Date: June 28, 2006

To: T10 Committee (SCSI)

From: George Penokie (IBM)

Subject: SAS-2: Multiple Broadcasts on Reset

Overview

SAS requires that two BROADCAST primitives be issued if a link reset or a hard reset occurs on a link. The first occurs at the start of the reset sequence and the second occurs on completion of the reset sequence.

This creates problems in at least two cases when JBOD SAS devices are connected to a RAID implementation:

   a)   when there are multiple RAIDed initiators attached on the SAS domain; and
   b)   anytime discovery is initiated.

The problem is that anytime a RAID initiator does a discovery (e.g., as the result of a BROADCAST) and finds out a drive has disappeared, it will mark that drive as missing thereby causing the RAID to become exposed. If a drive reappears in a subsequent discovery (e.g., as the result of receiving a second BROADCAST) a rebuild is initiated.

In the case where a RAID initiator issues a Hard Reset as part of a recovery process, that RAID initiator knows it will receive two BROADCASTs so it could ignore the first one and only do a discovery on the second BROADCAST. However, there is no way to tell the other initiators to ignore a BROADCAST. As a result the first BROADCAST would cause any RAID initiator that does not know about the reset to start a discovery and it my find the drive being reset is missing, causing it to mark the RAID as exposed. When that RAID initiator sees the second BROADCAST it will start another discovery and will find the same drive is there but it's already to late and the damage has been done.

This proposal recommends a new function response code to be returned for a SMP DISCOVER function and a SMP DISCOVER LIST function that would indicate the phy is busy and should be checked later to determine what is attached.

There is also a RETRY DELAY TIMER field that contains a recommended time to wait before retrying the SMP DISCOVER function or the SMP DISCOVER LIST function.

The recommended changes needed to incorporate this change into SAS-2 are as indicated below.

SAS-2 changes

4.7 Discover process

4.7.1 Discover process overview

Management application clients direct an SMP initiator port to request SMP functions from an SMP target port. Management application clients are located in every SAS initiator device and every self-configuring expander device. The discover process is the process of:

   a)   discovering all the SAS devices and expander devices in the SAS domain (i.e., determining their device types, SAS addresses, and supported protocols); and
   b)   configuring routing tables in the expander devices as needed.

A management application client performing the discover process shall perform a level-order (i.e., breadth-first) traversal of the SAS domain. The order of traversal shall be to discover:

   1)   the device(s) to which the device containing the management application client is attached;
   2)   if an attached device is an expander device, every device attached to that expander device; and
   3)   for each expander device found, every device attached to that expander device.

This order is repeated until all expander devices have been traversed. If the management application client is inside an expander device, then the process shall be repeated on each expander port.

Figure 1 shows an example of level-order traversal.
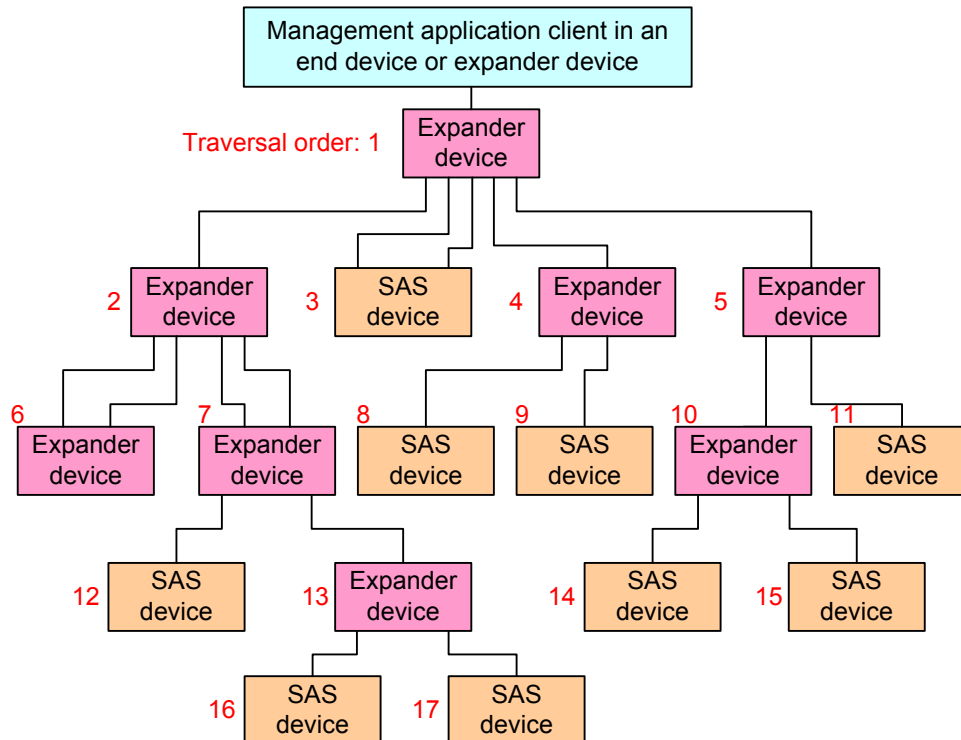
Note: Assume that the phy with the lowest phy identifier in each expander
device is on the top right, and the remaining phys have increasing phy
identifiers assigned in a counter-clockwise direction

Figure 1 — Level-order traversal example

The management application client determines whether an expander device or SAS device is attached at each point in the traversal. For the first device (i.e., the device directly attached), this is determined from the DEVICE TYPE field in the IDENTIFY address frame information received by the phy that the management application client is using. For other devices (i.e., devices not directly attached), this is determined from ATTACHED DEVICE TYPE field the SMP DISCOVER response (see 10.4.3.5) and the SMP DISCOVER LIST response (see 10.4.3.11.3).

If an expander device is attached, the management application client shall use the SMP REPORT GENERAL function (see 10.4.3.3) to determine how many phys are in the expander device and then use the SMP DISCOVER function (see 10.4.3.5) or the SMP DISCOVER LIST function (see 10.4.3.11) to determine what is attached to each expander phy (e.g., the device type, SAS address, and supported protocol(s)).

If the expander device's CONFIGURABLE ROUTE TABLE bit is set to one in the SMP REPORT GENERAL response, its own management application client shall configure its own expander route table as described in 4.7.3 and 4.7.4.

If a self-configuring expander device's CONFIGURING bit is set to one in the SMP REPORT GENERAL response, connection requests for destination ports two or more levels beyond the self-configuring expander device may result in responses such as OPEN_REJECT (NO DESTINATION) (see 7.2.5.12). If a management application client (e.g., in an end device) detects a self-configuring expander device with the CONFIGURING bit set to one, the SAS port shall stop the I_T Nexus Loss timer for I_T nexuses involving such destination ports as long as the CONFIGURING bit is set to one (see 8.2.2.1).

If a SAS device is attached, the discover process is not required to obtain any more information about the SAS device. Additional discovery software may access that SAS device, however:

   a) if the SAS device supports an SMP target port, the management application client may use SMP functions (e.g., REPORT GENERAL and REPORT MANUFACTURER INFORMATION) to determine additional information about the SAS target device;
   b) if the SAS device supports an SSP target port, a SCSI application client may transmit SCSI commands (e.g., INQUIRY and REPORT LUNS) to determine additional information about the SCSI target device; and
   c) if the end device supports an STP target port, an ATA application client may transmit ATA commands (e.g., IDENTIFY DEVICE and IDENTIFY PACKET DEVICE) to determine additional information about the ATA device.

The result of the discover process is that the management application client has the necessary information (e.g., the device type, SAS address, and supported protocol(s)) to communicate with each SAS device and expander device in the SAS domain and each configurable expander device is configured with the necessary expander route entries to allow routing of connection requests through the SAS domain.

If the discover process occurs and any phy within the target device is in the processes of link reset sequence, then any SMP DISCOVER function (see 10.4.3.5) or any SMP DISCOVER LIST function (see 10.4.3.11) should be terminated with a function result of PHY BUSY with the RETRY DELAY TIMER field set to a length of time that the management application client should wait before retrying the discover process.

Annex L contains an example implementation of how a management application client may perform the discover process.

The discover process may be aborted prior to completion and restarted if there is an indication that it may be based on incorrect information (e.g., reception of a Broadcast (Change) or a change in the EXPANDER CHANGE COUNT field returned in an SMP response).

10.4.3.2 SMP function response frame format

An SMP response frame is sent by an SMP target port in response to an SMP request frame. Table 1 defines the SMP response frame format.

Table 1 — SMP response frame format

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION							
2	FUNCTION RESULT							
3	RESPONSE LENGTH ((n - 7) / 4)							
4	ADDITIONAL RESPONSE BYTES							
m								
	Fill bytes, if needed							
n - 3	(MSB)							
n	CRC							(LSB)

The SMP FRAME TYPE field is included in each frame format defined in this clause, although that field is parsed by the SMP transport layer (see 9.4). The SMP FRAME TYPE field is set to 41h.

The FUNCTION field indicates the SMP function to which this frame is a response, and is defined in table 197 in 10.4.3.1.

The FUNCTION RESULT field is defined in table 2.

Table 2 — FUNCTION RESULT **field** (part 1 of 3)

Code	Name	SMP function(s)	Description
00h	SMP FUNCTION ACCEPTED	All	The SMP target port supports the SMP function. The ADDITIONAL RESPONSE BYTES field contains the requested information.
01h	UNKNOWN SMP FUNCTION	Unknown	The SMP target port does not support the requested SMP function. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
02h	SMP FUNCTION FAILED	All	The SMP target port supports the SMP function, but the requested SMP function failed. The ADDITIONAL RESPONSE BYTES may be present but shall be ignored.
03h	INVALID REQUEST FRAME LENGTH	All	The SMP target port supports the SMP function, but the SMP request frame length was invalid (i.e., did not match the frame size defined for the function). The ADDITIONAL RESPONSE BYTES may be present but shall be ignored.
04h	INVALID EXPANDER CHANGE COUNT	CONFIGURE GENERAL, CONFIGURE ROUTE INFORMATION, PHY CONTROL, PHY TEST FUNCTION, CONFIGURE PHY EVENT INFORMATION	The SMP target port supports the SMP function, but the EXPECTED EXPANDER CHANGE COUNT field does not match the current expander change count.
10h	PHY DOES NOT EXIST	DISCOVER, DISCOVER LIST, REPORT PHY ERROR LOG, REPORT PHY SATA, REPORT ROUTE INFORMATION, REPORT PHY EVENT INFORMATION, CONFIGURE ROUTE INFORMATION, PHY CONTROL, PHY TEST FUNCTION, CONFIGURE PHY EVENT INFORMATION	The phy specified by the PHY IDENTIFIER field or the STARTING PHY IDENTIFIER field in the SMP request frame does not exist (e.g., the value is not within the range of zero to the value of the NUMBER OF PHYS field reported in the SMP REPORT GENERAL response). The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.

Table 2 — FUNCTION RESULT **field** (part 2 of 3)

Code	Name	SMP function(s)	Description
11h	INDEX DOES NOT EXIST	REPORT ROUTE INFORMATION, CONFIGURE ROUTE INFORMATION	The phy specified by the PHY IDENTIFIER field in the SMP request frame does not have the table routing attribute (see 4.6.7.1), or the expander route index specified by the EXPANDER ROUTE INDEX field does not exist (i.e., the value is not in the range of 0000h to the value of the EXPANDER ROUTE INDEXES field in the SMP REPORT GENERAL response). The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
12h	PHY DOES NOT SUPPORT SATA	REPORT PHY SATA and PHY CONTROL (TRANSMIT SATA PORT SELECTION SIGNAL)	The phy specified by the PHY IDENTIFIER field in the SMP request frame is not part of an STP target port. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
13h	UNKNOWN PHY OPERATION	PHY CONTROL	The operation specified by the PHY OPERATION field in the SMP request frame is unknown. The SMP function had no affect. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
14h	UNKNOWN PHY TEST FUNCTION	PHY TEST FUNCTION	The operation specified by the PHY TEST FUNCTION field in the SMP request frame is unknown. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
15h	PHY TEST FUNCTION IN PROGRESS	PHY TEST FUNCTION	The specified phy is already performing a phy test function. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
16h	PHY VACANT	DISCOVER, DISCOVER LIST, REPORT PHY ERROR LOG, REPORT PHY SATA, REPORT ROUTE INFORMATION, REPORT PHY EVENT INFORMATION, CONFIGURE ROUTE INFORMATION, PHY CONTROL, CONFIGURE PHY EVENT INFORMATION	The SMP target port processing the SMP request frame does not have access to the phy (e.g., because of zoning or vendor-specific reasons), although the value is within the range of zero to the value of the NUMBER OF PHYS field reported in the SMP REPORT GENERAL response. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
17h	PHY EVENT INFORMATION SOURCE NOT SUPPORTED	CONFIGURE PHY EVENT INFORMATION	The phy event information source specified by a PHY EVENT INFORMATION SOURCE field is not supported.

Table 2 — FUNCTION RESULT **field** (part 3 of 3)

Code	Name	SMP function(s)	Description
20h	SMP ZONE VIOLATION	CONFIGURE GENERAL, ZONED BROADCAST, PHY CONTROL, PHY TEST FUNCTION, CONFIGURE PHY EVENT INFORMATION	The SMP target port supports the function, but zoning is enabled and the SMP initiator port does not have access to a necessary zone group according to the zone permission table (see 4.8.3.2).
xxh	PHY BUSY	DISCOVER, DISCOVER LIST	The SMP target port processing the SMP request frame temporarily does not have access to a phy (e.g., because of a link reset sequence). The RETRY DELAY TIMER field may indicate how long the management application client should wait before restarting the discover process.
All others	Reserved		

The RESPONSE LENGTH field indicates the number of dwords that follow, not including the CRC field. For compatibility with previous versions of this standard, a RESPONSE LENGTH field set to 00h sometimes indicates a non-zero number of dwords; this is defined in the function description.

The ADDITIONAL RESPONSE BYTES field definition depends on the SMP function requested. The maximum size of the ADDITIONAL RESPONSE BYTES field is 1 024 bytes, making the maximum size of the frame 1 032 bytes (i.e., 1 024 bytes of data + 4 bytes of header + 4 bytes of CRC).

Fill bytes shall be included after the ADDITIONAL RESPONSE BYTES field so the CRC field is aligned on a four byte boundary. The contents of the fill bytes are vendor specific.

The CRC field is included in each response frame format defined in this clause, although that field is defined by the SMP transport layer (see 9.4.1) and parsed by the SMP link layer (see 7.18).

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 SMP target ports.

> NOTE 1 - The DISCOVER LIST function (see 10.4.3.11) returns information about one or more phys.

Table 3 defines the request format.

Table 3 — 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	(MSB)	EXPANDER CHANGE COUNT						
5								(LSB)
6	Reserved							
7								
8	Reserved							IGNORE ZONE GROUP
9	PHY IDENTIFIER							
10	Reserved							
11								
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 SMP target port 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 SMP target port 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.

The PHY IDENTIFIER field specifies the phy (see 4.2.7) for which the information is being requested.

The CRC field is defined in 10.4.3.1.

Table 4 defines the response format.

Table 4 — DISCOVER response (part 1 of 2)

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

Table 4 — DISCOVER response (part 2 of 2)

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								
52	ATTACHED DEVICE NAME							
59								
60	Reserved				ZONE ADDRESS RESOLVED	ZONE GROUP PERSISTENT	ZONE PARTICIPATING	ZONING ENABLED
61	Reserved							
62								
63	ZONE GROUP							
64	(MSB)	CRC						
67								(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 0Fh. 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 RETRY DELAY TIMER field is defined in table 5.

Table 5 — RETRY DELAY TIMER **field**

Function result	Retry delay timer code	Description
PHY BUSY	0000h	No addition information
	0001h - FFEFh	The number of 100 milliseconds increments the management application client should wait before retrying the discover process.
	FFF0h - FFFDh	Reserved
	FFFEh	The management application client should handle this as it would a PHY VACANT function result.
	FFFFh	Reserved
All others	0000h - FFFFh	Reserved

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

10.4.3.11 DISCOVER LIST function

10.4.3.11.1 DISCOVER LIST function overview

The DISCOVER LIST function returns information about the device (i.e., some fields from the REPORT GENERAL response (see 10.4.3.3)) and one or more phys (i.e., some fields from the DISCOVER response (see 10.4.3.5)). This SMP function shall be implemented by all SMP target ports. This function is intended to provide the necessary information in a single SMP response for a self-configuring expander device to perform the discover process and configure its own expander routing table.

10.4.3.11.2 DISCOVER LIST request

Table 6 defines the request format.

Table 6 — DISCOVER LIST request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (16h)							
2	Reserved							
3	REQUEST LENGTH (06h)							
4	Reserved							
7								
9	STARTING PHY IDENTIFIER							
9	MAXIMUM NUMBER OF DESCRIPTORS							
10	IGNORE ZONE GROUP	Reserved			PHY FILTER			
11	Reserved				DESCRIPTOR TYPE			
12	Reserved							
15								
16	Vendor-specific							
27								
28	(MSB)							
31	CRC							(LSB)

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

The FUNCTION field shall be set to 16h.

The REQUEST LENGTH field shall be set to 06h.

The STARTING PHY IDENTIFIER field specifies the phy identifier of the first phy for which the information is being requested.

The MAXIMUM NUMBER OF DESCRIPTORS field specifies the maximum number of complete DISCOVER LIST descriptors that the management device server shall return.

The IGNORE ZONE GROUP bit is defined in the SMP DISCOVER request (see 10.4.3.5).

The PHY FILTER field is defined in table 7 and specifies a filter limiting which phys that the management device server shall return in the DISCOVER LIST descriptor list in the DISCOVER response.

Table 7 — PHY FILTER **field**

Code	Description
0h	All phys.
1h	Phys with the ATTACHED DEVICE TYPE field (see 10.4.3.5) set to 010b or 011b (i.e., attached to expander devices).
2h	Phys with the ATTACHED DEVICE TYPE field (see 10.4.3.5) set to a value other than zero (i.e., attached to end devices or expander devices).
All others	Reserved

The DESCRIPTOR TYPE field is defined in table 8 and specifies the DISCOVER LIST descriptor format and length.

Table 8 — DESCRIPTOR TYPE **field**

Code	DISCOVER LIST descriptor format	Descriptor length
0h	DISCOVER response defined in table 4 (see 10.4.3.5) not including the CRC field	The length of the DISCOVER response not including the CRC field
1h	SHORT FORMAT descriptor defined in table 227 (see 10.4.3.11.4)	24 bytes
All others	Reserved	

The CRC field is defined in 10.4.3.1.

10.4.3.11.3 DISCOVER LIST response

Table 9 defines the response format.

Table 9 — DISCOVER LIST response (part 1 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (16h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH ((n - 7) / 4)							
4	(MSB)	EXPANDER CHANGE COUNT						
5								(LSB)
6	RETRY DELAY TIMER field							
7								
8	STARTING PHY IDENTIFIER							
9	NUMBER OF DESCRIPTORS							
10	Reserved				PHY FILTER			
11	Reserved				DESCRIPTOR TYPE			

Table 9 — DISCOVER LIST response (part 2 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
12	DESCRIPTOR LENGTH							
13	Reserved							
15								
16	ZONING SUPPORTED	ZONING ENABLED	Reserved				CONFIGURING	CONFIGURABLE ROUTE TABLE
17	Reserved							
31								
32	Vendor specific							
47								
	DISCOVER LIST descriptor list							
48	DISCOVER LIST descriptor (first)(see table 8 in 10.4.3.11.1, and table 4 in 10.4.3.5 or table 227 in 10.4.3.11.4)							
	...							
n - 4	DISCOVER LIST descriptor (last)(see table 8 in 10.4.3.11.1, and table 4 in 10.4.3.5 or table 227 in 10.4.3.11.4)							
n - 3	(MSB)	CRC						
n								(LSB)

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

The FUNCTION field shall be set to 16h.

The FUNCTION RESULT field is defined in 10.4.3.2.

The RESPONSE LENGTH field contains the number of dwords that follow not including the CRC field.

The RETRY DELAY TIMER field is defined in table 5.

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

The STARTING PHY IDENTIFIER field indicates the phy identifier of the first phy in the DISCOVER LIST descriptor list.

10.4.3.16 PHY CONTROL function

The PHY CONTROL function requests actions by the specified phy. This SMP function may be implemented by any SMP target port. 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 4.8.3.2).

Table 10 defines the request format.

Table 10 — 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 (09h)							
4	(MSB) EXPECTED EXPANDER CHANGE COUNT							
5								(LSB)
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	(MSB) CRC							
43								(LSB)

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. 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 10.4.3.13).

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

Table 11 defines the PHY OPERATION field.

Table 11 — PHY OPERATION **field** (part 1 of 2)

Code	Operation	Description
00h	NOP	No operation.
01h	LINK RESET	If the specified phy is not a virtual phy, perform a link reset sequence (see 4.4) on the specified phy and enable the specified phy. If the specified phy is a virtual phy, perform an internal reset and enable the specified phy. See 7.11 for Broadcast (Change) requirements related to this phy operation in an expander device. Any affiliation (see 7.17.5) shall continue to be present. The phy shall bypass the SATA spinup hold state, if implemented (see 6.8.3.9). The SMP response shall be returned without waiting for the link reset to complete. During the link reset sequence the receipt any SMP DISCOVER function (see 10.4.3.5) or any SMP DISCOVER LIST function (see 10.4.3.11) is processed as defined in 4.7.1
02h	HARD RESET	If the specified phy is not a virtual phy, perform a link reset sequence (see 4.4) on the specified phy and enable the specified phy. If the attached phy is a SAS phy or an expander phy, the link reset sequence shall include a hard reset sequence (see 4.4.2). If the attached phy is a SATA phy, the phy shall bypass the SATA spinup hold state. See 7.11 for Broadcast (Change) requirements related to this phy operation in an expander device. If the specified phy is a virtual phy, perform an internal reset and enable the specified phy. Any affiliation (see 7.17.5) shall be cleared. The SMP response shall be returned without waiting for the hard reset to complete. During the link reset sequence the receipt any SMP DISCOVER function (see 10.4.3.5) or any SMP DISCOVER LIST function (see 10.4.3.11) is processed as defined in 4.7.1
03h	DISABLE	Disable the specified phy (i.e., stop transmitting valid dwords and receiving dwords on the specified phy). The LINK RESET and HARD RESET operations may be used to enable the phy. See 7.11 for Broadcast (Change) requirements related to this phy operation in an expander device.
04h	Reserved	
05h	CLEAR ERROR LOG	Clear the error log counters reported in the REPORT PHY ERROR LOG function (see 10.4.3.6) for the specified phy.

Table 11 — PHY OPERATION **field** (part 2 of 2)

Code	Operation	Description
06h	CLEAR AFFILIATION	Clear an affiliation (see 7.17.5) from the STP initiator port with the same SAS address as the SMP initiator port that opened this SMP connection. If there is no such affiliation, the SMP target port shall return a function result of SMP FUNCTION FAILED in the response frame.
07h	TRANSMIT SATA PORT SELECTION SIGNAL	This function shall only be supported by phys in an expander device. If the expander phy incorporates an STP/SATA bridge and supports SATA port selectors, the phy shall transmit the SATA port selection signal (see 6.6) which causes the SATA port selector to select the attached phy as the active host phy and make its other host phy inactive. See 7.11 for Broadcast (Change) requirements related to this phy operation in an expander device. Any affiliation (see 7.17.5) shall be cleared. If the expander phy does not support SATA port selectors, then the SMP target port shall return a function result of PHY DOES NOT SUPPORT SATA. If the expander phy supports SATA port selectors but is attached to a SAS phy or an expander phy, the SMP target port shall return a function result of SMP FUNCTION FAILED.
08h	CLEAR STP I_T NEXUS LOSS	The STP I_T NEXUS LOSS OCCURRED bit in the REPORT PHY SATA function (see 10.4.3.7) shall be set to zero.
All others	Reserved	

If the PHY IDENTIFIER field specifies the phy which is being used for the SMP connection and a phy operation of LINK RESET, HARD RESET, or DISABLE is requested, the SMP target port shall not perform the requested operation and shall return a function result of SMP FUNCTION FAILED in the response frame.