To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
Date: 6 July 2006
Subject: 06-320r0 SPC-4 Statistics logging for FUA and FUA_NV

Revision history
Revision 0 (6 July 2006) First revision

Related documents
spc4r05a - SCSI Primary Commands - 4 (SPC-4) revision 5a
05-248r4 Statistics and Performance log pages (George Penokie, IBM) - incorporated into spc4r05

Overview
A read or write command with the force unit access (FUA) bit set to one can take significantly longer to process than a command with the FUA bit set to zero. Statistics for those commands should be kept separately in the Statistics and Performance log pages recently added to SPC-4.

Commands with the force unit access nonvolatile (FUA_NV) bit can take significantly longer to process if the logical unit has no non-volatile cache memory but take no additional time if it has non-volatile cache memory. Since the behavior varies from that of commands with the FUA bit set to one, they are proposed to be counted separately.

Both number of commands and command processing time are counted; weighted versions are not proposed. Only commands with FUA or FUA_NV bits are counted, not commands like WRITE AND VERIFY that perform implicit force unit accesses.

Suggested changes to SPC-4

7.2.12 Statistics and Performance log pages

7.2.12.1 Statistics and Performance log pages overview

The Statistics and Performance log pages consist of a General Statistics and Performance log page and up to 31 Group Statistics and Performance log pages. Each Group Statistics and Performance log pages only collects statistics and performance information for the group number specified in a read CDB or a write CDB.

The General Statistics and Performance log page (see 7.2.12.2) provides the following statistics and performance results associated to the addressed logical unit:

a) Number of read commands;
b) Number of write commands;
c) Number of read logical blocks transmitted by a target port;
d) Number of write logical blocks received by a target port;
e) Read command processing time;
f) Write command processing time;
g) Sum of the command weights of the read commands plus write commands;
h) Sum of the weighted command time of the read commands plus write commands;
i) Idle time; and
j) Time interval.

The Group Statistics and Performance log pages (see 7.2.12.3) provide the following statistics and performance results associated to the addressed logical unit and the GROUP NUMBER field:

a) Number of read commands;
b) Number of write commands;
c) Number of read logical blocks transmitted by a target port;
d) Number of write logical blocks received by a target port;
e) Read command processing time; and
f) Write command processing time.

In the Statistics and Performance log pages, read and write commands are those shown in table 235.

Table 235 — Statistics and Performance log pages read and write commands

Read commands	Write commands
READ(6) READ(10) READ(12) READ(16) READ(32) READ CD READ CD MSF READ REVERSE(16) XDREAD(10) XDREAD(32)	WRITE(6) WRITE(10) WRITE(12) WRITE(16) WRITE(32) WRITE AND VERIFY(10) WRITE AND VERIFY(12) WRITE AND VERIFY(16) WRITE AND VERIFY(32) XDWRITE(10) XDWRITE(32)

7.2.12.2 General Statistics and Performance log page

Table 236 shows the General Statistics and Performance log page format.

Table 236 — General Statistics and Performance log page

Byte\Bit	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (19h)					
1	SUBPAGE CODE (00h)							
2	(MSB)							
3	PAGE LENGTH (~~5Ch~~7Ch)							(LSB)
General Statistics and Performance log parameters								
4	Statistics and Performance log parameter							
~~71~~135								
~~72~~136	Idle Time log parameter							
~~83~~147								
~~84~~148	Time Interval log parameter							
~~95~~159								

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.2.1.

Table 237 shows the Statistics and Performance log parameter format.

Table 237 — Statistics and Performance log parameter (part 1 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
0	(MSB)	PARAMETER CODE (0001h)						
1								(LSB)
2	DU	Obsolete	TSD	ETC	TMC		FORMAT AND LINKING	
3	PARAMETER LENGTH (~~40h~~80h)							
4	(MSB)	NUMBER OF READ COMMANDS						
11								(LSB)
12	(MSB)	NUMBER OF WRITE COMMANDS						
10								(LSB)
20	(MSB)	NUMBER OF LOGICAL BLOCKS RECEIVED BY A TARGET PORT						
27								(LSB)
28	(MSB)	NUMBER OF LOGICAL BLOCKS TRANSMITTED BY A TARGET PORT						
35								(LSB)
36	(MSB)	READ COMMAND PROCESSING TIME						
43								(LSB)
44	(MSB)	WRITE COMMAND PROCESSING TIME						
51								(LSB)
52	(MSB)	WEIGHTED NUMBER OF READ COMMANDS PLUS WRITE COMMANDS						
59								(LSB)
60	(MSB)	WEIGHTED READ COMMAND PROCESSING PLUS WRITE COMMAND PROCESSING						
67								(LSB)
68	(MSB)	NUMBER OF READ FUA COMMANDS						
75								(LSB)
76	(MSB)	NUMBER OF WRITE FUA COMMANDS						
83								(LSB)
84	(MSB)	NUMBER OF READ FUA_NV COMMANDS						
91								(LSB)

Table 237 — Statistics and Performance log parameter (part 2 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
92	(MSB)			NUMBER OF WRITE FUA_NV COMMANDS				
99								(LSB)
100	(MSB)			READ FUA COMMAND PROCESSING TIME				
107								(LSB)
108	(MSB)			WRITE FUA COMMAND PROCESSING TIME				
115								(LSB)
116	(MSB)			READ FUA_NV COMMAND PROCESSING TIME				
123								(LSB)
124	(MSB)			WRITE FUA_NV COMMAND PROCESSING TIME				
131								(LSB)

...

The NUMBER OF READ COMMANDS field contains the number of read commands (see 7.2.12.1) received by the logical unit.

The NUMBER OF WRITE COMMANDS field contains the number of write commands (see 7.2.12.1) received by the logical unit.

The READ COMMAND PROCESSING ~~INTERVALS~~TIME field contains the cumulative number of time intervals (see table 240) spent by the logical unit processing read commands (see 7.2.12.1) ~~by the logical unit~~.

The WRITE COMMAND PROCESSING ~~INTERVALS~~TIME field contains the cumulative number of time intervals (see table 240) spent by the logical unit processing write commands (see 7.2.12.1) ~~by the logical unit~~.

If task priority is supported (see SAM-4), then the WEIGHTED NUMBER OF READ COMMANDS PLUS WRITE COMMANDS field contains the cumulative command weight of the read commands and write commands (see 7.2.12.1) processed by the logical unit.

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If task priority is not supported, then the WEIGHTED NUMBER OF READ COMMANDS PLUS WRITE COMMANDS field shall be set to zero.

If task priority is supported (see SAM-4), then the WEIGHTED READ COMMAND PROCESSING PLUS WRITE COMMAND PROCESSING field contains the cumulative weighted command time of the time intervals (see table 240) spent processing read commands and write commands (see 7.2.12.1) by the logical unit.

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If task priority is not supported, then the WEIGHTED READ COMMAND PROCESSING PLUS WRITE COMMAND PROCESSING field shall be set to zero.

The NUMBER OF READ FUA COMMANDS field contains the number of read commands (see 7.2.12.1) with the FUA bit set to one received by the logical unit.

The NUMBER OF WRITE FUA COMMANDS field contains the number of write commands (see 7.2.12.1) with the FUA bit set to one received by the logical unit.

The NUMBER OF READ FUA_NV COMMANDS field contains the number of read commands (see 7.2.12.1) with the FUA_NV bit set to one received by the logical unit.

The NUMBER OF WRITE FUA_NV COMMANDS field contains the number of write commands (see 7.2.12.1) with the FUA_NV bit set to one received by the logical unit.

Editor's Note 1: An application can calculate the number of commands that had both FUA=0 and FUA_NV=0 using: (NUMBER OF READ COMMANDS - NUMBER OF READ FUA COMMANDS - NUMBER OF READ FUA_NV COMMANDS)

The READ FUA COMMAND PROCESSING TIME field contains the cumulative number of time intervals (see table 240) spent by the logical unit processing read commands (see 7.2.12.1) with the FUA bit set to one.

The WRITE FUA COMMAND PROCESSING TIME field contains the cumulative number of time intervals (see table 240) spent by the logical unit processing write commands (see 7.2.12.1) with the FUA bit set to one.

The READ FUA_NV COMMAND PROCESSING TIME field contains the cumulative number of time intervals (see table 240) spent by the logical unit processing read commands (see 7.2.12.1) with the FUA_NV bit set to one.

The WRITE FUA_NV COMMAND PROCESSING TIME field contains the cumulative number of time intervals (see table 240) spent by the logical unit processing write commands (see 7.2.12.1) with the FUA_NV bit set to one.

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7.2.12.3 Group Statistics and Performance (n) log page

The Group Statistics and Performance (n) log pages (see table 242) provide logging of statistics and performance of read and write operations based on group numbers. There are 31 Group Statistics and Performance (n) log pages one for each group number. The statistics and performance information associated with each group number is collected in the corresponding Group Statistics and Performance (n) log page (e.g., operations associated with group number 16 are logged in the Group Statistics and Performance (16) log page).

Table 242 — Group Statistics and Performance log page

Byte\Bit	7	6	5	4	3	2	1	0
0	DS	SPF (1b)	PAGE CODE (19h)					
1	SUBPAGE CODE (01h - 1Fh)							
2	(MSB)	PAGE LENGTH (~~34h~~74h)						
3								(LSB)
Group Statistics and Performance log parameters								
4	Group n Statistics and Performance log parameter							
~~55~~119								

...

Table 244 shows the format of Group n Statistics and Performance log parameter.

Table 244 — Group n Statistics and Performance log parameter (part 1 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
0	(MSB)							
1				PARAMETER CODE (0001h)				(LSB)
2	DU	Obsolete	TSD	ETC	TMC		FORMAT AND LINKING	
3	PARAMETER LENGTH (~~30h~~70h)							
4	(MSB)							
11				GROUP N NUMBER OF READ COMMANDS				(LSB)
12	(MSB)							
10				GROUP N NUMBER OF WRITE COMMANDS				(LSB)
20	(MSB)							
27				GROUP N NUMBER OF LOGICAL BLOCKS RECEIVED BY A TARGET PORT				(LSB)
28	(MSB)							
35				GROUP N NUMBER OF LOGICAL BLOCKS TRANSMITTED BY A TARGET PORT				(LSB)
36	(MSB)							
43				GROUP N READ COMMAND PROCESSING TIME				(LSB)
44	(MSB)							
51				GROUP N WRITE COMMAND PROCESSING TIME				(LSB)
52	(MSB)							
59				GROUP N NUMBER OF READ FUA COMMANDS				(LSB)
60	(MSB)							
67				GROUP N NUMBER OF WRITE FUA COMMANDS				(LSB)
68	(MSB)							
75				GROUP N NUMBER OF READ FUA_NV COMMANDS				(LSB)
76	(MSB)							
83				GROUP N NUMBER OF WRITE FUA_NV COMMANDS				(LSB)
84	(MSB)							
91				GROUP N READ FUA COMMAND PROCESSING TIME				(LSB)

Table 244 — Group n Statistics and Performance log parameter (part 2 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
92	(MSB)							
99				GROUP N WRITE FUA COMMAND PROCESSING TIME				(LSB)
100	(MSB)							
107				GROUP N READ FUA_NV COMMAND PROCESSING TIME				(LSB)
108	(MSB)							
115				GROUP N WRITE FUA_NV COMMAND PROCESSING TIME				(LSB)

...

The GROUP N NUMBER OF READ COMMANDS field contains the number of read commands (see 7.2.12.1) received by the logical unit.

The GROUP N NUMBER OF WRITE COMMANDS field contains the number of write commands (see 7.2.12.1) received by the logical unit.

...

The GROUP N READ COMMAND PROCESSING TIME field contains the cumulative number of time intervals spent by the logical unit processing read commands ~~by the logical unit~~ (see 1.1.2.1). Time intervals are defined in the Time Interval log parameter (see table 240) in the General Statistics and Performance log page (see 7.2.12.2).

The GROUP N WRITE COMMAND PROCESSING TIME field contains the cumulative number of time intervals spent by the logical unit processing write commands ~~by the logical unit~~ (see 1.1.2.1). Time intervals are defined in the Time Interval log parameter (see table 240) in the General Statistics and Performance log page (see 7.2.12.2).

The GROUP N NUMBER OF READ FUA COMMANDS field contains the number of read commands (see 7.2.12.1) with the FUA bit set to one received by the logical unit.

The GROUP N NUMBER OF WRITE FUA COMMANDS field contains the number of write commands (see 7.2.12.1) with the FUA bit set to one received by the logical unit.

The GROUP N NUMBER OF READ FUA_NV COMMANDS field contains the number of read commands (see 7.2.12.1) with the FUA_NV bit set to one received by the logical unit.

The GROUP N NUMBER OF WRITE FUA_NV COMMANDS field contains the number of write commands (see 7.2.12.1) with the FUA_NV bit set to one received by the logical unit.

The GROUP N READ FUA COMMAND PROCESSING TIME field contains the cumulative number of time intervals spent by the logical unit processing read commands (see 1.1.2.1) with the FUA bit set to one. Time intervals are defined in the Time Interval log parameter (see table 240) in the General Statistics and Performance log page (see 7.2.12.2).

The GROUP N WRITE FUA COMMAND PROCESSING TIME field contains the cumulative number of time intervals spent by the logical unit processing write commands (see 1.1.2.1) with the FUA bit set to one. Time intervals are defined in the Time Interval log parameter (see table 240) in the General Statistics and Performance log page (see 7.2.12.2).

The GROUP N READ FUA_NV COMMAND PROCESSING TIME field contains the cumulative number of time intervals spent by the logical unit processing read commands (see 1.1.2.1) with the FUA_NV bit set to one. Time intervals are defined in the Time Interval log parameter (see table 240) in the General Statistics and Performance log page (see 7.2.12.2).

The GROUP N WRITE FUA_NV COMMAND PROCESSING TIME field contains the cumulative number of time intervals spent by the logical unit processing write commands (see 1.1.2.1) with the FUA_NV bit set to one. Time intervals are defined in the Time Interval log parameter (see table 240) in the General Statistics and Performance log page (see 7.2.12.2).