To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
Date: 4 July 2007
Subject: 07-214r1 SAS-2 Mode and log page support for SNW-3 phy capabilities

Revision history

Revision 0 (2 May 2007) First revision (offshoot of 07-091r1).
Revision 1 (4 July 2007) Incorporated comments from May 2007 SAS protocol WG.

Related documents

sas2r08 - Serial Attached SCSI - 2 (SAS-2) revision 8
06-324/06-515 SAS-2 SAS-2 Modifications to speed negotiation (Steve Finch, ST Microelectronics and Amr
     Wassal, PMC-Sierra) - incorporated into sas2r08
06-363r3 SAS-2 SNW-3 bit definitions (Rob Elliott, HP) - incorporated into 06-324r7
07-091r3 - SAS-2 SMP DISCOVER support for SNW-3 phy capabilities (Rob Elliott, HP)
07-215 - SPC-4 Protocol-Specific log page subpages (Rob Elliott, HP)

Overview

For phys in SAS SSP end devices not controlled by SMP, applications need to be able to access the SNW-3 phy capabilities bits through protocol-specific mode page(s) and log page(s).

New information in SAS-2 that affects end devices includes the NEGOTIATED PHYSICAL LINK RATE field, a HARDWARE MUXING SUPPORTED bit, and the SNW-3 phy capabilities bits.

A GENERATION CODE field is added to the mode pages and log pages, so software can tell if it's retrieved a coherent set of them. There is no atomicity between a MODE SENSE and a LOG SENSE command.

A new mode page is proposed that is a peer of the Protocol-Specific Phy Control And Discover mode page, containing the fields newly defined in SAS-2 that don't fit into the existing mode page. The existing mode page lacks enough LENGTH fields to easily extend it.

Several log page options were presented in r0:

a)   Option A: extend the current Protocol-Specific Port log page SAS phy log descriptor. It has adequate LENGTH field definitions to do this and not confuse properly written software (but does entail adding fields after the end of a variable length structure, which may confuse improperly written software).

b)   Option B: Add a new log page that is a peer of the Protocol-Specific Port log page. This requires a change to SPC-4 (proposed independently in 07-215) to define all the subpages with log page code 18h as sharing the same structure as subpage 00h. The naming of the log pages becomes a bit confusing in a target device with target ports using multiple transport protocols, since different protocols would have different page names (and parameter definitions) for the same subpage numbers. Log page 18h/01h would return SAS-2 phy information for SAS target ports and something completely different for FC target ports.

c)   Option C: don't add the fields at all. Rely on the new GENERATION CODE field to link to the mode page values.

The May 2007 SAS protocol WG selected option C.

Suggested changes to SAS-2

10.2.7 SCSI mode parameters

10.2.7.1 SCSI mode parameters overview

Table 1 defines mode pages supported by logical units in SCSI target devices in SAS domains (i.e., with SSP target ports) that support the MODE SELECT or MODE SENSE commands.

Table 1 — SSP target port mode pages

Mode page code	Subpage code	Description	Reference
02h	00h	Disconnect-Reconnect mode page	10.2.7.2
18h	00h	Protocol-Specific Logical Unit mode page	10.2.7.6
	01h - DFh	Reserved	
	E0h - FEh	Vendor specific	
	FFh	Return all subpages for this mode page code	SPC-4
19h	00h	Protocol-Specific Port mode page	10.2.7.3
	01h	Phy Control And Discover mode page	10.2.7.4
	02h	Shared Port Control mode page	10.2.7.5
	03h	SAS-2 Phy mode page	10.2.7.6
	03h04h - DFh	Reserved	
	E0h - FEh	Vendor specific	
	FFh	Return all subpages for this mode page code	SPC-4

10.2.7.4 Phy Control And Discover mode page

The Phy Control And Discover mode page contains parameters that affect SSP target phy operation. If the mode page is implemented by one logical unit in a SCSI target device, it shall be implemented by all logical units in the SCSI target device that support the MODE SELECT or MODE SENSE commands.

The mode page policy (see SPC-4) for this mode page shall be shared. Parameters in this mode page shall affect only the referenced phy.

Table 296 defines the format of this mode page.

Table 293 — Phy Control And Discover mode page

Byte\Bit	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (19h)					
1	SUBPAGE CODE (01h)							
2	(MSB)	PAGE LENGTH (n - 3)						
3								(LSB)
4	Reserved							
5	Reserved				PROTOCOL IDENTIFIER (6h)			
6	~~Reserved~~GENERATION CODE							
7	NUMBER OF PHYS							
SAS phy mode descriptor list								
8	SAS phy mode descriptor (first)(see table 294)							
55								
...	...							
n - 47	SAS phy mode descriptor (last)(see table 294)							
n								

The PARAMETERS SAVEABLE (PS) bit is defined in SPC-4.

The SUBPAGE FORMAT (SPF) bit shall be set to one to access this mode page.

The PAGE CODE field shall be set to 19h.

The SUBPAGE CODE field shall be set to 01h.

The PAGE LENGTH field shall be set to the number of bytes in the page after the PAGE LENGTH field (i.e., 4 + (the value of the NUMBER OF PHYS field) × (the length in bytes of the SAS phy mode descriptor)).

The PROTOCOL IDENTIFIER field shall be set to 6h indicating this is a SAS SSP specific mode page.

The GENERATION CODE field is a one-byte counter that shall be incremented by one by the device server every time the values in the Phy Control and Discover mode page or the SAS-2 Phy mode page (see 10.2.7.5) field values are changed. A GENERATION CODE field set to 00h indicates the generation code is unknown. The device server shall shall wrap this field to 01h as the next increment after reaching its maximum value (i.e., FFh). The GENERATION CODE field is also contained in the Protocol-Specific Port log page and may be used to correlate phy settings across mode page and log page accesses.

> NOTE 1 - Device servers compliant with previous versions of this standard set the GENERATION CODE field to 00h.

The NUMBER OF PHYS field contains the number of phys in the SAS target device and indicates the number of SAS phy mode descriptors that follow. This field shall not be changeable with the MODE SELECT command.

The SAS phy mode descriptor list contains a SAS phy mode descriptor for each phy in the SAS target device, not just the SAS target port, starting with the lowest numbered phy and ending with the highest numbered phy.

Table 297 defines the SAS phy mode descriptor.

Table 294 — SAS phy mode descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved							
1	PHY IDENTIFIER							
2	Reserved							
3								
4	Reserved	ATTACHED DEVICE TYPE			ATTACHED REASON			
5	REASON				NEGOTIATED LOGICAL LINK RATE			
6	Reserved				ATTACHED SSP INITIATOR PORT	ATTACHED STP INITIATOR PORT	ATTACHED SMP INITIATOR PORT	Reserved
7	Reserved				ATTACHED SSP TARGET PORT	ATTACHED STP TARGET PORT	ATTACHED SMP TARGET PORT	Reserved
8	SAS ADDRESS							
15								
16	ATTACHED SAS ADDRESS							
23								
24	ATTACHED PHY IDENTIFIER							
25	Reserved							
31								
32	PROGRAMMED MINIMUM PHYSICAL LINK RATE				HARDWARE MINIMUM PHYSICAL LINK RATE			
33	PROGRAMMED MAXIMUM PHYSICAL LINK RATE				HARDWARE MAXIMUM PHYSICAL LINK RATE			
34	Reserved							
41								
42	Vendor specific							
43								
44	Reserved							
46								
47	Reserved							

The PROGRAMMED MINIMUM PHYSICAL LINK RATE field and PROGRAMMED MAXIMUM PHYSICAL LINK RATE field are defined in the SMP PHY CONTROL function (see 10.4.3.18).

The fields in the SAS phy mode descriptor not defined in this subclause are defined in the SMP DISCOVER response (see 10.4.3.5). These fields shall not be changeable with the MODE SELECT command.

10.2.7.6 SAS-2 Phy mode page [all new]

The SAS-2 Phy mode page contains parameters that affect SSP target phy operation that were first defined in SAS-2. If the mode page is implemented by one logical unit in a SCSI target device, it shall be implemented by all logical units in the SCSI target device that support the MODE SELECT or MODE SENSE commands.

The mode page policy (see SPC-4) for this mode page shall be shared. Parameters in this mode page shall affect only the referenced phy.

Table 293 defines the format of this mode page.

Table 293 — SAS-2 Phy mode page

Byte\Bit	7	6	5	4	3	2	1	0
0	PS	SPF (1b)	PAGE CODE (19h)					
1	SUBPAGE CODE (03h)							
2	(MSB)	PAGE LENGTH (n - 3)						
3								(LSB)
4	Reserved							
5	Reserved				PROTOCOL IDENTIFIER (6h)			
6	~~Reserved~~GENERATION CODE							
7	NUMBER OF PHYS							
SAS-2 phy mode descriptor list								
8	SAS-2 phy mode descriptor (first)(see table 294)							
27								
...	...							
n - 19	SAS-2 phy mode descriptor (last)(see table 294)							
n								

The PARAMETERS SAVEABLE (PS) bit is defined in SPC-4.

The SUBPAGE FORMAT (SPF) bit shall be set to one to access this mode page.

The PAGE CODE field shall be set to 19h.

The SUBPAGE CODE field shall be set to 03h.

The PAGE LENGTH field shall be set to the number of bytes in the page after the PAGE LENGTH field (i.e., 4 + (the value of the NUMBER OF PHYS field) × (the length in bytes of the SAS phy mode descriptor)).

The PROTOCOL IDENTIFIER field shall be set to 6h indicating this is a SAS SSP specific mode page.

The GENERATION CODE field is defined in the Phy Control and Discover mode page (see 10.2.7.4).

The NUMBER OF PHYS field contains the number of phys in the SAS target device and indicates the number of SAS-2 phy mode descriptors that follow. This field shall not be changeable with the MODE SELECT command.

The SAS-2 phy mode descriptor list contains a SAS-2 phy mode descriptor for each phy in the SAS target device, not just the SAS target port, starting with the lowest numbered phy and ending with the highest numbered phy.

Table 297 defines the SAS-2 phy mode descriptor.

Table 294 — SAS-2 phy mode descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved							
1	PHY IDENTIFIER							
2	(MSB)			DESCRIPTOR LENGTH (10h)				
3								(LSB)
4	PROGRAMMED PHY CAPABILITIES							
7								
8	CURRENT PHY CAPABILITIES							
11								
12	ATTACHED PHY CAPABILITIES							
15								
16	Reserved							
17								
18	Reserved			NEGOTIATED SSC	NEGOTIATED PHYSICAL LINK RATE			
19	Reserved							HARDWARE MUXING SUPPORTED

The DESCRIPTOR LENGTH field contains the length in bytes that follow in the descriptor and shall be set to 10h.

The fields in the SAS-2 phy mode descriptor not defined in this subclause are defined in the SMP DISCOVER response (see 10.4.3.5). These fields shall not be changeable with the MODE SELECT command.

[end of all-new SAS-2 Phy mode page section]

10.2.8 SCSI log parameters

10.2.8.1 Protocol-Specific Port log page

The Protocol-Specific Port log page for SAS SSP defined in table 205 is used to return phy event information concerning the SAS target device's phy(s).

Table 205 — Protocol-Specific Port log page for SAS SSP

Byte\Bit	7	6	5	4	3	2	1	0
0	DS	SPF (0b)	PAGE CODE (18h)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (m - 3)						
3								(LSB)
Protocol-specific port log parameter list								
4	Protocol-specific port log parameter (first)(see table 206)							
...	...							
m	Protocol-specific port log parameter (last)(see table 206)							

The DISABLE SAVE (DS) bit is defined in SPC-4.

The SUBPAGE FORMAT (SPF) bit shall be set to zero for access to this log page.

The PAGE CODE field shall be set to 18h.

The SUBPAGE CODE field shall be set to 00h.

The PAGE LENGTH field shall be set to the number of bytes in the log page after the PAGE LENGTH field.

Table 206 defines the format for the Protocol-Specific Port log parameter for SAS. The SAS log parameter is a list parameter (i.e., not a data counter) and only has cumulative (i.e., not threshold) values (see SPC-4).

Table 206 — Protocol-Specific Port log parameter for SAS

Byte\Bit	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (relative target port identifier)				
1								(LSB)
2	Parameter control byte							
2	DU	Obsolete	TSD	ETC	TMC		FORMAT AND LINKING	
3	PARAMETER LENGTH (y - 3)							
4	Reserved				PROTOCOL IDENTIFIER (6h)			
5	Reserved							
6	~~Reserved~~GENERATION CODE							
7	NUMBER OF PHYS							
	SAS phy log descriptor list							
8	SAS phy log descriptor (first)(see table 208)							
8 + m								
...	...							
y - m	SAS phy log descriptor (last)(see table 208)							
y								

The PARAMETER CODE field contains the relative target port identifier (see SPC-4) of the SSP target port that the log parameter describes.

Table 207 defines the values of the fields in the parameter control byte for the log parameter.

Table 207 — Parameter control byte in the Protocol-Specific Port log parameter for SAS

Field	Value for LOG SENSE	Value for LOG SELECT	Description
DU	0	0 or 1	The DU bit is not defined for list parameters, so shall be set to zero when read with the LOG SENSE command and shall be ignored when written with the LOG SELECT command.
TSD	0	0 or 1	The device server shall support implicitly saving the log parameter at vendor specific intervals.
ETC	0	0 or 1	The ETC bit is not defined for list parameters, so shall be set to zero when read with the LOG SENSE command and shall be ignored when written with the LOG SELECT command.
TMC	00b	any	The TMC field is not defined for list parameters, so shall be set to 00b when read with the LOG SENSE command and shall be ignored when written with the LOG SELECT command.
FORMAT AND LINKING	11b	11b	The log parameter is a binary format list parameter.

The PARAMETER LENGTH field is set to the number of bytes in the log parameter that follow the PARAMETER LENGTH field.

The PROTOCOL IDENTIFIER field is set to 6h.

The GENERATION CODE field is defined in the Phy Control and Discover mode page (see 10.2.7.4).

The NUMBER OF PHYS field contains the number of phys in the SAS target port (not in the entire SAS target device) and indicates the number of SAS phy log descriptors that follow.

The SAS phy log descriptor list contains SAS phy log descriptors.

Table 208 defines the SAS phy log descriptor.

Table 208 — SAS phy log descriptor (part 1 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved							
1	PHY IDENTIFIER							
2	Reserved							
3	SAS PHY LOG DESCRIPTOR LENGTH (m - 3)							
4	Reserved	ATTACHED DEVICE TYPE			ATTACHED REASON			
5	REASON				NEGOTIATED LOGICAL LINK RATE			
6	Reserved				ATTACHED SSP INITIATOR PORT	ATTACHED STP INITIATOR PORT	ATTACHED SMP INITIATOR PORT	Reserved

Table 208 — SAS phy log descriptor (part 2 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
7	Reserved				ATTACHED SSP TARGET PORT	ATTACHED STP TARGET PORT	ATTACHED SMP TARGET PORT	Reserved
8	SAS ADDRESS							
15								
16	ATTACHED SAS ADDRESS							
23								
24	ATTACHED PHY IDENTIFIER							
25	Reserved							
31								
32	(MSB) INVALID DWORD COUNT							
35								(LSB)
36	(MSB) RUNNING DISPARITY ERROR COUNT							
39								(LSB)
40	(MSB) LOSS OF DWORD SYNCHRONIZATION							
43								(LSB)
44	(MSB) PHY RESET PROBLEM							
47								(LSB)
48	Reserved							
50								
51	NUMBER OF PHY EVENT DESCRIPTORS							
Phy event descriptor list								
52	Phy event descriptor (first)(see table 254 in 10.4.3.11)							
63								
...	...							
m - 11	Phy event descriptor (last)(see table 254 in 10.4.3.11)							
m								

The SAS PHY LOG DESCRIPTOR LENGTH field indicates the number of bytes that follow in the SAS phy log descriptor. A SAS PHY LOG DESCRIPTOR LENGTH field set to zero indicates there are 44 additional bytes.

NOTE 2 - Logical units compliant with SAS and SAS-1.1 only support a 48 byte SAS phy log descriptor.

The INVALID DWORD COUNT field, RUNNING DISPARITY ERROR COUNT field, LOSS OF DWORD SYNCHRONIZATION field, and PHY RESET PROBLEM COUNT field are each defined in the SMP REPORT PHY ERROR LOG response (see 10.4.3.8).

For the INVALID DWORD COUNT field, RUNNING DISPARITY ERROR COUNT field, LOSS OF DWORD SYNCHRONIZATION COUNT field, and PHY RESET PROBLEM COUNT field, the phy may maintain any size counter but should maintain a 32-bit counter. If it reaches its maximum value, the counter shall stop and the device server shall set the field to FFFFFFFFh in the SAS phy log descriptor.

The number of phy event descriptors field indicates how many phy event descriptors follow.

Each phy event descriptor follows the format defined for the SMP REPORT PHY EVENT INFORMATION function in table 254 (see 10.4.3.11).

The fields in the SAS phy log descriptor not defined in this subclause are defined in the SMP DISCOVER response (see 10.4.3.5). These fields shall not be changeable with the LOG SELECT command.