To: T10 Technical Committee
From: Chris Martin (chris.martin@hp.com) and Rob Elliott, HP (elliott@hp.com)
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Subject: 07-027r0 SAS-2 SPC-4 Enabling and disabling Transport Layer Retries

Revision history
Revision 0 (9 January 2007) First revision

Related documents
sas2r06 - Serial Attached SCSI - 2 (SAS-2) revision 6

Overview
In SAS-1.1, transport layer retries are enabled or disabled via the Protocol-Specific Logical Unit mode page (18h/00h) TRANSPORT LAYER RETRIES bit (which has a mode page policy of shared or per-target port), controlled with the MODE SELECT command.

This has proven to be impractical. If the mode page is shared, multiple initiators that don't agree on the setting interfere with each other. This is less of a problem if the mode page is per I_T nexus, but such implementations are rare.

If the TRANSPORT LAYER RETRIES bit is set to one and saved, then the target exits hard reset with TLR enabled, before the initiator knows TLR is enabled. If it is not savable, then the target forgets the setting on a hard reset; the initiator has to constantly watch for unit attention conditions with an additional sense code of MODE PARAMETERS CHANGED (or an additional sense code for a reset condition that implies mode parameters changed) to realize that TLR has been turned off.

In an initiator, the lower layers of software/firmware are the ones that need control TLR. However, sending a MODE SELECT command requires involvement by upper layers. The MODE SENSE and MODE SELECT commands themselves may encounter errors and need to invoke TLR. An HBA may be confused if it receives an XFER_RDY with the RETRY DATA FRAMES bit set to one for a MODE SELECT command but it thinks TLR is disabled.

The RETRY DATA FRAMES bit in the frame header is proposed to be expanded into a 2-bit TLR CONTROL field that is also used for COMMAND and TASK frames to enable or disable TLR on a per-I_T_L_Q nexus basis, overriding any mode page values.

Table 1 — Proposed TLR CONTROL field

TLR CONTROL field = {New bit, old RETRY DATA FRAMES bit}	Description
00b	Legacy - for XFER_RDY, means TLR disabled per mode page (and used for COMMAND and TASK)
01b	Legacy - for XFER_RDY, means TLR enabled per mode page (not used for COMMAND or TASK)
10b	New - TLR disabled (overrides mode page)(for COMMAND, TASK, or XFER_RDY)
11b	New - TLR enabled (overrides mode page)(for COMMAND, TASK, or XFER_RDY)

Because SAS does not mandate that reserved fields in the SSP frame header be checked or not checked, an initiator sending a COMMAND frame with the RETRY DATA FRAMES bit set to one to a SAS-1.1 target could get an error or be silently ignored. An IDENTIFY address frame SSP TLR bit is proposed to indicate that the target device understands the 2-bit TLR CONTROL field, so the initiator knows in advance whether to try it.

Downside: SAS-1 was overly cautious about expander storage requirements and did not define that expanders return the entire IDENTIFY address frame contents in the DISCOVER response. So, a SAS-1.1 expander attached to a SAS-2 tape drive implementing the TLR CONTROL field will not provide that information

to a SAS-2 initiator. The SAS-2 initiator should assume the drive does not support TLR until it actually communicates with the drive (reading a new VPD page that indicates it does support TLR).

Suggested changes to SAS-2

7.8.2 IDENTIFY address frame

Table 2 defines the IDENTIFY address frame format used for the identification sequence. The IDENTIFY address frame is sent after the phy reset sequence completes if the physical link is a SAS physical link.

Table 2 — IDENTIFY address frame format

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved	DEVICE TYPE			ADDRESS FRAME TYPE (0h)			
1	Reserved				REASON			
2	Reserved				SSP INITIATOR PORT	STP INITIATOR PORT	SMP INITIATOR PORT	Restricted (for OPEN address frame)
3	Reserved			SSP TLR	SSP TARGET PORT	STP TARGET PORT	SMP TARGET PORT	Restricted (for OPEN address frame)
4	DEVICE NAME							
11								
12	SAS ADDRESS							
19								
20	PHY IDENTIFIER							
22	Reserved					INSIDE ZPSDS PERSISTENT	REQUESTED INSIDE ZPSDS	BREAK_REPLY CAPABLE
23	Reserved							
27								
28	(MSB) CRC							
31								(LSB)

The DEVICE TYPE field indicates the type of device containing the phy, and is defined in table 3.

Table 3 — DEVICE TYPE field

Code	Description
001b	End device
010b	Expander device
011b	Expander device compliant with a previous version of this standard
All others	Reserved

The ADDRESS FRAME TYPE field shall be set to 0h.

The REASON field indicates the reason for the link reset sequence and is defined in in table 4.

Table 4 — REASON field

Code	Description
0h	Unknown reason
1h	Power on
2h	Hard reset (e.g., phy received a HARD_RESET primitive during the hard reset sequence)(see 4.4.2), or SMP PHY CONTROL function HARD RESET phy operation (see 10.4.3.24)
3h	SMP PHY CONTROL function LINK RESET phy operation, or TRANSMIT SATA PORT SELECTION SIGNAL phy operation (see 10.4.3.24)
4h	Loss of dword synchronization (see 6.9)
5h	After the multiplexing sequence completes, MUX (LOGICAL LINK 0) received in logical link 1 or MUX (LOGICAL LINK 1) received in logical link 0 (see 6.10).
6h	I_T nexus loss timer expired in the STP target port of an STP/SATA bridge when the phy was attached to a SATA device (see 4.5)
7h	Break Timeout Timer expired (see 7.12.8)
8h	Phy test function stopped (see 10.4.3.25)
9h - Fh	Reserved

An SSP INITIATOR PORT bit set to one indicates that an SSP initiator port is present. An SSP INITIATOR PORT bit set to zero indicates that an SSP initiator port is not present. Expander devices shall set the SSP INITIATOR PORT bit to zero.

An STP INITIATOR PORT bit set to one indicates that an STP initiator port is present. An STP INITIATOR PORT bit set to zero indicates that an STP initiator port is not present. Expander devices shall set the STP INITIATOR PORT bit to zero.

An SMP INITIATOR PORT bit set to one indicates that an SMP initiator port is present. An SMP INITIATOR PORT bit set to zero indicates that an SMP initiator port is not present. Expander devices may set the SMP INITIATOR PORT bit to one.

An SSP TLR bit set to one indicates that an SSP target port is present and supports the TLR CONTROL field in the SSP frame header. An SSP TLR bit set to zero indicates either that an SSP target port is present but does not support the TLR CONTROL field in the SSP frame header, or that an SSP target port is not present. Expander devices shall set the SSP TLR bit to zero.

An SSP TARGET PORT bit set to one indicates that an SSP target port is present. An SSP TARGET PORT bit set to zero indicates that an SSP target port is not present. Expander devices shall set the SSP TARGET PORT bit to zero.

An STP TARGET PORT bit set to one indicates that an STP target port is present. An STP TARGET PORT bit set to zero indicates that an STP target port is not present. Expander devices shall set the STP TARGET PORT bit to zero.

An SMP TARGET PORT bit set to one indicates that an SMP target port is present. An SMP TARGET PORT bit set to zero indicates that an SMP target port is not present. Expander devices shall set the SMP TARGET PORT bit to one.

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The CRC field is defined in 7.8.1.

9.2.1 SSP frame format

Table 134 defines the SSP frame format.

Table 134 — SSP frame format

Byte\Bit	7	6	5	4	3	2	1	0
0	FRAME TYPE							
1	(MSB)	HASHED DESTINATION SAS ADDRESS						
3								(LSB)
4	Reserved							
5	(MSB)	HASHED SOURCE SAS ADDRESS						
7								(LSB)
8	Reserved							
9	Reserved							
10	Reserved				TLR CONTROL		RETRANSMIT	CHANGING DATA POINTER
10	~~Reserved~~					~~RETRY DATA FRAMES~~		
11	Reserved						NUMBER OF FILL BYTES	
12	Reserved							
13	Reserved							
15								
16	(MSB)	TAG						
17								(LSB)
18	(MSB)	TARGET PORT TRANSFER TAG						
19								(LSB)
20	(MSB)	DATA OFFSET						
23								(LSB)
24	INFORMATION UNIT (e.g., see table 136, table 138, table 140, table 141, or table 142)							
m								
	Fill bytes, if needed							
n - 3	(MSB)	CRC						
n								(LSB)

Table 135 defines the FRAME TYPE field, which defines the format of the INFORMATION UNIT field.

Table 135 — FRAME TYPE field

Code	Name of frame	Type of information unit	Originator	Information unit size (bytes)	Reference
01h	DATA frame (i.e., write DATA frame or read DATA frame)	Data information unit (i.e., write Data information unit or read Data information unit)	SSP initiator port or SSP target port	1 to 1 024	9.2.2.4
05h	XFER_RDY frame	Transfer Ready information unit	SSP target port	12	9.2.2.3
06h	COMMAND frame	Command information unit	SSP initiator port	28 to 284	9.2.2.1
07h	RESPONSE frame	Response information unit	SSP target port	24 to 1 024	9.2.2.5
16h	TASK frame	Task Management Function information unit	SSP initiator port	28	9.2.2.2
F0h - FFh	Vendor specific				
All others	Reserved				

The HASHED DESTINATION SAS ADDRESS field contains the hashed value of the destination SAS address (see 4.2.3). See 9.2.6.2.2 and 9.2.6.3.2 for transport layer requirements on checking this field.

The HASHED SOURCE SAS ADDRESS field contains the hashed value of the source SAS address (see 4.2.3). See 9.2.6.2.2 and 9.2.6.3.2 for transport layer requirements on checking this field.

~~The RETRY DATA FRAMES bit is set to one for XFER_RDY frames under the conditions defined in 9.2.4 and shall be set to zero for all other frame types. When set to one this bit specifies that the SSP initiator port may retry write DATA frames that fail.~~

Table 136 defines the TLR CONTROL field.

Table 136 — TLR CONTROL field [bit 0 replaces the current RETRY DATA FRAMES bit]

Code	Frame type(s)	Description
00b	COMMAND	The SSP target port shall: a) use the TRANSPORT LAYER RETRIES bit in the Protocol-Specific Logical Unit mode page (see 10.2.7.3) to enable or disable transport layer retries for this command; b) set the TLR CONTROL field to 01b in any XFER_RDY frames that it transmits for this command if the TRANSPORT LAYER RETRIES bit is set to one in the Protocol-Specific Logical Unit mode page; and c) set the TLR CONTROL field to 00b in any XFER_RDY frames that it transmits for this command if the TRANSPORT LAYER RETRIES bit is set to zero in the Protocol-Specific Logical Unit mode page.
	TASK	The SSP target port shall use the TRANSPORT LAYER RETRIES bit in the Protocol-Specific Logical Unit mode page (see 10.2.7.3) to enable or disable transport layer retries for this task management function.
	XFER_RDY	The SSP initiator port shall disable transport layer retries for write DATA transfers related to this XFER_RDY.
01b	XFER_RDY	The SSP initiator port shall enable transport layer retries for write DATA frames related to this XFER_RDY.
10b [a]	COMMAND	The SSP target port shall: a) disable transport layer retries for this command; and b) set the TLR CONTROL field to 10b in any XFER_RDY frames that it transmits for this command.
	TASK	The SSP target port shall disable transport layer retries for this task management function.
	XFER_RDY	The SSP initiator port shall disable transport layer retries for write DATA transfers related to this XFER_RDY.
11b [a]	COMMAND	The SSP target port shall: a) enable transport layer retries for this command; and b) shall set the TLR CONTROL field to 11b in any XFER_RDY frames that it transmits for this command.
	TASK	The SSP target port shall enable transport layer retries for this task management function.
	XFER_RDY	The SSP initiator port shall enable transport layer retries for write DATA transfers related to this XFER_RDY.
All others		Reserved

[a] The SSP initiator port shall only use codes 10b and 11b if the SSP target port reported an SSP TLR bit set to one in the IDENTIFY address frame (see 7.x.x).

The RETRANSMIT bit is set to one for TASK frames, RESPONSE frames, and XFER_RDY frames under the conditions defined in 9.2.4 and shall be set to zero for all other frame types. This bit specifies that the frame is a retransmission after the SSP port failed in its previous attempt to transmit the frame.

The CHANGING DATA POINTER bit is set to one for DATA frames under the conditions defined in 9.2.4 and shall be set to zero for all other frame types. When set to one this bit specifies that the frame is a retransmission after the SSP target port failed in its previous attempt to transmit the frame or a subsequent frame and the DATA OFFSET field of the frame may not be sequentially increased from that of the previous frame.

The NUMBER OF FILL BYTES field specifies the number of fill bytes between the INFORMATION UNIT field and the CRC field. The NUMBER OF FILL BYTES field shall be set to zero for all frame types except DATA frames as specified in 9.2.2.4 and RESPONSE frames as specified in 9.2.2.5 (i.e., all other frame types are already four-byte aligned).

The TAG field contains a value that allows the SSP initiator port to establish a context for commands and task management functions.

For COMMAND frames and TASK frames, the SSP initiator port shall set the TAG field to a value that is unique for the I_T nexus established by the connection (see 7.12). An SSP initiator port shall not reuse the same tag when transmitting COMMAND frames or TASK frames to different LUNs in the same SSP target port. An SSP initiator port may reuse a tag when transmitting frames to different SSP target ports. An SSP initiator port does not reuse a tag until it receives indication from the SSP target port that the tag is no longer in use (see 9.2.4, 9.2.5, and 10.2.2).

The TAG field in a COMMAND frame contains the task tag defined in SAM-4. The TAG field in a TASK frame does not correspond to a SAM-4 task tag, but corresponds to an SAM-4 association (see 10.2.1). The tag space used in the TAG fields is shared across COMMAND frames and TASK frames (e.g., if a tag is used for a COMMAND frame, it is not also used for a concurrent TASK frame).

For DATA, XFER_RDY, and RESPONSE frames, the SSP target port shall set the TAG field to the tag of the command or task management function to which the frame pertains.

The TARGET PORT TRANSFER TAG field provides an optional method for an SSP target port to establish the write data context when receiving a write DATA frame (i.e., determine the command to which the write data corresponds). Unlike the TAG field, which was assigned by the SSP initiator port, the TARGET PORT TRANSFER TAG field in a write DATA frame contains a value assigned by the SSP target port that was delivered to the SSP initiator port in the XFER_RDY frame requesting the write data.

NOTE 1 - The TARGET PORT TRANSFER TAG field may be useful when the SSP target port has more than one XFER_RDY frame outstanding (i.e., the SSP target port has transmitted an XFER_RDY frame for each of two or more commands and has not yet received all the write data for them).

SSP target ports may set the TARGET PORT TRANSFER TAG field to any value when transmitting any SSP frame. SSP target ports that use this field should set the TARGET PORT TRANSFER TAG field in every XFER_RDY frame to a value that is unique for the L_Q portion of the I_T_L_Q nexus (i.e., that is unique for every XFER_RDY that is outstanding from the SSP target port).

SSP initiator ports shall set the TARGET PORT TRANSFER TAG field as follows:

a) For each write DATA frame that is sent in response to an XFER_RDY frame, the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to the value that was in the corresponding XFER_RDY frame;
b) For each write DATA frame that is sent containing first burst data (see 9.2.2.4), the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to FFFFh; and
c) For frames other than write DATA frames, the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to FFFFh.

For DATA frames, the DATA OFFSET field is described in 9.2.2.4. For all other frame types, the DATA OFFSET field shall be ignored.

The INFORMATION UNIT field contains the information unit, the format of which is defined by the FRAME TYPE field (see table 135). The maximum size of the INFORMATION UNIT field is 1 024 bytes, making the maximum size of the frame 1 052 bytes (1 024 bytes of data + 24 bytes of header + 4 bytes of CRC).

Fill bytes shall be included after the INFORMATION UNIT field so the CRC field is aligned on a four byte boundary. The number of fill bytes are specified by the NUMBER OF FILL BYTES field. The contents of the fill bytes are vendor specific.

The CRC field contains a CRC value (see 7.5) that is computed over the entire SSP frame prior to the CRC field including the fill bytes (i.e., all data dwords between the SOF and EOF). The CRC field is checked by the link layer (see 7.16), not the transport layer.

10.2.7.2.3 Protocol-Specific Port mode page - Phy Control And Discover subpage

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Table 194 defines the SAS phy mode descriptor.

Table 194 — 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			Reserved			
5	Reserved				NEGOTIATED LOGICAL LINK RATE			
6	Reserved				ATTACHED SSP INITIATOR PORT	ATTACHED STP INITIATOR PORT	ATTACHED SMP INITIATOR PORT	Reserved
7	Reserved			ATTACHED SSP TLR	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							
47								

The PHY IDENTIFIER field, ATTACHED DEVICE TYPE field, NEGOTIATED LOGICAL LINK RATE field, ATTACHED SSP INITIATOR PORT bit, ATTACHED STP INITIATOR PORT bit, ATTACHED SMP INITIATOR PORT bit, ATTACHED SSP TLR bit, ATTACHED SSP TARGET PORT bit, ATTACHED STP TARGET PORT bit, ATTACHED SMP TARGET PORT bit, SAS ADDRESS field, ATTACHED SAS ADDRESS field, ATTACHED PHY IDENTIFIER, HARDWARE MINIMUM PHYSICAL LINK RATE field, and HARDWARE MAXIMUM PHYSICAL LINK RATE field are defined in the SMP DISCOVER response (see 10.4.3.7). These fields shall not be changeable with MODE SELECT.

10.2.8.1 Protocol-Specific Port log page

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Table 201 defines the SAS phy log descriptor.

Table 201 — 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			Reserved			
5	Reserved				NEGOTIATED LOGICAL LINK RATE			
6	Reserved				ATTACHED SSP INITIATOR PORT	ATTACHED STP INITIATOR PORT	ATTACHED SMP INITIATOR PORT	Reserved
7	Reserved			ATTACHED SSP TLR	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)

Table 201 — SAS phy log descriptor (part 2 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
40	(MSB)							
43				LOSS OF DWORD SYNCHRONIZATION				(LSB)
44	(MSB)							
47				PHY RESET PROBLEM				(LSB)
48								
50				Reserved				
51	NUMBER OF PHY EVENT DESCRIPTORS							
	Phy event descriptor list							
52								
63				Phy event descriptor (first)(see table 246 in 10.4.3.11)				
...	...							
m - 11								
m				Phy event descriptor (last)(see table 246 in 10.4.3.11)				

The PHY IDENTIFIER field, ATTACHED DEVICE TYPE field, NEGOTIATED LOGICAL LINK RATE field, ATTACHED SSP INITIATOR PORT bit, ATTACHED STP INITIATOR PORT bit, ATTACHED SMP INITIATOR PORT bit, ATTACHED SSP TLR bit, ATTACHED SSP TARGET PORT bit, ATTACHED STP TARGET PORT bit, ATTACHED SMP TARGET PORT bit, SAS ADDRESS field, ATTACHED SAS ADDRESS field, and ATTACHED PHY IDENTIFIER field are defined in the SMP DISCOVER response (see 10.4.3.7).

10.4.3.7 DISCOVER function

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Table 202 defines the response format.

Table 202 — DISCOVER response (part 1 of 3)

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (10h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (12h)							
4	(MSB)							
5				EXPANDER CHANGE COUNT				(LSB)
6								
8				Reserved				
9	PHY IDENTIFIER							

Table 202 — DISCOVER response (part 2 of 3)

Byte\Bit	7	6	5	4	3	2	1	0
10	Reserved							
11								
12	Reserved	ATTACHED DEVICE TYPE			Reserved			
13	Reserved				NEGOTIATED PHYSICAL LINK RATE			
14	Reserved				ATTACHED SSP INITIATOR	ATTACHED STP INITIATOR	ATTACHED SMP INITIATOR	ATTACHED SATA HOST
15	ATTACHED SATA PORT SELECTOR	Reserved		ATTACHED SSP TLR	ATTACHED SSP TARGET	ATTACHED STP TARGET	ATTACHED SMP TARGET	ATTACHED SATA DEVICE
16	SAS ADDRESS							
23								
24	ATTACHED SAS ADDRESS							
31								
32	ATTACHED PHY IDENTIFIER							
33	Reserved					ATTACHED INSIDE ZPSDS PERSISTENT	ATTACHED REQUESTED INSIDE ZPSDS	ATTACHED BREAK_REPLY CAPABLE
34	Reserved							
39								
40	PROGRAMMED MINIMUM PHYSICAL LINK RATE				HARDWARE MINIMUM PHYSICAL LINK RATE			
41	PROGRAMMED MAXIMUM PHYSICAL LINK RATE				HARDWARE MAXIMUM PHYSICAL LINK RATE			
42	PHY CHANGE COUNT							
43	VIRTUAL PHY	Reserved			PARTIAL PATHWAY TIMEOUT VALUE			
44	Reserved				ROUTING ATTRIBUTE			
45	Reserved	CONNECTOR TYPE						
46	CONNECTOR ELEMENT INDEX							
47	CONNECTOR PHYSICAL LINK							
48	Reserved							
49								
50	Vendor specific							
51								
52	ATTACHED DEVICE NAME							
59								

Table 202 — DISCOVER response (part 3 of 3)

Byte\Bit	7	6	5	4	3	2	1	0
60	Reserved	REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER	INSIDE ZPSDS PERSISTENT	REQUESTED INSIDE ZPSDS	ZONE ADDRESS RESOLVED	ZONE GROUP PERSISTENT	INSIDE ZPSDS	ZONING ENABLED
61	Reserved							
62								
63	ZONE GROUP							
64	SELF-CONFIGURATION STATUS							
65	SELF-CONFIGURATION LEVELS COMPLETED							
66	Reserved							
67								
68	SELF-CONFIGURATION SAS ADDRESS							
75								
76	(MSB) CRC							
79								(LSB)

The SMP FRAME TYPE field shall be set to 41h.

The FUNCTION field shall be set to 10h.

The FUNCTION RESULT field is defined in 10.4.3.2.

The RESPONSE LENGTH field shall be set to 12h. For compatibility with previous versions of this standard, a RESPONSE LENGTH field set to 00h indicates that there are 12 dwords before the CRC field.

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If a SAS phy reset sequence occurs (see 6.7.4)(i.e., one or more of the ATTACHED SSP INITIATOR PORT bit, ATTACHED STP INITIATOR PORT bit, the ATTACHED SMP INITIATOR PORT bit, the ATTACHED SSP TARGET PORT bit, the ATTACHED STP TARGET PORT bit, and/or the ATTACHED SMP TARGET PORT bit is set to one), then the ATTACHED SATA PORT SELECTOR bit, the ATTACHED SATA DEVICE bit, and the ATTACHED SATA HOST bit shall each be set to zero.

The ATTACHED SSP INITIATOR PORT bit indicates the value of the SSP INITIATOR PORT ~~field~~bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

The ATTACHED STP INITIATOR PORT bit indicates the value of the STP INITIATOR PORT ~~field~~bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

The ATTACHED SMP INITIATOR PORT bit indicates the value of the SMP INITIATOR PORT ~~field~~bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

The ATTACHED SSP TLR bit indicates the value of the SSP TLR bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

The ATTACHED SSP TARGET PORT bit indicates the value of the SSP TARGET PORT ~~field~~bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

The ATTACHED STP TARGET PORT bit indicates the value of the STP TARGET PORT ~~field~~bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

The ATTACHED SMP TARGET PORT bit indicates the value of the SMP TARGET PORT ~~field~~bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

The ATTACHED SSP INITIATOR PORT bit, ATTACHED STP INITIATOR PORT bit, ATTACHED SMP INITIATOR PORT bit, ATTACHED SSP TLR bit, ATTACHED SSP TARGET PORT bit, ATTACHED STP TARGET PORT bit, and ATTACHED SMP TARGET PORT bit shall be updated at the end of the identification sequence.

If a SATA phy reset sequence occurs (see 6.7.3)(i.e., the ATTACHED SATA PORT SELECTOR bit is set to one, the ATTACHED SATA DEVICE bit is set to one, or the ATTACHED SATA HOST bit is set to one), then the ATTACHED SSP INITIATOR PORT bit, ATTACHED STP INITIATOR PORT bit, ATTACHED SMP INITIATOR PORT bit, ATTACHED SSP TLR bit, ATTACHED SSP TARGET PORT bit, ATTACHED STP TARGET PORT bit, and ATTACHED SMP TARGET PORT bit shall each be set to zero.

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The CRC field is defined in 10.4.3.2.

10.4.3.13.4 DISCOVER LIST response SHORT FORMAT descriptor

Table 203 defines the SHORT FORMAT descriptor.

Table 203 — SHORT FORMAT descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	PHY IDENTIFIER							
1	FUNCTION RESULT							
2	Restricted	ATTACHED DEVICE TYPE			Restricted for DISCOVER response byte 12			
3	Restricted for DISCOVER response byte 13				NEGOTIATED PHYSICAL LINK RATE			
4	Restricted for DISCOVER response byte 14				ATTACHED SSP INITIATOR	ATTACHED STP INITIATOR	ATTACHED SMP INITIATOR	ATTACHED SATA HOST
5	ATTACHED SATA PORT SELECTOR	Restricted for DISCOVER response byte 15		ATTACHED SSP TLR	ATTACHED SSP TARGET	ATTACHED STP TARGET	ATTACHED SMP TARGET	ATTACHED SATA DEVICE
6	VIRTUAL PHY	Reserved			ROUTING ATTRIBUTE			
7	Reserved							
8	ZONE GROUP							
9	Restricted for DISCOVER response byte 60		INSIDE ZPSDS PERSISTENT	REQUESTED INSIDE ZPSDS	ZONE ADDRESS RESOLVED	ZONE GROUP PERSISTENT	INSIDE ZPSDS	Reserved
10	ATTACHED PHY IDENTIFIER							
11	PHY CHANGE COUNT							
12	ATTACHED SAS ADDRESS							
19								
20	Reserved							
23								

The PHY IDENTIFIER field indicates the phy for which physical configuration link information is being returned.

The FUNCTION RESULT field indicates the value that is returned in the FUNCTION RESULT field in the SMP DISCOVER response for the specified phy (e.g., SMP FUNCTION ACCEPTED, PHY VACANT, or PHY DOES NOT EXIST). If the FUNCTION RESULT field is set to PHY VACANT or PHY DOES NOT EXIST, the rest of the fields in the SHORT FORMAT descriptor shall be ignored.

The rest of the fields in the SHORT FORMAT descriptor are defined in the SMP DISCOVER response (see 10.4.3.7).

10.2.11 SCSI vital product data (VPD)

10.2.11.1 Device Identification VPD page

In the Device Identification VPD page (83h) returned by the INQUIRY command (see SPC-4), each logical unit in a SAS target device shall include the identification descriptors for the target port identifier (see 4.2.6) and the relative target port identifier (see SAM-4 and SPC-4) listed in table 204.

Table 204 — Device Identification VPD page identification descriptors for the SAS target port

Field in identification descriptor	Identification descriptor	
	Target port identifier	Relative target port identifier
IDENTIFIER TYPE	3h (i.e., NAA)	4h (i.e., relative target port identifier)
ASSOCIATION	01b (i.e., SCSI target port)	01b (i.e., SCSI target port)
CODE SET	1h (i.e., binary)	1h (i.e., binary)
IDENTIFIER LENGTH	8	4
PIV (protocol identifier valid)	1	1
PROTOCOL IDENTIFIER	6h (i.e., SAS)	6h (i.e., SAS)
IDENTIFIER	SAS address [a] in NAA IEEE Registered format (see 4.2.2)	Relative port identifier [b] as described in SAM-4 and SPC-4

[a] The IDENTIFIER field contains the SAS address of the SSP target port through which the INQUIRY command was received.

[b] The IDENTIFIER field contains the relative port identifier of the SSP target port through which the INQUIRY command was received.

In the Device Identification VPD page (83h) returned by the INQUIRY command (see SPC-4), each logical unit in a SAS target device shall include an identification descriptor for the SAS target device name (see 4.2.4)

using NAA format and may include an identification descriptor for the SAS target device name using the SCSI name string format as listed in table 205.

Table 205 — Device Identification VPD page identification descriptors for the SAS target device

Field in identification descriptor	Identification descriptor for SAS target device	
	NAA format (required)	SCSI name string format (optional)
IDENTIFIER TYPE	3h (i.e., NAA)	8h (i.e., SCSI name string)
ASSOCIATION	10b (i.e., SCSI target device)	10b (i.e., SCSI target device)
CODE SET	1h (i.e., binary)	3h (i.e., UTF-8)
IDENTIFIER LENGTH	8	24
PIV (protocol identifier valid)	1	1
PROTOCOL IDENTIFIER	6h (i.e., SAS)	6h (i.e., SAS)
IDENTIFIER	Device name of the SAS target device in NAA IEEE Registered format (see 4.2.2)	Device name of the SAS target device in SCSI name string format (e.g., “naa.” followed by 16 hexadecimal digits followed by 4 ASCII null characters)

Logical units may include identification descriptors in addition to those required by this standard (e.g., SCSI target devices with SCSI target ports using other SCSI transport protocols may return additional target device names for those other SCSI transport protocols).

10.2.11.2 Protocol-Specific VPD page [all new]

The Protocol-Specific VPD page (see SPC-4) contains target port specific parameters.

Table 206 defines the Protocol-Specific VPD page for SAS target ports.

Table 206 — Protocol-Specific VPD page for SAS SSP

Byte\Bit	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (90h)							
2	Reserved				PROTOCOL IDENTIFIER			
3	PAGE LENGTH (04h)							
4	Reserved							TLR SUPPORTED
5	Reserved							
7								

The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field are defined in SPC-4.

The PAGE CODE field shall be set to 90h.

The PROTOCOL IDENTIFIER field is defined in SPC-4 and shall be set to 06h.

The PAGE LENGTH field is defined in SPC-4 and shall be set to 04h.

A TLR SUPPORTED bit set to one indicates that all SAS target ports through which the logical unit is accessible support the TLR CONTROL field in the SSP frame header (see 9.1). A TLR SUPPORTED bit set to zero indicates

that one or more SAS target ports through which the logical unit is accessible does not support the TLR CONTROLfield in the SSP frame header.

Editor's Note 1: Add the outgoing IDENTIFY address frame transmitted by each phy in the target port? It is read-only.

Editor's Note 2: Add the incoming IDENTIFY address frame received by each phy in the target port? Much of that information is available in the Protocol-Specific Port log page and Protocol-Specific Port mode page. It is read-only in those pages (the values may change based on what it is attached to, not MODE SELECT commands).

Editor's Note 3: If any IDENTIFY information is added, the page would have to support multiple phys per port like a) the Protocol-Specific mode page (return information on all the phys in the port being used to access the VPD page) or b) the Protocol-Specific log page and the SCSI Ports VPD page (return information on all ports, and all phys within each port).

Suggested changes to SPC-4

7.2.xx Protocol-Specific VPD page [all new]

The Protocol-Specific VPD page contains protocol specific parameters that affect both:

a) the SCSI target port; and
b) the logical unit

involved in the I_T_L nexus used to return the VPD page.

Table 206 defines the Protocol-Specific VPD page.

Table 207 — Protocol-Specific VPD page

Byte\Bit	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER			PERIPHERAL DEVICE TYPE				
1	PAGE CODE (90h)							
2	Reserved				PROTOCOL IDENTIFIER			
3	PAGE LENGTH (n - 3)							
4	SCSI transport protocol specific VPD parameters							
n								

The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field are defined in 6.4.2.

The PAGE CODE field shall be set to 90h.

The PROTOCOL IDENTIFIER field contains one of the values shown in table 296 (see 7.5.1) to identify the SCSI transport protocol standard that defines the SCSI transport protocol specific data in this VPD page.

The PAGE LENGTH field indicates the length in bytes of the protocol specific VPD parameters.

The SCSI transport protocol specific VPD parameters data is defined by the SCSI transport protocol standard corresponding to the SCSI target port used in the I_T_L nexus used to return the Protocol-Specific VPD page.