in the INFORMATION field.

i) The information field is not defined for LOCATE(10) or LOCATE(16).

j) The information field is not well-defined for ERASE(16), READ(16), READ REVERSE(16), RECOVER BUFFERED DATA(16), and VERIFY(16). Is the residual relative to the original position? If so, the implicit LOCATE means the residual could be eight bytes.

Suggested Changes to SPI-4

[remove the length limit which will no longer be necessary]

14.3.5 SPI status information unit

…

If sense data is provided, the sense data valid bit (SNSVALID) shall be set to one and the SENSE DATA LIST LENGTH field shall specify the number of bytes in the SENSE DATA field. The SENSE DATA LIST LENGTH field shall only contain even lengths ~~greater than zero and shall not be set to a value greater than 252~~.

If no sense data is provided, the sense data valid bit (SNSVALID) shall be set to zero. The initiator shall ignore the SENSE DATA LIST LENGTH field and shall assume a length of zero.

Suggested Changes to SPC-3

[add the 252 byte limit to the sense data format.]

7.20.1 REQUEST SENSE command introduction

…

Device servers shall be capable of returning eighteen bytes of data in response to a REQUEST SENSE command. If the allocation length is eighteen or greater, and a device server returns less than eighteen bytes of data, the application client should assume that the bytes not transferred would have been zeros had the device server returned those bytes. Application clients may determine how much sense data has been returned by examining the ALLOCATION LENGTH field in the CDB and the ADDITIONAL SENSE LENGTH field in the sense data. Device servers shall not adjust the additional sense length to reflect truncation if the allocation length is less than the sense data available.

7.20.2 Sense data format

A VALID bit of zero indicates that the INFORMATION field is not ~~as defined in this standard~~valid. A VALID bit of one indicates the INFORMATION field contains valid information as defined in th~~is standard~~e command set standard. Device servers shall implement the VALID bit.

Response code value 70h (current errors) is described in 7.20.4. Device servers shall implement response code 70h. Response code value 71h (deferred errors) is described in 7.20.5. Implementation of response code 71h is optional. Response code 7Fh is for a vendor specific sense data formats. Response code values of 72h to 7Eh and 00h to 6Fh are reserved values are defined in table xx.

Table xx. RESPONSE CODE values

RESPONSE CODE value	**Type**	**Description**
00 – 6Fh		reserved
70h	M	current errors (see 7.20.4)
71h	O	deferred errors (see 7.20.5)
72h – 7Eh		reserved
7Fh	O	vendor-specific
Key: M = Command implementation is mandatory. O = Command implementation is optional.		

…

The contents of the INFORMATION field is device-type or command specific and is defined within the appropriate standard for the device type or command of interest. ~~Device servers shall implement the INFORMATION field.~~

[Option 1: add references to the command set standards after each device type number and remove the SSC portion altogether.]
[Option 2: remove this whole list. Text is added to the processor commands below. MMC-3, SBC-2, SSC-2 already describe their use. Printers are obsolete.]
Unless specified otherwise, ~~this~~ the INFORMATION field contains:

a) [this already exists in MMC/SBC] the ~~unsigned~~ logical block address associated with the sense key, for direct-access devices (device type 0)(see SBC-2), write-once devices (device type 4)(see SBC-2), CD-ROM devices (device type 5)(see MMC-3), and optical memory devices (device type 7)(see SBC-2). ~~If the logical block address value cannot be represented in four bytes, the VALID bit shall be set to zero;~~
b) [this already exists in SSC-2/elsewhere in SPC-3/SBC-2] the difference (residue) of the requested length minus the actual length in either bytes or blocks, as determined by the command, for sequential-access devices (device type 1)(see SSC-2)[already exists], printer devices (device type 2)[obsolete], processor devices (device type 3)(see clause 6)[needs to be added] and some direct access device commands (see SBC-2)[already exists], except as defined for d) below. Negative values are indicated by two's complement notation;
c) [this already exists elsewhere in SPC-3] the difference (residue) of the requested number of blocks minus the actual number of blocks copied or compared for the current segment descriptor of an EXTENDED COPY command (see 7.2); or
d) [this already exists in SSC]~~for sequential-access devices operating in buffered modes 1h or 2h that detect an unrecoverable write error when unwritten data blocks, filemarks, or setmarks remain in the buffer, the value of the INFORMATION field for all commands shall be:~~
   ~~a) the total number of data blocks, filemarks, and setmarks in the buffer if the device is in fixed block mode (i.e., BLOCK LENGTH field of the MODE SENSE block descriptor is non-zero and the FIXED bit of the WRITE command is one); or~~
   ~~b) the number of bytes in the buffer, including filemarks and setmarks, if the device is in variable mode (i.e., the FIXED bit of the WRITE command is zero).~~

~~For additional information on the use of the INFORMATION field by sequential-access devices see SSC.~~

The ADDITIONAL SENSE LENGTH field indicates the number of additional sense bytes to follow. The ADDITIONAL SENSE LENGTH shall be less than or equal to 244, limiting the total length of the sense data to 252 bytes. If the allocation length of the REQUEST SENSE CDB is too small to transfer all of the additional sense bytes, the additional sense length is not adjusted to reflect the truncation~~.~~

The COMMAND-SPECIFIC INFORMATION field contains information that depends on the command that encountered the exception condition. Further meaning for this field is defined within the command description. The COMMAND-SPECIFIC INFORMATION field is mandatory if the device server supports any of the following commands: EXTENDED COPY (see x.y) and REASSIGN BLOCKS (see SBC-2).

…
The additional sense bytes may contain command specific data, peripheral device specific data, or vendor specific data that further defines the nature of the CHECK CONDITION status.

10.2 RECEIVE command
The RECEIVE command (see table 195) requests that the device server transfer data to the initiator. The contents of the data are not defined by this standard.

…
The TRANSFER LENGTH field specifies the length in bytes of data that shall be transferred to the Data-In Buffer. A transfer length of zero indicates that no data shall be sent. This condition shall not be considered an error.

If the RECEIVE command fails with a CHECK CONDITION, the INFORMATION field of the sense data shall contain the difference (residue) of the requested length minus the actual length in bytes. Negative values are indicated by two's complement notation;

10.3 SEND command
The SEND command (see table 196) requests that the device server transfer data from the initiator.
…
An asynchronous event reporting (AER) bit of one indicates that the data to be transferred conforms to AER data format as defined in table 197. A SEND command with an AER bit of one shall be only issued to logical unit zero.

An AER bit of zero indicates that the data to be transferred are vendor specific.

The TRANSFER LENGTH field specifies the length in bytes of data that shall be transferred from the Data-Out Buffer.

A transfer length of zero indicates that no data shall be sent. This condition shall not be considered an error.

If the SEND command fails with a CHECK CONDITION, the INFORMATION field of the sense data shall contain the difference (residue) of the requested length minus the actual length in bytes. Negative values are indicated by two's complement notation;

…
If the SCSI-3 bit is zero, then the AEN data format, as defined by the SCSI-2 standard, shall be used. If the SCSI-3 bit is one, then the AER data format shown in table 197 shall be used.

The LUN field shall contain the logical unit number on which the asynchronous event occurred. The LUN field shall have the properties defined in SAM-2.

The sense data bytes shall have the format defined in 7.20.2.

Suggested Changes to SBC-2
4.2.1 Direct-access device type model
4.2.1.13 Error reporting

If any of the following conditions occur during the execution of a command, the command shall be terminated with CHECK CONDITION status and the sense key shall be set to the appropriate sense key with the appropriate additional sense code for the condition. Some errors may occur after the completion status has already been reported. For such errors, SPC-2 defines a deferred error reporting mechanism. Table 3 illustrates some error conditions and the applicable sense keys. The list does not provide an exhaustive enumeration of all conditions that may cause the CHECK CONDITION status.

Table 3 - Example error conditions

Condition	Sense key
Invalid logical block address	ILLEGAL REQUEST
Unsupported option requested	ILLEGAL REQUEST
Logical unit reset or medium change since last command from this application client	UNIT ATTENTION
Self diagnostic failed	HARDWARE ERROR
Unrecovered read error	MEDIUM ERROR or HARDWARE ERROR
Recovered read error	RECOVERED ERROR
Overrun or other error that might be resolved by repeating the command	ABORTED COMMAND
Attempt to write on write protected medium	DATA PROTECT

~~In the case of an invalid logical block address, the sense data INFORMATION field shall be set to the logical block address of the first invalid address.~~

~~In the case of an attempt to read a blank or previously unwritten block, the sense data INFORMATION field shall be set to the logical block address of the first blank block encountered. The data read up to that block shall be transferred (optical memory and write-once block devices only).~~

~~In the case of an attempt to write a previously written block when blank checking is enabled, the sense data INFORMATION field shall be set to the logical block address of the first non-blank block encountered (optical memory and write-once block devices only).~~

When an invalid logical block address is encountered, the first invalid logical block address shall be returned in the sense data. When a recovered read error is reported, the sense data shall contain the logical block address of the last recovered error during the trasfer. When an unrecovered read error is reported, the sense data shall contain the logical block address of the unrecovered logical block.

To return a 4-byte logical block address, the sense data VALID bit shall be set to one and the INFORMATION field shall be set to the logical block address. To return an 8-byte logical block address:

a) the sense data shall include additional sense bytes;
b) the additional sense bytes shall include the 8-byte logical block address (not necessarily the first additional bytes) at an offset divisible by 8;
c) the valid bit shall be set to one; and
d) the INFORMATION field of the sense data shall contain the offset of the logical block address in the sense data.

[Editor's note: this is the direct access model, so mentioning optical and write-once is inappropriate. They have their own error reporting sections.]

4.2.3 Model for XOR commands
4.2.3.6 Error handling considerations
4.2.3.6.4 Secondary errors - errors resulting from the secondary command

The second class of errors consists of exception conditions resulting from the failure of a secondary command. The sense data for such errors shall be passed to the initiator of the primary command in the additional sense code field of the sense data.

If the primary target detects the exception (i.e., by some means other than receiving CHECK CONDITION status from the secondary target) it shall:

1) terminate the primary command with CHECK CONDITION status;
2) set the sense key to ABORTED COMMAND if there are no primary errors to report. Otherwise, the sense key shall be set according to the primary error;
3) set the first byte of the COMMAND SPECIFIC INFORMATION field of the sense data to the starting byte number, relative to the first byte of sense data, of an area that contains the primary target's sense data for the secondary error. A zero value in this byte indicates no secondary error has been detected by the primary target. The secondary sense data shall be built in the standard sense data format as defined for the REQUEST SENSE command; and
4) in the case of a REBUILD or REGENERATE primary command, set the third byte of the COMMAND SPECIFIC INFORMATION field of the sense data to an index value indicating the target identifier of the failing secondary target. This value shall be an index into the source descriptor entries of the parameter data of the primary command, and shall point to the entry containing the target identifier of the failing device; 0 points to the first entry, 1 points to the second entry, etc. This byte shall be ignored if the primary command is not a REBUILD or REGENERATE.

If the secondary target detects the exception, the primary target receives CHECK CONDITION status from the secondary target. The primary target shall recover the sense data associated with the exception condition, clear any exception conditions associated with the CHECK CONDITION status, and shall:

1) terminate the primary command with CHECK CONDITION status;
2) set the sense key to ABORTED COMMAND if there are no primary errors to report. Otherwise, the sense key shall be set according to the primary error;
3) set the second byte of the COMMAND SPECIFIC INFORMATION field of the sense data to the starting byte number, relative to the first byte of sense data, of an area that contains (unchanged) the secondary target's status byte followed by its sense data. A zero value in this byte indicates no secondary error has been reported by the secondary target; and
4) in the case of a REBUILD or REGENERATE (primary) command, set the third byte of the COMMAND SPECIFIC INFORMATION field of the sense data to an index value indicating the target identifier of the failing secondary target. This value shall be an index into the source descriptor entries of the parameter data of the primary command, and shall point to the entry containing the target identifier of the failing device; 0 points to the first entry, 1 points to the second entry, etc. This byte is invalid and shall be ignored if the primary command is not a REBUILD or REGENERATE.

For a given primary command, if errors are generated by more than one secondary command, the sense data shall contain error information for the secondary error first obtained by the primary target.

Since, for secondary errors, the sense key is set to ABORTED COMMAND only if there are no primary errors to report (see item 2 above), the first and second bytes of the COMMAND SPECIFIC INFORMATION field should be checked, even when the sense key is a value other than ABORTED COMMAND, to determine if any secondary errors have occurred.

Note 1 - All three of the above error types might occur during the same third party operation. If this happens, there are three unique pieces of error information contained in the sense data: one for the primary error (starting at byte 0), and two for the secondary errors (in the additional sense code).

4.3 Model for optical memory block devices

4.3.3 Error reporting

If any of the following conditions occur during the execution of a command the device server shall return CHECK CONDITION status and the appropriate sense key shall be set with the appropriate additional sense code for the condition. Table 4 illustrates some error conditions and the applicable sense keys. The list does not provide an exhaustive enumeration of all conditions that may cause the CHECK CONDITION status.

Table 4 - Error condition examples

Condition	Sense key
Invalid logical block address	ILLEGAL REQUEST
Unsupported option requested	ILLEGAL REQUEST
Logical unit reset or medium change since last command from this application client	UNIT ATTENTION
Self diagnostic failed	HARDWARE ERROR
Unrecovered read error	MEDIUM ERROR or HARDWARE ERROR
Recovered read error	RECOVERED ERROR
Overrun or other error that might be resolved by repeating the command	ABORTED COMMAND
Attempt to write on write protected medium	DATA PROTECT
Attempt to read a blank or previously unwritten block	BLANK CHECK
Attempt to write a previously written block and blank checking is enabled	BLANK CHECK
Attempt to write on read-only medium	DATA PROTECT

~~In the case of an invalid logical block address, the sense data INFORMATION field shall be set to the logical block address of the first invalid address.~~

~~In the case of an attempt to read a blank or previously unwritten block, the sense data INFORMATION field shall be set to the logical block address of the first blank block encountered. The data read up to that block shall be transferred.~~

~~In the case of an attempt to write a previously written block when blank checking is enabled, the sense data INFORMATION field shall be set to the logical block address of the first non-blank block encountered.~~

When an invalid logical block address is encountered, the first invalid logical block address shall be returned in the sense data. When a recovered read error is reported, the sense data shall contain the logical block address of the last recovered error during the trasfer. When an unrecovered read error is reported, the sense data shall contain the logical block address of the unrecovered logical block. When an attempt is made to read a blank or previously unwritten block, the first blank or unwritten logical block address shall be returned in the sense data. The data read up to that block shall be transferred. When an attempt is made to write a previously written block when blank checking is enabled, the first non-black logical block address shall be returned in the sense data.

To return a 4-byte logical block address, the sense data VALID bit shall be set to one and the INFORMATION field shall be set to the logical block address. To return an 8-byte logical block address:

a) the sense data shall include additional sense bytes;
b) the additional sense bytes shall include the 8-byte logical block address (not necessarily the first additional bytes) at an offset divisible by 8;
c) the valid bit shall be set to one; and

d) the INFORMATION field of the sense data shall contain the offset of the logical block address in the sense data.

4.4 Model for write-once block devices

4.4.5 Error reporting

If any of the following conditions occur during the execution of a command the device server shall return CHECK CONDITION status and the appropriate sense key shall be set with the additional sense code for the condition. Table 5 illustrates some error conditions and the applicable sense keys. The list does not provide an exhaustive enumeration of all conditions that may cause the CHECK CONDITION status.

Table 5 - Error condition examples

Condition	Sense key
Invalid logical block address	ILLEGAL REQUEST
Unsupported option requested	ILLEGAL REQUEST
Logical unit reset or medium change since last command from this application client	UNIT ATTENTION
Self diagnostic failed	HARDWARE ERROR
Unrecovered read error	MEDIUM ERROR or HARDWARE ERROR
Recovered read error	RECOVERED ERROR
Overrun or other error that might be resolved by repeating the command	ABORTED COMMAND
Attempt to write on write protected medium	DATA PROTECT
Attempt to read a blank or previously unwritten block	BLANK CHECK
Attempt to write a previously written block and blank checking is enabled	BLANK CHECK

~~In the case of an invalid logical block address, the sense data INFORMATION field shall be set to the logical block address of the first invalid address.~~

~~In the case of an attempt to read a blank or previously unwritten block, the sense data INFORMATION field shall be set to the logical block address of the first blank block encountered. The data read up to that block shall be transferred.~~

~~In the case of an attempt to write a previously written block and blank checking is enabled, the sense INFORMATION field shall be set to the logical block address of the first non-blank block encountered.~~

When an invalid logical block address is encountered, the first invalid logical block address shall be returned in the sense data. When a recovered read error is reported, the sense data shall contain the logical block address of the last recovered error during the trasfer. When an unrecovered read error is reported, the sense data shall contain the logical block address of the unrecovered logical block. When an attempt is made to read a blank or previously unwritten block, the first blank or unwritten logical block address shall be returned in the sense data. The data read up to that block shall be transferred. When an attempt is made to write a previously written block when blank checking is enabled, the first non-black logical block address shall be returned in the sense data.

To return a 4-byte logical block address, the sense data VALID bit shall be set to one and the INFORMATION field shall be set to the logical block address. To return an 8-byte logical block address:

a) the sense data shall include additional sense bytes;
b) the additional sense bytes shall include the 8-byte logical block address (not necessarily the first additional bytes) at an offset divisible by 8;
c) the valid bit shall be set to one; and
d) the INFORMATION field of the sense data shall contain the offset of the logical block address in the sense data.

5.1.14 REASSIGN BLOCKS command

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If the block device is unable to successfully complete a REASSIGN BLOCKS command, the command shall terminate with CHECK CONDITION status with the appropriate sense information. If LONGLBA is set to zero, ~~T~~the logical block address of the first defect descriptor not reassigned shall be returned in the COMMAND-SPECIFIC INFORMATION field of the sense data. If LONGLBA is set to one:

a) the sense data shall include additional sense bytes;
b) the additional sense bytes shall include the 8-byte logical block address (not necessarily the first additional bytes) at an offset divisible by 8;
c) the valid bit shall be set to one; and
d) the COMMAND-SPECIFIC NFORMATION field of the sense data shall contain the offset of the logical block address in the sense data.

If information about the first defect descriptor not reassigned is not available, or if all the defects have been reassigned, ~~this~~ the COMMAND-SPECIFIC INFORMATION field shall be set to FFFFFFFFh. ~~if LONGLBA is set to zero or FFFFFFFF FFFFFFFFh if LONGLBA is set to one.~~

If the REASSIGN BLOCKS command failed due to an unexpected unrecoverable read error that would cause the loss of data in a block not specified in the defect list, the Logical block address of the unrecoverable block shall be returned in the INFORMATION field of the sense data and the valid bit shall be set to one.

Note 2 - If the REASSIGN BLOCKS command returns CHECK CONDITION status and the sense data COMMAND-SPECIFIC INFORMATION field ~~contains~~ provides a valid logical block address, the application client should remove all defect descriptors from the defect list prior to the one ~~returned in~~provided by the COMMAND-SPECIFIC INFORMATION field. If the sense key is MEDIUM ERROR and the VALID bit is one (the INFORMATION field ~~contains~~ provides the valid block address) the application client should insert that new defective logical block address into the defect list and reissue the REASSIGN BLOCKS command with the new defect list. Otherwise, the application client should perform any corrective action indicated by the sense data and then reissue the REASSIGN BLOCKS command with the new defect list.

[where does it say that information contains a valid block address on a MEDIUM ERROR? Only indirectly from the read-write error recovery page description for unrecoverable errors, plus the table showing unrecoverable errors can generate MEDIUM ERROR sense keys.]

5.2.3 MEDIUM SCAN command

…

A REQUEST SENSE command following a satisfied MEDIUM SCAN command shall:

a) return a sense key of EQUAL if the scan was satisfied by a contiguous set of blocks equal in size to the number of blocks requested. If the PRA bit is one and the scan was satisfied by a contiguous set of blocks less than the number of blocks requested, then a sense key of NO SENSE shall be returned;

b) return the valid bit set to one;
c) return the logical block address of the first logical block of the contiguous set of blocks that satisfied the scan criteria in the INFORMATION field;
d) return the number of contiguous logical blocks meeting the scan criteria in the COMMAND-SPECIFIC INFORMATION field.

[Editor's note: The MEDIUM SCAN command is currently only available in a short LBA version, so no change is needed at this time.]

6.2.7 Read-write error recovery page

The read-write error recovery page (see Table 112) specifies the error recovery parameters the device server shall use during any command that performs a read or write operation to the medium (e.g., READ, WRITE, WRITE AND VERIFY, etc.).

...

The individual bit definitions for EER, PER, DTE and DCR are contained in Table 113. The combinations of these bits are explained in Table 114.

...

Table 114 - Combined error recovery parameter descriptions

EER	PER	DTE	DCR	Description
0	0	0	0	The full number of retries (specified in the READ, WRITE or VERIFY RETRY COUNT field) and error correction are attempted to recover the data (EER and DCR equal 0). A CHECK CONDITION is not reported at the completion of the command for recovered errors (PER equal 0). The command terminates with CHECK CONDITION status before the transfer count is exhausted only if an unrecoverable error is detected. If an unrecoverable data error occurred, the data in the block with the unrecoverable error may or may not be transferred to the application client depending on the setting of the transfer block (TB) bit (read operation only).
0	0	0	1	Error correction is disabled (DCR equal one) so only the full number of retries (specified in the READ, WRITE or VERIFY RETRY COUNT field) are attempted to recover the data (EER equal 0). A CHECK CONDITION is not reported at the completion of the command for recoverable errors (PER equal 0). The command terminates with CHECK CONDITION status before the transfer count is exhausted only if an unrecoverable error is detected. If an unrecoverable data error occurred, the data in the block with the unrecoverable error may or may not be transferred to the application client depending on the setting of the transfer block (TB) bit (read operation only).
0	0	1	0	Invalid mode (PER shall be set to one if DTE is one). [1]
0	0	1	1	Invalid mode (PER shall be set to one if DTE is one). [1]
0	1	0	0	The full number of retries (specified in the READ, WRITE or VERIFY RETRY COUNT field) and error correction are attempted to recover the data (EER and DCR equal 0). The command terminates with CHECK CONDITION status before the transfer count is exhausted only if an unrecoverable error is detected. If an unrecoverable data error occurred, the data in the block with the unrecoverable error may or may not be transferred to the application client depending on the setting of the transfer block (TB) bit (read operation only). A CHECK CONDITION with a sense key of RECOVERED ERROR is reported at the completion of the command for any recoverable error that occurs (PER equal 1). The ~~INFORMATION field in the~~ sense data shall contain the logical block address of the last recovered error that occurred during the transfer.
0	1	0	1	Error correction is disabled (DCR equal one) so only the full number of

				retries (specified in the READ, WRITE or VERIFY RETRY COUNT field) are attempted to recover the data (EER equal 0). The command terminates with CHECK CONDITION status before the transfer count is exhausted only if an unrecoverable error is detected. If an unrecoverable data error occurred, the data in the block with the unrecoverable error may or may not be transferred to the application client depending on the setting of the transfer block (TB) bit (read operation only). A CHECK CONDITION with a sense key of RECOVERED ERROR is reported at the completion of the command for any recoverable error that occurs (PER equal 1). The ~~INFORMATION field in the~~ sense data shall contain the logical block address of the last recovered error that occurred during the transfer.
0	1	1	0	The full number of retries (specified in the READ, WRITE or VERIFY RETRY COUNT field) and error correction are attempted to recover the data (EER and DCR equal 0). The command terminates with CHECK CONDITION status before the transfer count is exhausted if any error (recoverable or unrecoverable) is detected (DTE equal 1). The ~~INFORMATION field in the~~ sense data shall contain the logical block address of the block in error. If an unrecoverable data error occurs the data in the block with the error may or may not be transferred to the application client depending on the setting of the transfer block (TB) bit (read operation only.)
0	1	1	1	Error correction is disabled (DCR equal one) so only the full number of retries (specified in the READ, WRITE or VERIFY RETRY COUNT field) are attempted to recover the data (EER equal 0). The command terminates with CHECK CONDITION status before the transfer count is exhausted if any error (recoverable or unrecoverable) is detected (DTE equal 1). The ~~INFORMATION field in the~~ sense data shall contain the logical block address of the block in error. If an unrecoverable data error occurs the data in the block with the error may or may not be transferred to the application client depending on the setting of the transfer block (TB) bit (read operation only).
1	0	0	0	The fewest possible retries and error correction are attempted to recover the data (EER equal one and DCR equal 0). A CHECK CONDITION is not reported at the completion of the command for recoverable errors (PER equal 0). The command terminates with CHECK CONDITION status before the transfer count is exhausted only if an unrecoverable error is detected. If an unrecoverable data error occurred, the data in the block with the unrecoverable error may or may not be transferred to the application client depending on the setting of the transfer block (TB) bit (read operation only).
1	0	0	1	Invalid mode (DCR shall be set to zero if EER is one).[1]
1	0	1	0	Invalid mode (PER shall be set to one if DTE is one). [1]
1	0	1	1	Invalid mode (PER shall be set to one if DTE is one). [1]
1	1	0	0	The fewest possible retries and error correction are attempted to recover the data (EER equal one and DCR equal 0). The command terminates with CHECK CONDITION status before the transfer count is exhausted only if an unrecoverable error is detected. If an unrecoverable data error occurred, the data in the block with the unrecoverable error may or may not be transferred to the application client depending on the setting of the transfer block (TB) bit (read operation only). A CHECK CONDITION with a sense key of RECOVERED ERROR is reported at the completion of the command for any recoverable error that occurs (PER equal 1). The ~~INFORMATION field in the~~ sense data shall contain the logical block address of the last recovered error that occurred during the transfer.
1	1	0	1	Invalid mode (DCR shall be set to zero if EER is one). [1]

1	1	1	0	The fewest possible retries and error correction are attempted to recover the data (EER equal one and DCR equal 0). The command terminates with CHECK CONDITION status before the transfer count is exhausted if any error (recoverable or unrecoverable) is detected (DTE equal 1). The ~~INFORMATION field in the~~ sense data shall contain the logical block address of the block in error. If an unrecoverable data error occurs the data in the block with the error may or may not be transferred to the application client depending on the setting of the transfer block (TB) bit (read operation only).
1	1	1	1	Invalid mode (DCR shall be set to zero if EER is one). [1]
Note (1) If an invalid mode for the error recovery combination is sent by the application client the device server shall return CHECK CONDITION status and the sense key shall be set to ILLEGAL REQUEST with the additional sense code set to INVALID FIELD IN PARAMETER LIST				

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The HEAD OFFSET COUNT field specifies in two's-complement notation an incremental offset position from the track center to the radial position the heads shall be moved. The effect of this field on write operations is unspecified. A HEAD OFFSET COUNT of zero indicates that no offset is specified. A positive value indicates moving in the direction of increasing logical block addresses. A negative value indicates moving in the direction of decreasing logical block addresses. Any value specified in this field does not preclude the device server from using positive or negative head offset during error recovery. However, after any error recovery is completed the device server shall return the head offset to the value specified in this field.

Note 34 - The degree of offset for each incremental value and the number of valid values are vendor-specific. The number of valid values should be equal for the positive and negative head offset counts.

The device server shall return CHECK CONDITION status and set the sense key to ILLEGAL REQUEST with the appropriate additional sense code for the condition if an unsupported head offset value is specified. The VALID bit shall be set to one and the INFORMATION field shall be set to the positive value of the maximum head offset count that is supported. The device server shall set the VALID bit to zero if the device server is unable to determine the maximum head offset count supported.

Note 35 - If the device server does not support this field, it returns a zero value in the MODE SENSE command).

[Editor's note: does the head offset field need to be expanded for long LBAs? We never resolved the issue of which of the head, cylinder, and sector fields needs to increase.]

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The DATA STROBE OFFSET COUNT field specifies in two's-complement notation an incremental position to where the recovered data strobe shall be adjusted from its nominal setting. The effect of this field on write operations is unspecified. A value of zero indicates that no data strobe offset is specified. A positive value indicates movement in a positive direction as defined by the device server. A negative value indicates movement in the negative direction as defined by the device server. Any value specified in this field does not preclude the device server from using positive or negative data strobe offset during error recovery. However, after any error recovery is completed the device server shall return the data strobe offset to the value specified in this field.

Note 36 - The degree of offset for each incremental value and the number of valid values are vendor-specific. The number of valid values should be equal for the positive and negative data strobe offset counts.

The device server shall return CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST with the appropriate additional sense code for the condition if an unsupported data strobe offset count value is specified. The VALID bit shall be set to one

and the INFORMATION field shall be set to the positive value of the maximum data strobe offset count that is supported. The device server shall set the valid bit to zero if the device server is unable to determine the maximum data strobe offset supported.

Note 3 - If the device server does not support the DATA STROBE OFFSET COUNT field, it returns a zero value in the MODE SENSE command.

Suggested Changes to SSC-2

[Editor's note: none of the explicit commands return an LBA in the INFORMATION field, so the only problem is SPACE(16) with the potential for an 8 byte residual.]

7.9 SPACE(16) command

The SPACE(16) command (see table 48) operates identically to the SPACE(6) command (see 6.6), but allows specifying a COUNT field up to eight bytes in length and has parameter data out that specifies the logical block address on the medium. Following completion of a SPACE(16) command a READ POSITION command shall be issued to obtain positioning information for continued operation in the explicit block address mode.

If an application client requests an unsupported function, the command shall be terminated with CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense code shall be set to INVALID FIELD IN CDB, and:

a) the sense data shall include additional sense bytes;

b) the additional sense bytes shall include, at an offset divisible by 8, the 8-byte magnitude of the count field minus the magnitude of the blocks, filemarks, or setmarks spaced over;

c) the VALID bit shall be set to one; and

d) the INFORMATION field of the sense data shall contain the offset of the 8-byte magnitude in the sense data.