

To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
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Subject: 08-183r0 SAS-2 Add device slot numbering fields to DISCOVER

Revision history

Revision 0 (28 March 2008) First revision

Related documents

sas2r14 - Serial Attached SCSI - 2 (SAS-2) revision 14

Overview

This proposal is a SAS-2 letter ballot comment.

Initiator discovery software needs to retrieve enough information about an attached drive to describe the drive to a user, and would prefer to do this based solely on information retrieved by the discover process (using SMP functions). Extended information is available through SCSI Enclosure Services (SES), but that requires many steps:

1. complete the SMP discover process

- 1) locate the SES logical unit
 - 1) poll each discovered SAS target device with REPORT LUNS
 - 2) poll each discovered logical unit with INQUIRY
- 2) retrieve the Configuration diagnostic page (with a RECEIVE DIAGNOSTIC RESULTS command)
- 3) retrieve the Enclosure Status diagnostic page (with a RECEIVE DIAGNOSTIC RESULTS command)
- 4) retrieve the Additional Element Status diagnostic page (with a RECEIVE DIAGNOSTIC RESULTS command)
- 5) tie the SES information back to the SMP information based on SAS addresses and

just to present a disk drive.

Instead, a few more SES fields can be included into the DISCOVER response:

- a) Device Slot Number - a number used to identify the bay (i.e., device slot) within the enclosure. Binary number 1-254 (255 means no bay).
- b) Enclosure Number - a number used to identify the enclosure within a set of enclosures (e.g., the depth in a daisy-chain). Binary number 1-254 (255 means no number).
- c) Path To Enclosure - a 2-byte ASCII string used to identify the path to the enclosure (e.g., a switch port number). Two ASCII spaces mean no path identifier.

This defers the need to consult with SES.

These fields are not important enough to expand DISCOVER LIST - they don't contain information needed for expanders performing self-configuration, which is the main customer for DISCOVER LIST.

Different systems will use different terminology for the levels; the key request is that 3 levels be possible.

Sample displays:

Port 1A, Enclosure 1, Device Slot 1

Port 1A, Enclosure 1, Device Slot 2

...

Port 3A, Enclosure 4, Device Slot 1

...

Port 3A, Enclosure 4, Device Slot 8 (e.g., internal cable assembly with SGPIO)

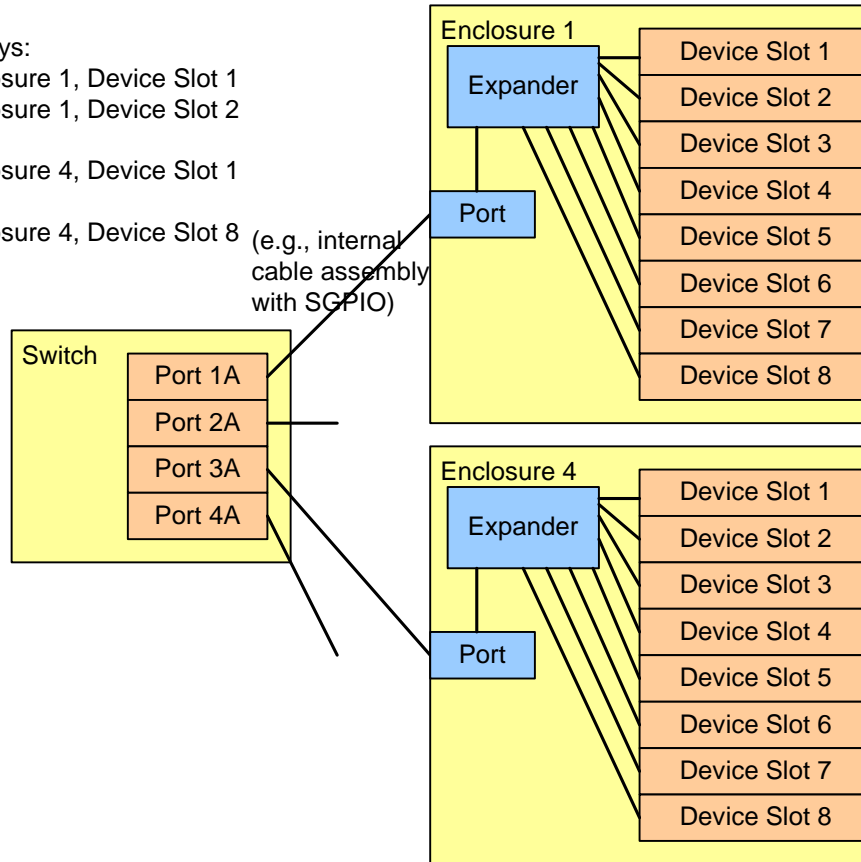


Figure 1 — Device slot number examples

Suggested changes

10.4.3.9 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 102 - The DISCOVER LIST function (see 10.4.3.14) returns information about one or more phys.

Table 388 defines the request format.

Table 388 — DISCOVER request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (10h)								
2	Reserved								
3	REQUEST LENGTH (02h)								
4	Reserved								
7	Reserved								
8	Reserved							IGNORE ZONE GROUP	
9	PHY IDENTIFIER								
10	Reserved								
11	Reserved								
12	(MSB)	CRC							
15							(LSB)		

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

The FUNCTION field shall be set to 10h.

The REQUEST LENGTH field shall be set to 02h. For compatibility with previous versions of this standard, a REQUEST LENGTH field set to 00h specifies that there are 2 dwords before the CRC field.

An IGNORE ZONE GROUP bit set to one specifies that the management device server shall return information about the specified phy (i.e., the phy specified by the PHY IDENTIFIER field) regardless of the zone permission table.

An IGNORE ZONE GROUP bit set to zero specifies that the management device server shall:

- a) if the SMP initiator port has access to the specified phy based on the zone permission table, return the requested information; and
- b) if the SMP initiator port does not have access to the specified phy, return a function result of PHY VACANT in the response frame (see table 315 in 10.4.3.2).

If the management device server is not in a zoning expander device with zoning enabled, it shall ignore the IGNORE ZONE GROUP bit.

The PHY IDENTIFIER field specifies the phy (see 4.2.8) for which the information is being requested.

The CRC field is defined in 10.4.3.1.

Table 389 defines the response format.

Table 389 — DISCOVER response (part 1 of 3)

Byte\Bit	7	6	5	4	3	2	1	0
Header								
0	SMP FRAME TYPE (41h)							
1	FUNCTION (10h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (1Ah)							
4	(MSB)	EXPANDER CHANGE COUNT						(LSB)
5								
6	Reserved							
8								
9	PHY IDENTIFIER							
10	Reserved							
11								
Received IDENTIFY address frame fields								
12	Reserved	ATTACHED DEVICE TYPE			ATTACHED REASON			
13	Reserved				NEGOTIATED LOGICAL 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								
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 for IDENTIFY address frame-related fields							
39								
Other SAS-1.1 fields (and SAS-2 fields implemented by SAS-1.1 expanders)								
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							

Table 389 — DISCOVER response (part 2 of 3)

Byte\Bit	7	6	5	4	3	2	1	0
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								
SAS-2 miscellaneous fields								
52	ATTACHED DEVICE NAME							
59								
60	Reserved	REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER	INSIDE ZPSDS PERSISTENT	REQUESTED INSIDE ZPSDS	Reserved	ZONE GROUP PERSISTENT	INSIDE ZPSDS	ZONING ENABLED
61	Reserved for zoning-related fields							
62								
63	ZONE GROUP							
64	SELF-CONFIGURATION STATUS							
65	SELF-CONFIGURATION LEVELS COMPLETED							
66	Reserved for self-configuration related fields							
67								
68	SELF-CONFIGURATION SAS ADDRESS							
75								
SAS-2 link reset sequence related fields								
76	PROGRAMMED PHY CAPABILITIES							
79								
80	CURRENT PHY CAPABILITIES							
83								
84	ATTACHED PHY CAPABILITIES							
87								

Table 389 — DISCOVER response (part 3 of 3)

Byte\Bit	7	6	5	4	3	2	1	0	
88	Reserved								
93	Reserved								
94	REASON				NEGOTIATED PHYSICAL LINK RATE				
95	Reserved						NEGOTIATED SSC	HARDWARE MUXING SUPPORTED	
Default, saved, and shadow zone phy information									
96	Reserved	DEFAULT INSIDE ZPSDS PERSISTENT	DEFAULT REQUESTED INSIDE ZPSDS	Reserved	DEFAULT ZONE GROUP PERSISTENT	Reserved	Reserved	DEFAULT ZONING ENABLED	
97	Reserved								
98	Reserved								
99	DEFAULT ZONE GROUP								
100	Reserved	SAVED INSIDE ZPSDS PERSISTENT	SAVED REQUESTED INSIDE ZPSDS	Reserved	SAVED ZONE GROUP PERSISTENT	Reserved	Reserved	SAVED ZONING ENABLED	
101	Reserved								
102	Reserved								
103	SAVED ZONE GROUP								
104	Reserved	SHADOW INSIDE ZPSDS PERSISTENT	SHADOW REQUESTED INSIDE ZPSDS	Reserved	SHADOW ZONE GROUP PERSISTENT	Reserved	Reserved	Reserved	
105	Reserved								
106	Reserved								
107	SHADOW ZONE GROUP								
Other SAS-2 fields									
108	DEVICE SLOT NUMBER								
109	GROUP NUMBER								
110	CONNECTOR IDENTIFIER								
111	CONNECTOR IDENTIFIER								
Footer									
108 112	(MSB)	CRC							
111 115								(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 1Ah. 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.

The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response (see 10.4.3.3).

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

The ATTACHED DEVICE TYPE field indicates the device type attached to this phy and is defined in table 390.

Table 390 — ATTACHED DEVICE TYPE field

Code	Description
000b	No device attached
001b	SAS device or SATA device
010b	Expander device
011b	Expander device compliant with a previous version of this standard
All others	Reserved

If the phy is a physical phy, the ATTACHED DEVICE TYPE field shall only be set to a value other than 000b after:

- if a SAS device or expander device is attached, after the identification sequence is complete;
- if a SATA phy is attached and the STP/SATA bridge does not retrieve IDENTIFY (PACKET) DEVICE data, after the STP/SATA bridge receives the initial Register - Device to Host FIS; and
- if a SATA phy is attached and the STP/SATA bridge retrieves IDENTIFY (PACKET) DEVICE data, after the STP/SATA bridge receives IDENTIFY (PACKET) DEVICE data or it encounters a failure retrieving that data.

If the phy is a physical phy and a SAS phy or expander phy is attached, the ATTACHED REASON field indicates the value of the REASON field received in the IDENTIFY address frame (see 7.8.2) during the identification sequence. If the phy is a physical phy and a SATA phy is attached, the ATTACHED REASON field shall be set to 0h after the initial Register - Device to Host FIS has been received. If the phy is a virtual phy, the ATTACHED REASON field shall be set to 0h.

The NEGOTIATED LOGICAL LINK RATE field is defined in table 391 and indicates the logical link rate being used by the phy. For physical phys, this is negotiated during the link reset sequence. For virtual phys, this field should be set to the maximum physical link rate supported by the expander device. This field may be different from the negotiated physical link rate when multiplexing is enabled.

Table 391 — NEGOTIATED LOGICAL LINK RATE field

NEGOTIATED PHYSICAL LINK RATE field	Multiplexing	NEGOTIATED LOGICAL LINK RATE field
9h (i.e., G2)	Disabled	9h (i.e., 3 Gbps)
	Enabled	8h (i.e., 1,5 Gbps)
Ah (i.e., G3)	Disabled	Ah (i.e., 6 Gbps)
	Enabled	9h (i.e., 3 Gbps)
All others	Any	Same as the NEGOTIATED LOGICAL LINK RATE field

NOTE 103 - In previous versions of this standard that did not define multiplexing, the NEGOTIATED LOGICAL LINK RATE field was called the NEGOTIATED PHYSICAL LINK RATE field and the NEGOTIATED PHYSICAL LINK RATE field in byte 94 did not exist.

Table 392 defines the ATTACHED SATA PORT SELECTOR bit and the ATTACHED SATA DEVICE bit.

Table 392 — ATTACHED SATA PORT SELECTOR **and** ATTACHED SATA DEVICE **bits**

ATTACHED SATA PORT SELECTOR bit value ^a ^b ^d	ATTACHED SATA DEVICE bit value ^c ^d	Description
0	0	Either: a) the phy is a virtual phy; or b) the phy is a physical phy, and neither a SATA port selector nor a SATA device is attached and ready on the selected phy.
0	1	The phy is a physical phy and the attached phy is a SATA device phy. No SATA port selector is present (i.e., the SP state machine did not detect COMWAKE in response to the initial COMINIT, but sequenced through the normal (non-SATA port selector) SATA device OOB sequence).
1	0	The phy is a physical phy, the attached phy is a SATA port selector host phy, and either: a) the attached phy is the inactive host phy, or b) the attached phy is the active host phy and a SATA device is either not present or not ready behind the SATA port selector (i.e., the SP state machine detected COMWAKE while waiting for COMINIT).
1	1	The phy is a physical phy, the attached phy is a SATA port selector's active host phy and a SATA device is present behind the SATA port selector (i.e., the SP state machine detected COMWAKE while waiting for COMINIT, timed out waiting for COMSAS, and exchanged COMWAKE with an attached SATA device).
^a The ATTACHED SATA PORT SELECTOR bit is invalid if the NEGOTIATED LOGICAL LINK RATE field is set to UNKNOWN (i.e., 0h), DISABLED (i.e., 1h), or RESET_IN_PROGRESS (i.e., 5h). ^b Whenever the ATTACHED SATA PORT SELECTOR bit changes, the phy shall originate a Broadcast (Change)(see 7.11). ^c For the purposes of the ATTACHED SATA DEVICE bit, a SATA port selector is not considered a SATA device. ^d The ATTACHED SATA PORT SELECTOR bit and the ATTACHED SATA DEVICE bit are updated as specified in the SP state machine (see 6.8).		

An ATTACHED SATA HOST bit set to one indicates a SATA host port is attached. An ATTACHED SATA HOST bit set to zero indicates a SATA host port is not attached.

NOTE 104 - Support for SATA hosts is outside the scope of this standard.

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.

An ATTACHED SSP INITIATOR PORT bit set to one indicates the attached phy supports an SSP initiator port. An ATTACHED SSP INITIATOR PORT bit set to zero indicates the attached phy does not support an SSP initiator port. If the phy is a physical phy, the ATTACHED SSP INITIATOR PORT bit indicates the value of the SSP INITIATOR PORT bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

An ATTACHED STP INITIATOR PORT bit set to one indicates the attached phy supports an STP initiator port. An ATTACHED STP INITIATOR PORT bit set to zero indicates the attached phy does not support an STP initiator port.

If the phy is a physical phy, the ATTACHED STP INITIATOR PORT bit indicates the value of the STP INITIATOR PORT bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

An ATTACHED SMP INITIATOR PORT bit set to one indicates the attached phy supports an SMP initiator port. An ATTACHED SMP INITIATOR PORT bit set to zero indicates the attached phy does not support an SMP initiator port. If the phy is a physical phy, the ATTACHED SMP INITIATOR PORT bit indicates the value of the SMP INITIATOR PORT bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

An ATTACHED SSP TARGET PORT bit set to one indicates the attached phy supports an SSP target port. An ATTACHED SSP TARGET PORT bit set to zero indicates the attached phy does not support an SSP target port. If the phy is a physical phy, the ATTACHED SSP TARGET PORT bit indicates the value of the SSP TARGET PORT bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

An ATTACHED STP TARGET PORT bit set to one indicates the attached phy supports an STP target port. An ATTACHED STP TARGET PORT bit set to zero indicates the attached phy does not support an STP target port. If the phy is a physical phy, the ATTACHED STP TARGET PORT bit indicates the value of the STP TARGET PORT bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

An ATTACHED SMP TARGET PORT bit set to one indicates the attached phy supports an SMP target port. An ATTACHED SMP TARGET PORT bit set to zero indicates the attached phy does not support an SMP target port. If the phy is a physical phy, the ATTACHED SMP TARGET PORT bit indicates the value of the SMP TARGET PORT bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

If the phy is a physical phy, the ATTACHED SSP INITIATOR PORT bit, ATTACHED STP INITIATOR PORT bit, ATTACHED SMP INITIATOR PORT 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 TARGET PORT bit, ATTACHED STP TARGET PORT bit, and ATTACHED SMP TARGET PORT bit shall each be set to zero.

If the phy is an expander phy, the SAS ADDRESS field contains the SAS address of the expander device (see 4.2.4). If the phy is a SAS phy, the SAS ADDRESS field contains the SAS address of the SAS port (see 4.2.7). If the phy is a physical phy, the SAS ADDRESS field contains the value of the SAS ADDRESS field transmitted in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

The ATTACHED SAS ADDRESS field is defined as follows:

- a) if the attached port is an expander port, the ATTACHED SAS ADDRESS field contains the SAS address of the attached expander device (see 4.2.4);
- b) if the attached port is a SAS port, the ATTACHED SAS ADDRESS field contains SAS address of the attached SAS port (see 4.2.7); and
- c) if the attached port is a SATA device port, the ATTACHED SAS ADDRESS field contains the SAS address of the STP/SATA bridge (see 4.6.2).

For a physical phy, the ATTACHED SAS ADDRESS field contains the value of the SAS ADDRESS field received in the IDENTIFY address frame (see 7.8.2) during the identification sequence, and shall be updated:

- a) after the identification sequence completes, if a SAS phy or expander phy is attached; or
- b) after the COMSAS Detect Timeout timer expires (see 6.8.3.9), if a SATA phy is attached.

An STP initiator port should not make a connection request to the attached SAS address until the ATTACHED DEVICE TYPE field is set to a value other than 000b (see table 390).

The ATTACHED PHY IDENTIFIER field is defined as follows:

- a) if the attached phy is a SAS phy, the ATTACHED PHY IDENTIFIER field contains the phy identifier of the attached SAS phy in the attached SAS device;
- b) if the attached phy is an expander phy, the ATTACHED PHY IDENTIFIER field contains the phy identifier (see 4.2.8) of the attached expander phy in the attached expander device; and
- c) if the attached phy is a SATA device phy, the ATTACHED PHY IDENTIFIER field contains 00h;

- d) if the attached phy is a SATA port selector phy and the expander device is able to determine the port of the SATA port selector to which it is attached, the ATTACHED PHY IDENTIFIER field contains 00h or 01h; and
- e) if the attached phy is a SATA port selector phy and the expander device is not able to determine the port of the SATA port selector to which it is attached, the ATTACHED PHY IDENTIFIER field contains 00h.

If the phy is a physical phy and the attached phy is a SAS phy or an expander phy, the ATTACHED PHY IDENTIFIER field contains the value of the PHY IDENTIFIER field received in the IDENTIFY address frame (see 7.8.2) during the identification sequence.

For a physical phy, the ATTACHED PHY IDENTIFIER field shall be updated:

- a) after the identification sequence completes, if a SAS phy or expander phy is attached; or
- b) after the COMSAS Detect Timeout timer expires (see 6.8.3.9), if a SATA phy is attached.

If the phy is a physical phy, the ATTACHED INSIDE ZPSDS PERSISTENT bit indicates the value of the INSIDE ZPSDS PERSISTENT bit received in the IDENTIFY address frame (see 7.8.2) from the attached phy during the identification sequence. If the phy is a virtual phy, the ATTACHED INSIDE ZPSDS PERSISTENT bit shall be set to zero.

If the phy is a physical phy, the ATTACHED REQUESTED INSIDE ZPSDS bit indicates the value of the REQUESTED INSIDE ZPSDS bit received in the IDENTIFY address frame (see 7.8.2) from the attached phy during the identification sequence. If the phy is a virtual phy, the ATTACHED REQUESTED INSIDE ZPSDS bit shall be set to zero.

If the phy is a physical phy, the ATTACHED BREAK_REPLY CAPABLE bit indicates the value of the BREAK_REPLY CAPABLE bit received in the IDENTIFY address frame (see 7.8.2) during the identification sequence. If a phy reset sequence occurs (see 6.7) then the ATTACHED BREAK_REPLY CAPABLE bit shall be set to zero. If the phy is a virtual phy, the ATTACHED BREAK_REPLY CAPABLE bit shall be set to zero.

The PROGRAMMED MINIMUM PHYSICAL LINK RATE field indicates the minimum physical link rate set by the PHY CONTROL function (see 10.4.3.27). The values are defined in table 393. The default value shall be the value of the HARDWARE MINIMUM PHYSICAL LINK RATE field.

The HARDWARE MINIMUM PHYSICAL LINK RATE field indicates the minimum physical link rate supported by the phy. The values are defined in table 394.

The PROGRAMMED MAXIMUM PHYSICAL LINK RATE field indicates the maximum physical link rate set by the PHY CONTROL function (see 10.4.3.27). The values are defined in table 393. The default value shall be the value of the HARDWARE MAXIMUM PHYSICAL LINK RATE field.

Table 393 — PROGRAMMED MINIMUM PHYSICAL LINK RATE and PROGRAMMED MAXIMUM PHYSICAL LINK rate fields

Code	Description
0h	Not programmable
1h - 7h	Reserved
8h	1,5 Gbps
9h	3 Gbps
Ah	6 Gbps
Bh - Fh	Reserved for future physical link rates

The `HARDWARE_MAXIMUM_PHYSICAL_LINK_RATE` field indicates the maximum physical link rate supported by the phy. The values are defined in table 394. If the phy is a virtual phy, this field should be set to the maximum physical link rate supported by the expander device.

Table 394 — `HARDWARE_MINIMUM_PHYSICAL_LINK_RATE` and `HARDWARE_MAXIMUM_PHYSICAL_LINK_RATE` fields

Code	Description
0h - 7h	Reserved
8h	1,5 Gbps
9h	3 Gbps
Ah	6 Gbps
Bh - Fh	Reserved for future physical link rates

The `PHY_CHANGE_COUNT` field counts the number of Broadcast (Change)s originated by an expander phy. Expander devices shall support this field. Other device types shall not support this field. This field shall be set to zero at power on. The expander device shall increment this field at least once when:

- a) it originates a Broadcast (Change) for an expander phy-related reason described in 7.11 from the specified expander phy; or
- b) the zone phy information changes for the specified expander phy (e.g., when a locked expander device is unlocked (see 4.9.6.5)),

and shall not increment this field when forwarding a Broadcast (Change).

After incrementing the `PHY_CHANGE_COUNT` field, the expander device is not required to increment the `PHY_CHANGE_COUNT` field again unless a `DISCOVER` response is transmitted. The `PHY_CHANGE_COUNT` field shall wrap to zero after the maximum value (i.e., FFh) has been reached.

NOTE 105 - Application clients that use the `PHY_CHANGE_COUNT` field should read it often enough to ensure that it does not increment a multiple of 256 times between reading the field.

A `VIRTUAL_PHY` bit set to one indicates the phy is a virtual phy and is part of an internal port and the attached device is contained within the expander device. A `VIRTUAL_PHY` bit set to zero indicates the phy is a physical phy and the attached device is not contained within the expander device.

The `PARTIAL_PATHWAY_TIMEOUT_VALUE` field indicates the partial pathway timeout value in microseconds (see 7.12.4.4) set by the `PHY_CONTROL` function (see 10.4.3.27).

NOTE 106 - The recommended default value for `PARTIAL_PATHWAY_TIMEOUT_VALUE` is 7 μ s.

The ROUTING ATTRIBUTE field indicates the routing attribute supported by the phy (see 4.6.7.1) and is defined in table 395.

Table 395 — ROUTING ATTRIBUTE field

Code	Name	Description
0h	Direct routing attribute	Direct routing method for attached end devices. Attached expander devices are not supported on this phy.
1h	Subtractive routing attribute	Either: a) subtractive routing method for attached expander devices; or b) direct routing method for attached end devices.
2h	Table routing attribute	Either: a) table routing method for attached expander devices; or b) direct routing method for attached end devices.
All others	Reserved	

The ROUTING ATTRIBUTE field shall not change based on the attached device type.

The CONNECTOR TYPE field indicates the type of connector used to access the phy, as reported by the enclosure services process for the enclosure (see the SAS Connector element in SES-2). A CONNECTOR TYPE field set to 00h indicates no connector information is available and that the CONNECTOR ELEMENT INDEX field and the CONNECTOR PHYSICAL LINK fields are invalid and shall be ignored.

The CONNECTOR ELEMENT INDEX indicates the element index of the SAS Connector element representing the connector used to access the phy, as reported by the enclosure services process for the enclosure (see the SAS Connector element in SES-2).

The CONNECTOR PHYSICAL LINK field indicates the physical link in the connector used to access the phy, as reported by the enclosure services process for the enclosure (see the SAS Connector element in SES-2).

The ATTACHED DEVICE NAME field is defined as follows:

- a) if the attached phy is an expander phy, the ATTACHED DEVICE NAME field contains the device name of the attached expander device (see 4.2.4);
- b) if the attached phy is a SAS phy, the ATTACHED DEVICE NAME field contains the device name of the attached SAS device (see 4.2.7); and
- c) if the attached phy is a SATA device phy, the ATTACHED DEVICE NAME field contains the world wide name of the SATA device (see 4.6.2) or 00000000 00000000h.

For physical phys, table 396 defines how the ATTACHED DEVICE NAME field is updated.

Table 396 — ATTACHED DEVICE NAME field

Condition	Update time	Value
A SAS phy or expander phy is attached	Completion of the identification sequence	The management device server shall set this field to the DEVICE NAME field in the incoming IDENTIFY address frame (i.e., the attached expander device name or attached SAS device name (see 4.2.4))
A SATA phy is attached	Expiration of the COMSAS Detect Timeout timer (see 6.6.3)	The management device server shall set this field to 00000000 00000000h
	Reception of IDENTIFY (PACKET) DEVICE data from the SATA device ^a	Either: a) if IDENTIFY (PACKET) DEVICE data word 255 (i.e., the Integrity word) is correct and words 108-111 (i.e., the World Wide Name field) are not set to zero, the management device server shall set this field to the world wide name indicated by words 108-111 according to table 12 in 4.2.5; b) if IDENTIFY (PACKET) DEVICE data word 255 (i.e., the Integrity word) is correct and words 108-111 (i.e., the World Wide Name) are set to zero, the management device server shall set this field to 00000000 00000000h; or c) if IDENTIFY (PACKET) DEVICE data word 255 (i.e., the Integrity word) is not correct, the management device server shall set this field to 00000000 00000000h.
	Processing a PHY CONTROL function SET ATTACHED DEVICE NAME phy operation	The management device server shall set this field to the value specified in the ATTACHED DEVICE NAME field in the PHY CONTROL request (see 10.4.3.27).
^a This row only applies if the expander device originates the IDENTIFY (PACKET) DEVICE command.		

A REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER bit set to one indicates that the zoning expander device set the REQUESTED INSIDE ZPSDS bit to zero in the zone phy information at the completion of the last link reset sequence. A REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER bit set to zero indicates that the zoning expander device did not set the REQUESTED INSIDE ZPSDS bit to zero in the zone phy information at the completion of the last link reset sequence.

NOTE 107 - The zone manager may use the REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER bit to determine why the REQUESTED INSIDE ZPSDS bit has changed in the DISCOVER response from the value to which it last set the bit.

The INSIDE ZPSDS PERSISTENT bit indicates the value of the INSIDE ZPSDS PERSISTENT bit in the zone phy information (see 4.9.3.1).

The REQUESTED INSIDE ZPSDS bit indicates the value of the REQUESTED INSIDE ZPSDS bit in the zone phy information (see 4.9.3.1).

The ZONE GROUP PERSISTENT bit indicates the value of the ZONE GROUP PERSISTENT bit in the zone phy information (see 4.9.3.1).

The INSIDE ZPSDS bit indicates the value of the INSIDE ZPSDS bit in the zone phy information (see 4.9.3.1).

A ZONING ENABLED bit set to one indicates that zoning is enabled in the expander device. A ZONING ENABLED bit set to zero indicates that zoning is disabled in the expander device.

The ZONE GROUP field indicates the value of the ZONE GROUP field in the zone phy information (see 4.9.3.1).

The SELF-CONFIGURATION STATUS field indicates the status of a self-configuring expander device pertaining to the specified phy and is defined in table 397.

Table 397 — SELF-CONFIGURATION STATUS field

Code	Description
00h	No status available
01h - FFh	As defined for the STATUS TYPE field in the self-configuration status descriptor in the REPORT SELF-CONFIGURATION STATUS response (see table 323 in 10.4.3.5)

The SELF-CONFIGURATION LEVELS COMPLETED field indicates the number of levels of expander devices beyond the expander port containing the specified phy for which the self-configuring expander device's management application client has completed the discover process and is defined in table 398.

Table 398 — SELF-CONFIGURATION LEVELS COMPLETED field

Code	Description
00h	The management application client: a) has not begun the discover process through the expander port containing the specified phy; or b) has not completed the discover process through the expander port containing the specified phy.
01h	The management application client has completed discovery of the expander device attached to the expander port containing the specified phy (i.e., level 1).
02h	The management application client has completed discovery of the expander devices attached to the expander device attached to the expander port containing the specified phy (i.e., level 2).
...	...
FFh	The management application client has completed discovery of the expander devices attached at level 255.

NOTE 108 - The self-configuration levels completed field does not reflect the level of externally configurable expander devices that the configuration subprocess updates to enable the discover process to proceed to higher levels.

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 PROGRAMMED PHY CAPABILITIES field indicates the SNW-3 phy capabilities bits that are going to be transmitted in the next link reset sequence containing SNW-3 as defined in table 98 in 6.7.4.2.3.3.

The CURRENT PHY CAPABILITIES field indicates the outgoing SNW-3 phy capabilities bits transmitted in the last link reset sequence as defined in table 98 in 6.7.4.2.3.3. If the last link reset sequence did not include SNW-3 or was a SATA link reset sequence, the current 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 as defined in table 98 in 6.7.4.2.3.3. 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 REASON field indicates the reason for the last reset of the phy. If the phy is a physical phy, the REASON field indicates the value of the REASON field transmitted in the IDENTIFY address frame (see 7.8.2) during the identification sequence. If the phy is a physical phy and a SATA phy is attached, the REASON field indicates the reason for the link reset sequence (see 7.8.2).

A NEGOTIATED SSC field set to one indicates that SSC is enabled (see 5.3.8). A NEGOTIATED SSC field set to zero indicates that SSC is disabled. The NEGOTIATED SSC field is only valid when the NEGOTIATED PHYSICAL LINK RATE field is greater than or equal to 8h.

The NEGOTIATED PHYSICAL LINK RATE field is defined in table 399. If the phy is a physical phy, this field indicates the physical link rate negotiated during the link reset sequence. If the phy is a virtual phy, this field should be set to the maximum physical link rate supported by the expander device. The negotiated physical link rate may be less than the programmed minimum physical link rate or greater than the programmed maximum physical link rate if the programmed physical link rates have been changed since the last link reset sequence.

Table 399 — NEGOTIATED PHYSICAL LINK RATE field

SP state machine ResetStatus state machine variable	Code	Description
UNKNOWN	0h	Phy is enabled; unknown physical link rate. ^a
DISABLED	1h	Phy is disabled.
PHY_RESET_PROBLEM	2h	Phy is enabled; a phy reset problem occurred (see 6.7.4.2.4).
SPINUP_HOLD	3h	Phy is enabled; detected a SATA device and entered the SATA spinup hold state. The SMP PHY CONTROL function (see 10.4.3.27) phy operations of LINK RESET and HARD RESET may be used to release the phy.
PORT_SELECTOR	4h	Phy is enabled; detected a SATA port selector. The physical link rate has not been negotiated since the last time the phy's SP state machine entered the SP0:OOB_COMINIT state. The SATA spinup hold state has not been entered since the last time the phy's SP state machine entered the SP0:OOB_COMINIT state. The value in this field may change to 3h, 8h, 9h, or Ah if attached to the active phy of the SATA port selector. Presence of a SATA port selector is indicated by the ATTACHED SATA PORT SELECTOR bit (see table 392).
RESET_IN_PROGRESS	5h	Phy is enabled; the expander phy is performing an SMP PHY CONTROL function (see 10.4.3.27) phy operation of LINK RESET or HARD RESET. This value is returned if the specified phy contained a value of 8h, 9h, or Ah in this field when an SMP PHY CONTROL function phy operation of LINK RESET or HARD RESET phy operation is processed.
UNSUPPORTED_PHY_ATTACHED	6h	Phy is enabled; a phy is attached without any commonly supported settings.
Reserved	7h	Reserved
G1	8h	Phy is enabled; 1,5 Gbps physical link rate.
G2	9h	Phy is enabled; 3 Gbps physical link rate.
G3	Ah	Phy is enabled; 6 Gbps physical link rate.
Reserved	Bh - Fh	Phy is enabled; reserved for future logical or physical link rates.
^a This code may be used by an application client in its local data structures to indicate an unknown negotiated logical or physical link rate (e.g., before the discover process has queried the phy).		

A HARDWARE MUXING SUPPORTED bit set to one indicates the phy supports multiplexing (see 6.10). A HARDWARE MUXING SUPPORTED bit set to zero indicates the phy does not support multiplexing. This value is not adjusted based on the negotiated physical link rate.

The DEFAULT INSIDE ZPSDS PERSISTENT bit contains the default value of the INSIDE ZPSDS PERSISTENT bit in the zone phy information (see 4.9.3.1).

The DEFAULT REQUESTED INSIDE ZPSDS bit contains the default value of the REQUESTED INSIDE ZPSDS bit in the zone phy information (see 4.9.3.1).

The DEFAULT ZONE GROUP PERSISTENT bit contains the default value of the ZONE GROUP PERSISTENT bit in the zone phy information (see 4.9.3.1).

The DEFAULT ZONING ENABLED bit contains the default value of the ZONING ENABLED bit (see 4.9.3.1).

The DEFAULT ZONE GROUP field contains the default value of the ZONE GROUP field in the zone phy information (see 4.9.3.1).

The SAVED INSIDE ZPSDS PERSISTENT bit contains the default value of the INSIDE ZPSDS PERSISTENT bit in the zone phy information (see 4.9.3.1).

The SAVED REQUESTED INSIDE ZPSDS bit contains the default value of the REQUESTED INSIDE ZPSDS bit in the zone phy information (see 4.9.3.1).

The SAVED ZONE GROUP PERSISTENT bit contains the default value of the ZONE GROUP PERSISTENT bit in the zone phy information (see 4.9.3.1).

The SAVED ZONING ENABLED bit contains the default value of the ZONING ENABLED bit (see 4.9.3.1).

The SAVED ZONE GROUP field contains the default value of the ZONE GROUP field in the zone phy information (see 4.9.3.1).

The SHADOW INSIDE ZPSDS PERSISTENT bit contains the default value of the INSIDE ZPSDS PERSISTENT bit in the zone phy information (see 4.9.3.1).

The SHADOW REQUESTED INSIDE ZPSDS bit contains the default value of the REQUESTED INSIDE ZPSDS bit in the zone phy information (see 4.9.3.1).

The SHADOW ZONE GROUP PERSISTENT bit contains the default value of the ZONE GROUP PERSISTENT bit in the zone phy information (see 4.9.3.1).

The SHADOW ZONING ENABLED bit contains the default value of the ZONING ENABLED bit (see 4.9.3.1).

The SHADOW ZONE GROUP field contains the default value of the ZONE GROUP field in the zone phy information (see 4.9.3.1).

The DEVICE SLOT NUMBER field indicates the number of the enclosure device slot to which the phy provides access, as reported by the enclosure services process for the enclosure (see the Additional Element Status descriptor for Device Slot and Array Device Slot elements in SES-2). A DEVICE SLOT NUMBER field set to FFh indicates that no device slot number is available.

The ENCLOSURE NUMBER field indicates the number of the enclosure to which the phy provides access. An ENCLOSURE NUMBER field set to FFh indicates that no enclosure number is available.

NOTE 109 - This may be the same as the Group ID reported via the SGPIO input stream from the enclosure (see SFF-8485).

The PATH TO ENCLOSURE field contains a left-aligned ASCII string indicating the path to the enclosure to which the phy provides access (e.g., a number assigned to the expander phy). An ENCLOSURE NUMBER field set to 2020h (i.e., two space characters) indicates that no path information is available.

The CRC field is defined in 10.4.3.2.