

To: T10 Technical Committee  
 From: Rob Elliott, HP (elliott@hp.com)  
 Date: 28 February 2007  
 Subject: 07-091r0 SAS-2 SMP function support for SNW-3 phy capabilities

**Revision history**

Revision 0 (28 February 2007) First revision (offshoot of 06-362r3).

**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

**Overview**

Applications need to be able to access the SNW-3 phy capabilities bits via SMP functions (for phys controlled by management device servers).

This proposal adds four fields to the SMP DISCOVER response:

- a) incoming phy capabilities bits last received by the phy (including the START bit and the PARITY bit)
- b) outgoing phy capabilities bits last sent by the phy (including the START bit and the PARITY bit)
- c) outgoing phy capabilities bits that may be changed via PHY CONTROL (only bits 8-13, which specify G1-G3 with/without SSC)
- d) outgoing changeable phy capabilities bits as specified via PHY CONTROL (only bits 8-13).

and one field to the SMP PHY CONTROL request:

- e) outgoing changeable phy capabilities bits (only bits 8-13 honored).

This proposal does *not* add access to the phy capabilities bits for SSP end devices in the Protocol-Specific Phy Control And Discover mode page or the Protocol-Specific Port log page.

**Suggested changes to SAS-2**

**10.4.3.5 DISCOVER function**

The DISCOVER function returns information about the specified phy. This SMP function provides information from the IDENTIFY address frame received by the phy and additional phy-specific information. This SMP function shall be implemented by all management device servers.

NOTE 1 - The DISCOVER LIST function (see 10.4.3.12) returns information about one or more phys.

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Table 236 defines the response format.

**Table 236 — DISCOVER response** (part 1 of 4)

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (10h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (17h)								
4	(MSB)	EXPANDER CHANGE COUNT							
5								(LSB)	

Table 236 — DISCOVER response (part 2 of 4)

Byte\Bit	7	6	5	4	3	2	1	0
6	Reserved							
8	Reserved							
9	PHY IDENTIFIER							
10	Reserved							
11	Reserved							
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 TARGET	ATTACHED STP TARGET	ATTACHED SMP TARGET	ATTACHED SATA DEVICE
16	SAS ADDRESS							
23	SAS ADDRESS							
24	ATTACHED SAS ADDRESS							
31	ATTACHED SAS ADDRESS							
32	ATTACHED PHY IDENTIFIER							
33	Reserved					ATTACHED INSIDE ZPSDS PERSISTENT	ATTACHED REQUESTED INSIDE ZPSDS	ATTACHED BREAK_REPLY CAPABLE
34	Reserved							
39	Reserved							
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	Reserved							
50	Vendor specific							
51	Vendor specific							

Table 236 — DISCOVER response (part 3 of 4)

Byte\Bit	7	6	5	4	3	2	1	0
52	ATTACHED DEVICE NAME							
59	ATTACHED DEVICE NAME							
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	Reserved							
63	ZONE GROUP							
64	SELF-CONFIGURATION STATUS							
65	SELF-CONFIGURATION LEVELS COMPLETED							
66	Reserved							
67	Reserved							
68	SELF-CONFIGURATION SAS ADDRESS							
75	SELF-CONFIGURATION SAS ADDRESS							
<del>76</del>	<del>Reserved</del>							
<del>94</del>	<del>Reserved</del>							
<a href="#">76</a>	<a href="#">(bit 0)</a>	<a href="#">PHY CAPABILITIES CHANGEABLE</a>						<a href="#">(bit 7)</a>
<a href="#">79</a>	<a href="#">(bit 24)</a>	<a href="#">PHY CAPABILITIES CHANGEABLE</a>						<a href="#">(bit 31)</a>
<a href="#">80</a>	<a href="#">(bit 0)</a>	<a href="#">PROGRAMMED PHY CAPABILITIES SUPPORTED</a>						<a href="#">(bit 7)</a>
<a href="#">83</a>	<a href="#">(bit 24)</a>	<a href="#">PROGRAMMED PHY CAPABILITIES SUPPORTED</a>						<a href="#">(bit 31)</a>
<a href="#">84</a>	<a href="#">(bit 0)</a>	<a href="#">PHY CAPABILITIES</a>						<a href="#">(bit 7)</a>
<a href="#">87</a>	<a href="#">(bit 24)</a>	<a href="#">PHY CAPABILITIES</a>						<a href="#">(bit 31)</a>
<a href="#">88</a>	<a href="#">(bit 0)</a>	<a href="#">ATTACHED PHY CAPABILITIES</a>						<a href="#">(bit 7)</a>
<a href="#">91</a>	<a href="#">(bit 24)</a>	<a href="#">ATTACHED PHY CAPABILITIES</a>						<a href="#">(bit 31)</a>
92	Reserved							
93	Reserved							
94	Reserved				NEGOTIATED PHYSICAL LINK RATE			

Table 236 — DISCOVER response (part 4 of 4)

Byte\Bit	7	6	5	4	3	2	1	0
95	Reserved							HARDWARE MUXING SUPPORTED
96	(MSB)	CRC						
99								(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 17h. 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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The SELF-CONFIGURATION SAS ADDRESS field indicates the SAS address of the SMP target port to which the self-configuring expander device established a connection or attempted to establish a connection using the specified phy and resulted in the status indicated by the SELF-CONFIGURATION STATUS field.

The PHY CAPABILITIES CHANGEABLE field indicates the SNW-3 phy capabilities bits (see table 84 in 6.7.4.2.3.3) that are changeable with the SMP PHY CONTROL function (see 10.4.3.18). A bit set to one indicates the bit is changeable. A bit set to zero indicates the bit is not changeable. Table 84 in 6.7.4.2.3.3 defines which bits may be changeable. A changeable multi-bit field is indicated with each bit in the field set to one, even if all possible values of the field are not supported.

The PROGRAMMED PHY CAPABILITIES SUPPORTED field indicates the SNW-3 phy capabilities bits set by the SMP PHY CONTROL function (see 10.4.3.18). Non-changeable bits shall be set to zero. The default value for each changeable bit shall be the value of the corresponding bit in the PHY CAPABILITIES CHANGEABLE field.

The PHY CAPABILITIES field indicates the outgoing SNW-3 phy capabilities bits transmitted in the last link reset sequence. If the last link reset sequence did not include SNW-3 or was a SATA link reset sequence, the PHY CAPABILITIES field shall be set to zero.

The ATTACHED PHY CAPABILITIES field indicates the incoming SNW-3 phy capabilities bits received in the last SNW-3. If the last link reset sequence did not include SNW-3 or was a SATA link reset sequence, the ATTACHED PHY CAPABILITIES field shall be set to zero.

The CRC field is defined in 10.4.3.2.

#### 10.4.3.18 PHY CONTROL function

The PHY CONTROL function requests actions by the specified phy. This SMP function may be implemented by any management device server. In zoning expander devices, if zoning is enabled then this function shall only be processed from SMP initiator ports that have access to zone group 2 or the zone group of the specified phy (see 4.9.3.2).

Table 289 defines the request format.

**Table 289 — PHY CONTROL request**

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (91h)							
2	Reserved							
3	REQUEST LENGTH ( <del>09h</del> 0Bh)							
4	(MSB)	EXPECTED EXPANDER CHANGE COUNT						(LSB)
5								
6	Reserved							
8								
9	PHY IDENTIFIER							
10	PHY OPERATION							
11	Reserved							UPDATE PARTIAL PATHWAY TIMEOUT VALUE
12	Reserved							
31								
32	PROGRAMMED MINIMUM PHYSICAL LINK RATE				Reserved			
33	PROGRAMMED MAXIMUM PHYSICAL LINK RATE				Reserved			
34	Reserved							
35								
36	Reserved				PARTIAL PATHWAY TIMEOUT VALUE			
37	Reserved							
39								
40	(bit 0)	<a href="#">PROGRAMMED PHY CAPABILITIES SUPPORTED</a>						(bit 7)
43	(bit 24)							(bit 31)
4044	(MSB)	CRC						(LSB)
4347								

The SMP FRAME TYPE field shall be set to 40h.

The FUNCTION field shall be set to 91h.

The REQUEST LENGTH field shall be set to ~~09h~~0Ah. For compatibility with previous versions of this standard, a REQUEST LENGTH field set to 00h specifies that there are 9 dwords before the CRC field.

The EXPECTED EXPANDER CHANGE COUNT field is defined in the SMP CONFIGURE GENERAL request (see 10.4.3.14).

The PHY IDENTIFIER field specifies the phy (see 4.2.7) to which the SMP PHY CONTROL request applies.

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An UPDATE PARTIAL PATHWAY TIMEOUT VALUE bit set to one specifies that the PARTIAL PATHWAY TIMEOUT VALUE field shall be honored. An UPDATE PARTIAL PATHWAY TIMEOUT VALUE bit set to zero specifies that the PARTIAL PATHWAY TIMEOUT VALUE field shall be ignored.

The PROGRAMMED MINIMUM PHYSICAL LINK RATE field specifies the minimum physical link rate the phy shall support during a link reset sequence (see 4.4.1). Table 290 defines the values for this field. If the value does not match the lowest physical link rate specified in the PROGRAMMED PHY CAPABILITIES field, the management device server shall not change the current SNW-3 phy capabilities, shall return a function result of SMP FUNCTION FAILED in the response frame, and shall not perform the requested phy operation. This value is reported in the DISCOVER response (see 10.4.3.5). If this field is changed along with a phy operation of LINK RESET or HARD RESET, that phy operation shall utilize the new value for this field. This value is reported in the DISCOVER response (see 10.4.3.5).

The PROGRAMMED MAXIMUM PHYSICAL LINK RATE field specifies the maximum physical link rates the phy shall support during a link reset sequence (see 4.4.1). Table 290 defines the values for this field. If the value does not match the highest physical link rate specified in the PROGRAMMED PHY CAPABILITIES field, the management device server shall not change the current SNW-3 phy capabilities, shall return a function result of SMP FUNCTION FAILED in the response frame, and shall not perform the requested phy operation. This value is reported in the DISCOVER response (see 10.4.3.5). If this field is changed along with a phy operation of LINK RESET or HARD RESET, that phy operation shall utilize the new value for this field. This value is reported in the DISCOVER response (see 10.4.3.5).

**Table 290** — PROGRAMMED MINIMUM PHYSICAL LINK RATE **and** PROGRAMMED MAXIMUM PHYSICAL LINK RATE **fields**

Code	Description
0h	Do not change current value
1h -7h	Reserved
8h	1,5 Gbps
9h	3,0 Gbps
Ah	6 Gbps
Bh - Fh	Reserved for future physical link rates

If the PROGRAMMED MINIMUM PHYSICAL LINK RATE field or the PROGRAMMED MAXIMUM PHYSICAL LINK RATE field is set to an unsupported or reserved value, or the PROGRAMMED MINIMUM PHYSICAL LINK RATE field and PROGRAMMED MAXIMUM PHYSICAL LINK RATE field are set to an invalid combination of values (e.g., the minimum is greater than the maximum), the management device server shall not change either of their values and may return a function result of SMP FUNCTION FAILED in the response frame. If it returns a function result of SMP FUNCTION FAILED, it shall not perform the requested phy operation.

The PARTIAL PATHWAY TIMEOUT VALUE field specifies the amount of time in microseconds the expander phy shall wait after receiving an Arbitrating (Blocked On Partial) confirmation from the ECM before requesting that the ECM resolve pathway blockage (see 7.12.4.5). A PARTIAL PATHWAY TIMEOUT VALUE field value of zero (i.e., 0  $\mu$ s) specifies that partial pathway resolution shall be requested by the expander phy immediately upon reception of an Arbitrating (Blocked On Partial) confirmation from the ECM. The PARTIAL PATHWAY TIMEOUT VALUE field is only honored when the UPDATE PARTIAL PATHWAY TIMEOUT VALUE bit is set to one. This value is reported in the DISCOVER response (see 10.4.3.5).

The PROGRAMMED PHY CAPABILITIES field specifies the outgoing SNW-3 phy capabilities that the phy shall use in every subsequent link reset sequence containing an SNW-3. If the phy does not support the value (e.g., a non-changeable bit is set to one) or the minimum and maximum physical link rates do not match the PROGRAMMED MINIMUM PHYSICAL LINK RATE field and the PROGRAMMED MAXIMUM PHYSICAL LINK RATE field, the management device server shall not change the current SNW-3 phy capabilities, shall return a function result of SMP FUNCTION FAILED in the response frame, and shall not perform the requested phy operation. This value is reported in the DISCOVER response (see 10.4.3.5).

The CRC field is defined in 10.4.3.1.

Table 291 defines the response format.

**Table 291 — PHY CONTROL response**

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (91h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (00h)								
4	(MSB)	CRC						(LSB)	
7									

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

The FUNCTION field shall be set to 91h.

The FUNCTION RESULT field is defined in 10.4.3.2.

The RESPONSE LENGTH field shall be set to 00h.

The CRC field is defined in 10.4.3.2.