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To: **T10 CAP Working Group**
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Subject: **SPC-4, Combinations of bits and fields in the LOG SELECT CDB and log parameters**

1 Related documents

04-389r6, SPC-4: Log Parameter Subpages, Kevin Butt, IBM
05-308r0, SPC-4 Remove restriction on counting log parameters, Michael Banther, H-P
SPC-3 r23

2 Introduction

While going through Kevin Butt's proposal and looking closely at SPC-3, I had difficulty comprehending the meaning of the combinations of bits in the LOG SELECT CDB and in the log parameters. To help my understanding, I made several very large tables trying to list every possible combination of interrelated bits and fields. Then I reduced the large tables to three much smaller tables that I thought contained all of the possibilities.

I worked with Michael Banther to incorporate the essence of his rounding proposal (05-308R0). This includes expanding the combinations of LP and LBIN to define how a parameter wraps by combining these bits into the FACL field.

After input from the CAP working group making minor modifications to the tables, Revision 2 of this proposal shows the specific changes proposed for SPC-4, incorporating the tables. The text remaining in clause 6.5 LOG SELECT command is only that which describes the CDB and actions taken based on values exclusively in the CDB (i.e., when the PARAMETER LIST LENGTH = 0000h). This includes the cases for "all values". All text exclusive to "parameters" has been moved to clause 7.2 Log parameters. The first section of this proposal shows affected clauses of the draft standard with revisions. The second section of this proposal shows the affected clauses with as they would be with revisions accepted and incorporated.

3 Proposal showing revisions

6.4 LOG SELECT command

The LOG SELECT command (see table 1) provides a means for an application client to manage statistical information maintained by the SCSI target device about the SCSI target device or its logical units. Device servers that implement the LOG SELECT command shall also implement the LOG SENSE command. Structures in the form of log parameters within log pages are defined as a way to manage the log data. The LOG SELECT command provides for sending zero or more log pages via the Data-Out Buffer. This standard defines the format of the log pages~~,~~ but does not define the conditions and events that are logged.

Table 1 — LOG SELECT command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (4Ch)							
1	Reserved						PCR	SP
2	PC		Reserved					
3	Reserved							
6								
7	(MSB)	PARAMETER LIST LENGTH						
8								(LSB)
9	CONTROL							

The values in the parameter code reset (PCR) bit, the save parameters (SP) bit, and the page control (PC) field specify actions that a SCSI target device performs after receiving a LOG SELECT command.

The PARAMETER LIST LENGTH field specifies the length in bytes of the parameter list that shall be located in the Data-Out Buffer. A parameter list length of zero specifies that no log pages shall be transferred. This condition shall not be considered an error.

Table 2 defines the meaning of the combinations of values for the PCR bit, the SP bit, and the PC field when the PARAMETER LIST LENGTH FIELD contains 0000h (i.e., there is no parameter data being sent with the LOG SELECT command).

Table 2 — Meaning for combinations of PCR, SP, and PC (part 1 of 2)

pcr	sp	pc	Description
0b	0b	0xb	This is not an error. The device server shall make no change to any current threshold values or any current cumulative values and shall not save any values to non-volatile media.
0b	xb	10b	The device server shall set all current threshold values to the vendor specific default threshold values[a] and shall not save any values to non-volatile media.
0b	xb	11b	The device server shall set all current cumulative values to the vendor specific default cumulative values[a] and shall not save any values to non-volatile media.

[a] Vendor specific default threshold values and vendor specific default cumulative values may be zero.
[b] Saving of cumulative and threshold values is optional.
[c] The command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

Table 2 — Meaning for combinations of PCR, SP, and PC (part 2 of 2)

pcr	sp	pc	Description
0b	1b	00b	The device server shall make no change to any current threshold values, and: a) if the device server implements saving of the current threshold values[b], then the device server shall save all current threshold values to non-volatile media, or b) if the device server does not.implement saving of the current threshold values[b], then the device server shall terminate the command[c].
0b	1b	01b	The device server shall make no change to any current cumulative values, and: a) if the device server implements saving of the current cumulative values[b], then the device server shall save all current threshold values to non-volatile media, or b) if the device server does not.implement saving of the current cumulative values[b], then the device server shall terminate the command[c].
1b	0b	xx	The device server shall: 1) set all current threshold values to the vendor specific default threshold values[a]; 2) set all current cumulative values to the vendor specific default cumulative values[a]; and 3) not save any values to non-volatile media.
1b	1b	00b	If the device server: a) implements saving of the current threshold values[b], then the device server shall: 1) save all current threshold values to non-volatile media; 2) set all current threshold values to the vendor specific default threshold values[a]; and 3) set all current cumulative values to the vendor specific default cumulative values[a]; or b) does not implement saving of the current threshold values[b], then the device server shall terminate the command[c].
1b	1b	01b	If the device server: a) implements saving of the current cumulative values[b], then the device server shall: 1) save all current cumulative values to non-volatile media; 2) set all current threshold values to the vendor specific default threshold values[a]; and 3) set all current cumulative values to the vendor specific default cumulative values[a]; or b) If the device server does not implement saving of the current cumulative values, then the device server shall terminate the command[c].
1b	1b	1xb	The device server: 1) shall set all current threshold values to the vendor specific default threshold values[a]; 2) shall set all current cumulative values to the vendor specific default cumulative values[a]; and 3) shall not save any values to non-volatile media.

[a] Vendor specific default threshold values and vendor specific default cumulative values may be zero.
[b] Saving of cumulative and threshold values is optional.
[c] The command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

~~A parameter code reset (pcr) bit set to one and a parameter list length of zero shall cause all implemented parameters to be set to the vendor specific default values (e.g., zero).~~ If the PCR bit is set to one and the parameter list length is greater than zero, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB. ~~A pcr bit set to zero specifies that the log parameters shall not be reset.~~

A save parameters (sp) bit set to one specifies that after performing the specified LOG SELECT operation the device server shall save to nonvolatile memory all parameters identified as saveable by the ds bit in the log page (see 7.2). A sp bit set to zero specifies that parameters shall not be saved.

Saving of log parameters is optional and indicated for each log parameter by the ds bit in the log page. Log parameters also may be saved at vendor specific times subject to the tsd bit (see 7.2) in the log parameter and the gltsd bit in the Control mode page (see 7.4.6). If the logical unit does not implement saved parameters for any log parameter and the sp bit is set to one, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

It is not an error to set the sp bit to one and to set the ds bit of a log parameter to one. In this case, the parameter value for that log parameter is not saved.

The page control (pc) field defines the type of parameter values to be selected. The pc field is defined in table 3.

Table 3 — Page control (pc) field

pc	LOG SELECT parameter values	LOG SENSE parameter values
00b	Current threshold values	Threshold values
01b	Current cumulative values	Cumulative values
10b	Default threshold values	Default threshold values
11b	Default cumulative values	Default cumulative values

The current cumulative values may be updated by the device server or by the application client using the LOG SELECT command to reflect the cumulative number of events experienced by the logical unit. Fields in the parameter control byte (see 7.2) of each log parameter control the updating and saving of the current cumulative parameters.

The device server shall set the current threshold parameters to the default threshold values in response to a LOG SELECT command with the pc field set to 10b and the parameter list length field set to zero.

The device server shall set all cumulative parameters to their default values in response to a LOG SELECT command with the pc field set to 11b and the parameter list length field set to zero.

The current threshold values may only be modified by the application client via the LOG SELECT command. If the application client attempts to change current threshold values that are not available or not implemented for that log parameter, then the device server shall terminate the LOG SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST. The saving of current threshold parameters and the criteria for the current threshold being met are controlled by bits in the parameter control byte (see 7.2).

NOTE 1 - Log pages or log parameters that are not available may become available at some later time (e.g., after the logical unit has become ready).

The actions that a SCSI target device performs after receiving a LOG SELECT command determined by the values in the PCR bit, the SP, and the PC field when the PARAMETER LIST LENGTH FIELD contains a value greater than 0000h are defined in 7.2.

The parameter list length field specifies the length in bytes of the parameter list that shall be located in the Data-Out Buffer. A parameter list length of zero specifies that no log pages shall be transferred. This condition shall not be considered an error. If an application client sends page codes or parameter codes within the parameter list that are reserved or not implemented by the logical unit, then the device server shall terminate the LOG SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

~~If a parameter list length results in the truncation of any log parameter, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST. The additional sense code should be set to PARAMETER LIST LENGTH ERROR or may be set to INVALID FIELD IN CDB.~~

~~The application client should send log pages in ascending order by page code value if the Data-Out Buffer contains multiple log pages. If the Data-Out Buffer contains multiple log parameters within a log page, then they should be sent in ascending order by parameter code value. If the application client sends log pages out of order or parameter codes out of order, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.~~

~~NOTE 2 Application clients should issue LOG SENSE commands prior to issuing LOG SELECT commands to determine supported log pages and page lengths.~~

~~The SCSI target device may provide independent sets of log parameters for each logical unit or for each combination of logical units and I_T nexuses. If the SCSI target device does not support independent sets of log parameters and any log parameters are changed that affect other I_T nexuses, then the device server shall establish a unit attention condition (see SAM-3) for the initiator port associated with every I_T nexus except the I_T nexus on which the LOG SELECT command was received, with the additional sense code set to LOG PARAMETERS CHANGED.~~

~~If an application client sends a log parameter that is not supported by the logical unit, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.~~

Additional information about the LOG SELECT command is in Annex C.

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7.2 Log parameters

7.2.1 Log page structure and page codes for all device types

This subclause describes the log page structure and the log pages that are applicable to all SCSI devices. Log pages specific to each device type are described in the command standard (see 3.1.18) that applies to that device type. The LOG SELECT command (see 6.5) supports the ability to send zero or more log pages. The LOG SENSE command (see 6.6) returns a single log page specified in the PAGE CODE field of the CDB.

Each log page begins with a four-byte page header followed by zero or more variable-length log parameters defined for that log page. The log page format is defined in table 4.

Table 4 — Log page format

Bit / Byte	7	6	5	4	3	2	1	0
0	DS	SPF	PAGE CODE					
1	SUBPAGE CODE							
2	(MSB)		PAGE LENGTH (n-3)					
3								(LSB)
	Log parameter(s)							
4			Log parameter (First)					
x+3			(Length x)					
			.					
			.					
n-y+1			Log parameter (Last)					
n			(Length y)					

[editor's note: the DS bit and SP bit are in what was a two-bit field labeled "reserved". The SUBPAGE CODE field is in an 8-bit field that was labeled "reserved".]

The disable save (DS) bit operates in conjunction with the PCR bit, the SP bit, and the PARAMETER LIST LENGTH FIELD in the LOG SELECT CDB (see 6.4). Table 5 defines the meaning for all of the combinations of values for the PCR bit, the SP bit, and the DS bit when the PARAMETER LIST LENGTH FIELD contains a value greater than 0000h (i.e., parameter data is being sent with the LOG SELECT command).

Table 5 — Meaning for all combinations of PCR, SP, and DS when PARAMETER LIST LENGTH > 0000h

PCR	SP	DS	Description
0b	0b	xb	The device server shall set the specified values[a] to the values in the parameter list and shall not save any values to non-volatile media.
0b	1b	0b	The device server shall set the specified values[a] to the values in the parameter list and, a) If the specified values[a] are default threshold values or default cumulative values, then no values shall be saved; b) If the specified values[a] are current threshold values or current cumulative values and the device server implements saving of the specified values[a], the device server shall save the specified values[a] in the parameter list to non-volatile media; or c) If the specified values[a] are current threshold values or current cumulative values and the device server does not implement saving of the specified values[a], then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.
0b	1b	1b	The device server shall set the specified values[a] to the values in the parameter list and shall not save any values to non-volatile media.
1b	xb	xb	The device server shall terminate the command (see 6.4).

[a] The specified values are determined by the values in the PC field~~, the lp bit,~~ and the ~~lbin bit~~ FACL field (see table 6).

If the SubPage Format (SPF) bit is set to zero, then the SUBPAGE CODE field shall contain 00h. If the SPF bit is set to one, then the SUBPAGE CODE field shall contain a value between 01h and FFh.The value in the PAGE CODE field ~~is~~contains the number of the log page that is being transferred.

The value in the SUBPAGE code field contains the number of the log subpage that is being transferred.

If an application client specifies a value in the PAGE CODE field or SUBPAGE CODE field that is reserved or not implemented by the logical unit, then the device server shall terminate the LOG SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

[editor's note: we'll flesh out the subpage stuff as we add in material from other proposals.]

The value in the PAGE LENGTH field is the length in bytes of the following log parameters. If the application client sends a log page length that results in the truncation of any parameter, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

Most log pages contain one or more special data structures called log parameters (see table 6). Log parameters may be data counters of a particular event(s), the conditions under which certain operations were performed, or list parameters that contain a character string description of a particular event.

Table 6 — Log parameter

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				PARAMETER CODE				(LSB)
2	DU	OBSOLETE~~DS~~	TSD	ETC	TMC		~~LBIN LP~~FACL	
3	PARAMETER LENGTH (n-3)							
4				PARAMETER VALUE				
n								

Each log parameter begins with a four-byte parameter header followed by one or more bytes of PARAMETER VALUE data.

The PARAMETER CODE field identifies the log parameter being transferred for that log page. If an application client specifies a value in the PARAMETER CODE field that is reserved or not implemented by the logical unit, then the device server shall terminate the LOG SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The DU bit,~~ ds bit,~~ TSD bit, ETC bit, TMC field, ~~LBIN bit,~~ and ~~LP bit~~FACL field are collectively referred to as the parameter control byte. These fields are described in this subclause.

For cumulative log parameter values, indicated by the PC field of the LOG SELECT and LOG SENSE commands, the disable update (DU) bit is defined as follows:

a) DU set to zero indicates that the device server shall update the log parameter value to reflect all events that should be noted by that parameter; or
b) DU set to one indicates that the device server shall not update the log parameter value except in response to a LOG SELECT command that specifies a new value for the parameter.

NOTE 3 - When updating cumulative log parameter values, a device server may use volatile memory to hold these values until a LOG SELECT or LOG SENSE command is received with an SP bit set to one or a vendor specific event occurs. As a result the updated cumulative log parameter values may be lost if a power cycle occurs.

The DU bit is not defined for threshold values, indicated by the PC field of the LOG SENSE command, or for list parameters as indicated by the ~~LP bit~~FACL field. The device server shall ignore the value of the DU bit in any such log parameters received with a LOG SELECT command.

~~A disable save (ds) bit set to zero indicates that the logical unit supports saving for that log parameter. The device server shall save the current cumulative or the current threshold parameter value, depending on the value in the pc field of the CDB, in response to a LOG SELECT or LOG SENSE command with an sp bit set to one. A ds bit set to one indicates that the logical unit does not support saving that log parameter in response to a LOG SELECT or LOG SENSE command with an sp bit set to one.~~

A target save disable (TSD) bit set to zero indicates that the logical unit implicitly saves the log parameter at vendor specific intervals. This implicit saving operation shall be done frequently enough to insure that the cumulative parameter values retain statistical significance (i.e., across power cycles). A TSD bit set to one indicates that either the logical unit does not implicitly save the log parameter or implicit saving of the log parameter has been disabled individually by an application client setting the TSD bit to one. An application client may disable the implicit saving for all log parameters without changing any TSD bits using the GLTSD bit in the Control mode page (see 7.4.6).

An enable threshold comparison (ETC) bit set to one indicates that a comparison to the threshold value is performed whenever the cumulative value is updated. An ETC bit set to zero indicates that a comparison is not performed. The value of the ETC bit is the same for cumulative and threshold parameters.

The threshold met criteria (TMC) field (see table 7) defines the basis for comparison of the cumulative and threshold values. The TMC field is valid only if the ETC bit is set to one. The value of the TMC field is the same for cumulative and threshold parameters.

Table 7 — Threshold met criteria

Code	Basis for comparison		
00b	Every update of the cumulative value		
01b	Cumulative value	equal to	threshold value
10b	Cumulative value	not equal to	threshold value
11b	Cumulative value	greater than	threshold value

If the ETC bit is set to one and the result of the comparison is true, a unit attention condition shall be established for the initiator port associated with every I_T nexus, with the additional sense code set to THRESHOLD CONDITION MET.

The ~~list binary (LBIN) bit, the list parameter (LP) bit,~~format and cross-linkage (FACL) field and the PC field in the LOG SELECT CDB (see 6.4) operate in conjunction with each other. Table 8 defines the meaning for all of the combinations of values for the ~~LBIN bit, the LP bit,~~FACL field and the PC field when the PCR bit is set to zero and

the PARAMETER LIST LENGTH FIELD contains a value greater than 0000h (i.e., parameter data is being sent with the LOG SELECT command).

Table 8 — Meaning for all combinations of the FACL field and the PC field~~, LP bit, and LBIN bit~~

FACL[a]	PC[b]	Description
00b	00b	The specified log parameter values are current threshold values.[c]
00b	01b	The specified log parameter values are current cumulative values.[c]
00b	10b	The specified log parameter values are default threshold values.[c]
00b	11b	The specified log parameter values are default cumulative values.[c]
01b	xxb	The specified log parameter values are ASCII data (see 4.4.1).
10b	00b	The specified log parameter values are current threshold values.[d]
10b	01b	The specified log parameter values are current cumulative values.[d]
10b	10b	The specified log parameter values are default threshold values.[d]
10b	11b	The specified log parameter values are default cumulative values.[d]
11b	xxb	The specified log parameter values are binary data.[d]

[a] The FACL field is contained in the log parameter and is not present when the PARAMETER LIST LENGTH field contains 0000h.
[b] When the FACL field is set to 01b or 11b, then the specified values are neither threshold nor cumulative data, and the content of the PC field is ignored.
[c] If another parameter reported in this log page reaches its maximum value, then this parameter shall stop incrementing until reinitialized by a LOG SELECT command.
[d] If another parameter reported in this log page reaches its maximum value, then this parameter shall not stop incrementing. This parameter may be reinitialized by a LOG SELECT command.

~~The list binary (lbin) bit is only valid if the lp bit is set to one. If the lp bit is set to one and the lbin bit is set to zero, then the list parameter is ASCII data (see 4.4.1). If the lp bit is set to one and the lbin bit is set to one, then the list parameter is binary data.~~

The ~~list parameter (LP) bit~~LSB of the FACL field indicates the format of the log parameter. If ~~an application client attempts to set~~ the value of the ~~LP bit~~LSB of the FACL field in a LOG SELECT command is set to a value other than the ~~one~~value returned for the same parameter in the LOG SENSE command, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

A~~n LP bit~~ FACL field set to ~~zero~~00b or 10b indicates that the parameter is a data counter. Data counters are associated with one or more events~~; the~~. A data counter is updated whenever one of these events occurs by incrementing the counter value. If each data counter has associated with it a vendor specific maximum value, then upon reaching this maximum value, the data counter shall not be incremented (i.e., its value does not wrap). When a data counter reaches its maximum value, the device server shall set the associated DU bit to one. If the data counter is at or reaches its maximum value during the processing of a command, the device server shall complete the command. If the command completes correctly, except for the data counter being at its maximum value, and if the RLEC bit of the Control mode page (see 7.4.6) is set to one, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to RECOVERED ERROR, and the additional sense code set to LOG COUNTER AT MAXIMUM.

A FACL field set to 01b or 11b indicates that the parameter is a list parameter. ~~An~~If the ~~LP bit~~ FACL field is set to ~~one indicates that the parameter is a list parameter. List parameters are not counters and thus~~01b or 11b, then the ETC field and the TMC field~~s~~ shall be set to zero. If the value of the FACL field is set to 01b or 11b and either

the ETC field or the TMC field is set to a non-zero value in a LOG SELECT command, then the device server shall terminate the command with CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST and the additional sense code to INVALID FIELD IN PARAMETER LIST.

The PARAMETER LENGTH field specifies the length in bytes of the following PARAMETER VALUE field. If the application client specifies a parameter length value that results in the truncation of the PARAMETER VALUE field, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If an application client sends a log parameter that is not supported by the logical unit, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If more than one list parameter is defined in a single log page, the following rules apply to assigning parameter codes:

a) The parameter updated last shall have a higher parameter code than the ~~previous~~ parameter updated previously, except as defined in rule b); and
b) When the maximum parameter code value supported by the logical unit is reached, the device server shall assign the lowest parameter code value to the next log parameter (i.e., wrap-around parameter codes). If the associated LOG SELECT command completes without error~~correctly~~, except for the parameter code being at its maximum value, and if the RLEC bit of the Control mode page (see 7.4.6) is set to one, then the command shall be terminated with CHECK CONDITION status, with the sense key set to RECOVERED ERROR, and the additional sense code set to LOG LIST CODES EXHAUSTED.

NOTE 4 - List parameters may be used to store the locations of defective blocks in the following manner. When a defective block is identified, a list parameter is updated to reflect the location and cause of the defect. When the next defect is encountered, the list parameter with the next higher parameter code is updated to record this defect. The size of the log page may be made vendor specific to accommodate memory limitations. It is recommended that one or more data counter parameters be defined for the log page to keep track of the number of valid list parameters and the parameter code of the parameter with the oldest recorded defect. This technique may be adapted to record other types of information.

~~The parameter length field specifies the length in bytes of the following parameter value. If the application client sends a parameter length value that results in the truncation of the parameter value, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.~~

If the application client sends a log parameter value that is outside the range supported by the logical unit, and rounding is implemented for that parameter, the device server may either:

a) Round to an acceptable value and terminate the command as described in 5.4; or
b) Terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

~~When any counter in a log page reaches its maximum value, incrementing of all counters in that log page shall cease until reinitialized by the application client via a LOG SELECT command. If the rlec bit of the Control mode page is set to one, then the device server shall report the exception condition.~~

If a device server receives multiple log pages in the same LOG SELECT command, and the log pages are not in ascending order by page code value, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If a device server receives multiple log parameters within a log page in the same LOG SELECT command, and the parameters are not in ascending order by parameter code value, then the device server shall

terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

NOTE 5 - Application clients should issue LOG SENSE commands prior to issuing LOG SELECT commands to determine supported log pages and page lengths.

The SCSI target device may provide independent sets of log parameters for each logical unit or for each combination of logical units and I_T nexuses. If the SCSI target device does not support independent sets of log parameters and any log parameters are changed that affect other I_T nexuses, then the device server shall establish a unit attention condition (see SAM-3) for the initiator port associated with every I_T nexus except the I_T nexus on which the LOG SELECT command was received, with the additional sense code set to LOG PARAMETERS CHANGED.

4 Proposal after inclusion of revisions

6.4 LOG SELECT command

The LOG SELECT command (see table 9) provides a means for an application client to manage statistical information maintained by the SCSI target device about the SCSI target device or its logical units. Device servers that implement the LOG SELECT command shall also implement the LOG SENSE command. Structures in the form of log parameters within log pages are defined as a way to manage the log data. The LOG SELECT command provides for sending zero or more log pages via the Data-Out Buffer. This standard defines the format of the log pages but does not define the conditions and events that are logged.

Table 9 — LOG SELECT command

Bit / Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (4Ch)							
1	Reserved						PCR	SP
2	PC		Reserved					
3	Reserved							
6								
7	(MSB)	PARAMETER LIST LENGTH						
8								(LSB)
9	CONTROL							

The values in the parameter code reset (PCR) bit, the save parameters (SP) bit, and the page control (pc) field specify actions that a SCSI target device performs after receiving a LOG SELECT command.

The PARAMETER LIST LENGTH field specifies the length in bytes of the parameter list that shall be located in the Data-Out Buffer. A parameter list length of zero specifies that no log pages shall be transferred. This condition shall not be considered an error.

Table 10 defines the meaning of the combinations of values for the PCR bit, the SP bit, and the PC field when the PARAMETER LIST LENGTH field contains 0000h (i.e., there is no parameter data being sent with the LOG SELECT command).

Table 10 — Meaning for combinations of PCR, SP, and PC (part 1 of 2)

PCR	SP	PC	Description
0b	0b	0xb	This is not an error. The device server shall make no change to any current threshold values or any current cumulative values and shall not save any values to non-volatile media.
0b	xb	10b	The device server shall set all current threshold values to the vendor specific default threshold values[a] and shall not save any values to non-volatile media.
0b	xb	11b	The device server shall set all current cumulative values to the vendor specific default cumulative values[a] and shall not save any values to non-volatile media.

Notes -
[a] Vendor specific default threshold values and vendor specific default cumulative values may be zero.
[b] Saving of cumulative and threshold values is optional.
[c] The command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

Table 10 — Meaning for combinations of PCR, SP, and PC (part 2 of 2)

PCR	SP	PC	Description
0b	1b	00b	The device server shall make no change to any current threshold values, and: a) if the device server implements saving of the current threshold values[b], then the device server shall save all current threshold values to non-volatile media, or b) if the device server does not.implement saving of the current threshold values[b], then the device server shall terminate the command[c].
0b	1b	01b	The device server shall make no change to any current cumulative values, and: a) if the device server implements saving of the current cumulative values[b], then the device server shall save all current threshold values to non-volatile media, or b) if the device server does not.implement saving of the current cumulative values[b], then the device server shall terminate the command[c].
1b	0b	xx	The device server shall: 1) set all current threshold values to the vendor specific default threshold values[a]; 2) set all current cumulative values to the vendor specific default cumulative values[a]; and 3) not save any values to non-volatile media.
1b	1b	00b	If the device server: a) implements saving of the current threshold values[b], then the device server shall: 1) save all current threshold values to non-volatile media; 2) set all current threshold values to the vendor specific default threshold values[a]; and 3) set all current cumulative values to the vendor specific default cumulative values[a]; or b) does not implement saving of the current threshold valuesb, then the device server shall terminate the command[c].
1b	1b	01b	If the device server: a) implements saving of the current cumulative values[b], then the device server shall: 1) save all current cumulative values to non-volatile media; 2) set all current threshold values to the vendor specific default threshold values[a]; and 3) set all current cumulative values to the vendor specific default cumulative values[a]; or b) If the device server does not implement saving of the current cumulative values, then the device server shall terminate the command[c].
1b	1b	1xb	The device server: 1) shall set all current threshold values to the vendor specific default threshold values[a]; 2) shall set all current cumulative values to the vendor specific default cumulative values[a]; and 3) shall not save any values to non-volatile media.

Notes -
[a] Vendor specific default threshold values and vendor specific default cumulative values may be zero.
[b] Saving of cumulative and threshold values is optional.
[c] The command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the PCR bit is set to one and the parameter list length is greater than zero, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The current threshold values may only be modified by the application client via the LOG SELECT command.

NOTE 6 - Log pages or log parameters that are not available may become available at some later time (e.g., after the logical unit has become ready).

The actions that a SCSI target device performs after receiving a LOG SELECT command determined by the values in the PCR bit, the SP, and the PC field when the PARAMETER LIST LENGTH field contains a value greater than 0000h are defined in 7.2.

Additional information about the LOG SELECT command is in Annex C.

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7.2 Log parameters

7.2.1 Log page structure and page codes for all device types

This subclause describes the log page structure and the log pages that are applicable to all SCSI devices. Log pages specific to each device type are described in the command standard (see 3.1.18) that applies to that device type. The LOG SELECT command (see 6.5) supports the ability to send zero or more log pages. The LOG SENSE command (see 6.6) returns a single log page specified in the PAGE CODE field of the CDB.

Each log page begins with a four-byte page header followed by zero or more variable-length log parameters defined for that log page. The log page format is defined in table 4.

Table 11 — Log page format

Bit / Byte	7	6	5	4	3	2	1	0
0	DS	SPF	PAGE CODE					
1	SUBPAGE CODE							
2	(MSB)							
3	PAGE LENGTH (n-3)							(LSB)
	Log parameter(s)							
4	Log parameter (First)							
x+3	(Length x)							
	.							
n-y+1	Log parameter (Last)							
n	(Length y)							

The disable save (DS) bit operates in conjunction with the PCR bit, the SP bit, and the PARAMETER LIST LENGTH field in the LOG SELECT CDB (see 6.4). Table 5 defines the meaning for all of the combinations of values for

the PCR bit, the SP bit, and the DS bit when the PARAMETER LIST LENGTH field contains a value greater than 0000h (i.e., parameter data is being sent with the LOG SELECT command).

Table 12 — Meaning for all combinations of PCR, SP, and DS when PARAMETER LIST LENGTH > 0000h

PCR	SP	DS	Description
0b	0b	xb	The device server shall set the specified values[a] to the values in the parameter list and shall not save any values to non-volatile media.
0b	1b	0b	The device server shall set the specified values[a] to the values in the parameter list and, a) If the specified values[a] are default threshold values or default cumulative values, then no values shall be saved; b) If the specified values[a] are current threshold values or current cumulative values and the device server implements saving of the specified values[a], the device server shall save the specified values[a] in the parameter list to non-volatile media; or c) If the specified values[a] are current threshold values or current cumulative values and the device server does not implement saving of the specified values[a], then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.
0b	1b	1b	The device server shall set the specified values[a] to the values in the parameter list and shall not save any values to non-volatile media.
1b	xb	xb	The device server shall terminate the command (see 6.4).

Notes -
[a] The specified values are determined by the values in the PC field and the FACL field (see table 6).

If the SubPage Format (SPF) bit is set to zero, then the SUBPAGE CODE field shall contain 00h. If the SPF bit is set to one, then the SUBPAGE CODE field shall contain a value between 01h and FFh. The value in the PAGE CODE field contains the number of the log page that is being transferred.

The value in the SUBPAGE CODE field contains the number of the log subpage that is being transferred.

If an application client specifies a value in the PAGE CODE field or SUBPAGE CODE field that is reserved or not implemented by the logical unit, then the device server shall terminate the LOG SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

[editor's note: we'll flesh out the subpage stuff as we add in material from other proposals.]

The value in the PAGE LENGTH field is the length in bytes of the following log parameters. If the application client sends a log page length that results in the truncation of any parameter, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

Most log pages contain one or more special data structures called log parameters (see table 6). Log parameters may be data counters of a particular event(s), the conditions under which certain operations were performed, or list parameters that contain a character string description of a particular event.

Table 13 — Log parameter

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
1				PARAMETER CODE				(LSB)
2	DU	OBSOLETE	TSD	ETC	TMC		FACL	
3	PARAMETER LENGTH (n-3)							
4								
n				PARAMETER VALUE				

Each log parameter begins with a four-byte parameter header followed by one or more bytes of PARAMETER VALUE data.

The PARAMETER CODE field identifies the log parameter being transferred for that log page. If an application client specifies a value in the PARAMETER CODE field that is reserved or not implemented by the logical unit, then the device server shall terminate the LOG SELECT command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

The DU bit, TSD bit, ETC bit, TMC field, and FACL field are collectively referred to as the parameter control byte. These fields are described in this subclause.

For cumulative log parameter values, indicated by the PC field of the LOG SELECT and LOG SENSE commands, the disable update (DU) bit is defined as follows:

a) DU set to zero indicates that the device server shall update the log parameter value to reflect all events that should be noted by that parameter; or
b) DU set to one indicates that the device server shall not update the log parameter value except in response to a LOG SELECT command that specifies a new value for the parameter.

NOTE 7 - When updating cumulative log parameter values, a device server may use volatile memory to hold these values until a LOG SELECT or LOG SENSE command is received with an SP bit set to one or a vendor specific event occurs. As a result the updated cumulative log parameter values may be lost if a power cycle occurs.

The DU bit is not defined for threshold values, indicated by the PC field of the LOG SENSE command, or for list parameters as indicated by the FACL field. The device server shall ignore the value of the DU bit in any such log parameters received with a LOG SELECT command.

A target save disable (TSD) bit set to zero indicates that the logical unit implicitly saves the log parameter at vendor specific intervals. This implicit saving operation shall be done frequently enough to insure that the cumulative parameter values retain statistical significance (i.e., across power cycles). A TSD bit set to one indicates that either the logical unit does not implicitly save the log parameter or implicit saving of the log parameter has been disabled individually by an application client setting the TSD bit to one. An application client may disable the implicit saving for all log parameters without changing any TSD bits using the GLTSD bit in the Control mode page (see 7.4.6).

An enable threshold comparison (ETC) bit set to one indicates that a comparison to the threshold value is performed whenever the cumulative value is updated. An ETC bit set to zero indicates that a comparison is not performed. The value of the ETC bit is the same for cumulative and threshold parameters.

The threshold met criteria (TMC) field (see table 7) defines the basis for comparison of the cumulative and threshold values. The TMC field is valid only if the ETC bit is set to one. The value of the TMC field is the same for cumulative and threshold parameters.

Table 14 — Threshold met criteria

Code	Basis for comparison
00b	Every update of the cumulative value
01b	Cumulative value equal to threshold value
10b	Cumulative value not equal to threshold value
11b	Cumulative value greater than threshold value

If the ETC bit is set to one and the result of the comparison is true, a unit attention condition shall be established for the initiator port associated with every I_T nexus, with the additional sense code set to THRESHOLD CONDITION MET.

The format and cross-linkage (FACL) field and the PC field in the LOG SELECT CDB (see 6.4) operate in conjunction with each other. Table 8 defines the meaning for all of the combinations of values for the FACL field and the PC field when the PCR bit is set to zero and the PARAMETER LIST LENGTH field contains a value greater than 0000h (i.e., parameter data is being sent with the LOG SELECT command).

Table 15 — Meaning for all combinations of the FACL field and the PC field

FACL[a]	PC[b]	Description
00b	00b	The specified log parameter values are current threshold values.[c]
00b	01b	The specified log parameter values are current cumulative values.[c]
00b	10b	The specified log parameter values are default threshold values.[c]
00b	11b	The specified log parameter values are default cumulative values.[c]
01b	xxb	The specified log parameter values are ASCII data (see 4.4.1).
10b	00b	The specified log parameter values are current threshold values.[d]
10b	01b	The specified log parameter values are current cumulative values.[d]
10b	10b	The specified log parameter values are default threshold values.[d]
10b	11b	The specified log parameter values are default cumulative values.[d]
11b	xxb	The specified log parameter values are binary data.[d]

Notes -
[a] The FACL field is contained in the log parameter and is not present when the PARAMETER LIST LENGTH field contains 0000h.
[b] When the FACL field is set to 01b or 11b, then the specified values are neither threshold nor cumulative data, and the content of the PC field is ignored.
[c] If another parameter reported in this log page reaches its maximum value, then this parameter shall stop incrementing until reinitialized by a LOG SELECT command.
[d] If another parameter reported in this log page reaches its maximum value, then this parameter shall not stop incrementing. This parameter may be reinitialized by a LOG SELECT command.

The LSB of the FACL field indicates the format of the log parameter. If the value of the LSB of the FACL field in a LOG SELECT command is set to a value other than the value returned for the same parameter in the LOG SENSE command, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

A FACL field set to 00b or 10b indicates that the parameter is a data counter. Data counters are associated with one or more events. A data counter is updated whenever one of these events occurs by incrementing the counter value. If each data counter has associated with it a vendor specific maximum value, then upon reaching this maximum value, the data counter shall not be incremented (i.e., its value does not wrap). When a data counter reaches its maximum value, the device server shall set the associated DU bit to one. If the data counter is at or reaches its maximum value during the processing of a command, the device server shall complete the command. If the command completes correctly, except for the data counter being at its maximum value, and if the RLEC bit of the Control mode page (see 7.4.6) is set to one, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to RECOVERED ERROR, and the additional sense code set to LOG COUNTER AT MAXIMUM.

A FACL field set to 01b or 11b indicates that the parameter is a list parameter. If the FACL field is set to 01b or 11b, then the ETC field and the TMC field shall be set to zero. If the value of the FACL field is set to 01b or 11b and either the ETC field or the TMC field is set to a non-zero value in a LOG SELECT command, then the device server shall terminate the command with CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST and the additional sense code to INVALID FIELD IN PARAMETER LIST.

The PARAMETER LENGTH field specifies the length in bytes of the following PARAMETER VALUE field. If the application client specifies a parameter length value that results in the truncation of the PARAMETER VALUE field, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If an application client sends a log parameter that is not supported by the logical unit, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If more than one list parameter is defined in a single log page, the following rules apply to assigning parameter codes:

a) The parameter updated last shall have a higher parameter code than the parameter updated previously, except as defined in rule b); and
b) When the maximum parameter code value supported by the logical unit is reached, the device server shall assign the lowest parameter code value to the next log parameter (i.e., wrap-around parameter codes). If the associated LOG SELECT command completes without error, except for the parameter code being at its maximum value, and if the RLEC bit of the Control mode page (see 7.4.6) is set to one, then the command shall be terminated with CHECK CONDITION status, with the sense key set to RECOVERED ERROR, and the additional sense code set to LOG LIST CODES EXHAUSTED.

NOTE 8 - List parameters may be used to store the locations of defective blocks in the following manner. When a defective block is identified, a list parameter is updated to reflect the location and cause of the defect. When the next defect is encountered, the list parameter with the next higher parameter code is updated to record this defect. The size of the log page may be made vendor specific to accommodate memory limitations. It is recommended that one or more data counter parameters be defined for the log page to keep track of the number of valid list parameters and the parameter code of the parameter with the oldest recorded defect. This technique may be adapted to record other types of information.

If the application client sends a log parameter value that is outside the range supported by the logical unit, and rounding is implemented for that parameter, the device server may either:

a) Round to an acceptable value and terminate the command as described in 5.4; or
b) Terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If a device server receives multiple log pages in the same LOG SELECT command, and the log pages are not in ascending order by page code value, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If a device server receives multiple log parameters within a log page in the same LOG SELECT command, and the parameters are not in ascending order by parameter code value, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

NOTE 9 - Application clients should issue LOG SENSE commands prior to issuing LOG SELECT commands to determine supported log pages and page lengths.

The SCSI target device may provide independent sets of log parameters for each logical unit or for each combination of logical units and I_T nexuses. If the SCSI target device does not support independent sets of log parameters and any log parameters are changed that affect other I_T nexuses, then the device server shall establish a unit attention condition (see SAM-3) for the initiator port associated with every I_T nexus except the I_T nexus on which the LOG SELECT command was received, with the additional sense code set to LOG PARAMETERS CHANGED.