To: T10 Technical Committee
From: Tyson Hartshorn, Steve Johnson LSI
Date: July 17, 2007
Subject: Serial Attached SCSI - 2 (SAS-2)

Revision history

Revision 0, 07-039 (March 2, 2007) First revision.
Revision 1, 07-039 (March 20, 2007) Second Revision.
Revision 2, 07-039 (April 23, 2007) Third Revision.
Revision 3, 07-039 (June 11, 2007) Fourth Revision
Revision 4, 07-039 (July 17, 2007) Fifth Revision

Related documents

sas2r10 - Serial Attached SCSI 2.

Overview

The REPORT SELF-CONFIGURATION STATUS function currently only supports a maximum of 256 descriptors. Changes are proposed to increase the index fields from 8 bits to 16 bits to support more than 256 descriptors and to provide an indicator in REPORT GENERAL and DISCOVER LIST for initiators to determine if new events have been added or not. This prevents querying via the REPORT SELF-CONFIGURATION STATUS request every time a change occurs on the topology.

Suggested changes

Increase the following fields in REPORT SELF-CONFIGURATION STATUS from 8 bits to 16 bits:

1) The STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field of the request.
2) The STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field of the response.
3) The MAXIMUM SUPPORTED SELF-CONFIGURATION STATUS DESCRIPTORS field of the response.
4) The TOTAL NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS field of the response.

Add 16 bit field to the REPORT GENERAL and DISCOVER LIST responses to indicate the index of the last self configuration status log written by the management device server.

Add 16 bit field to the REPORT GENERAL response to indicate the number of self configuration status logs that the device management server can store.

Add STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field to the REPORT SELF-CONFIGURATION response to indicate the index value of the first descriptor in the response list.

Add verbiage in the usage model section in Chapter 4 to describe the mechanism for storing and retrieving these logs.

Table 180 defines the response format.

Table 180 — REPORT GENERAL response (part 1 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (00h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH ~~(0Eh)~~ (0Fh)							
4	(MSB)							
5	EXPANDER CHANGE COUNT							(LSB)
6	(MSB)							
7	EXPANDER ROUTE INDEXES							(LSB)
8	Reserved							
9	NUMBER OF PHYS							
10	TABLE TO TABLE SUPPORTED	Reserved				CONFIGURES OTHERS	CONFIGURING	EXTERNALLY CONFIGURABLE ROUTE TABLE
11	Reserved							
12	ENCLOSURE LOGICAL IDENTIFIER							
19								
20	Reserved							
29								
30	(MSB)							
31	STP BUS INACTIVITY TIME LIMIT							(LSB)
32	(MSB)							
33	STP MAXIMUM CONNECT TIME LIMIT							(LSB)
34	(MSB)							
35	STP SMP I_T NEXUS LOSS TIME							(LSB)
36	Reserved			ZONE LOCKED	PHYSICAL PRESENCE SUPPORTED	PHYSICAL PRESENCE ASSERTED	ZONING SUPPORTED	ZONING ENABLED
37	Reserved							
38	(MSB)							
39	MAXIMUM NUMBER OF ROUTED SAS ADDRESSES							(LSB)

Table 180 — REPORT GENERAL response (part 2 of 2)

Byte\Bit	7	6	5	4	3	2	1	0
40	ACTIVE ZONE MANAGER SAS ADDRESS							
47								
48	(MSB)							
49	ZONE LOCK INACTIVITY TIME LIMIT							(LSB)
50	Reserved							
51								
52	Reserved							
53	FIRST ENCLOSURE CONNECTOR ELEMENT INDEX							
54	NUMBER OF ENCLOSURE CONNECTOR ELEMENT INDEXES							
55	Reserved							
56	REDUCED FUNCTIONALITY	Reserved						
57	TIME TO REDUCED FUNCTIONALITY							
58	INITIAL TIME TO REDUCED FUNCTIONALITY							
59	MAXIMUM REDUCED FUNCTIONALITY TIME							
~~60~~	(MSB)			~~CRC~~				
~~63~~								(LSB)
60	(MSB)			LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX				
61								(LSB)
62	(MSB)			MAXIMUM NUMBER OF STORED SELF-CONFIGURATION STATUS DESCRIPTORS				
63								(LSB)
64	(MSB)			CRC				
67								(LSB)

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

The FUNCTION field shall be set to 00h.

The FUNCTION RESULT field is defined in 10.4.3.2.

The RESPONSE LENGTH field shall be set to ~~0Eh~~ 0Fh. For compatibility with previous versions of this standard, a RESPONSE LENGTH field set to 00h indicates that there are 6 dwords before the CRC field.

The EXPANDER CHANGE COUNT field counts the number of Broadcast (Change)s originated by an expander device (see 7.11). Management device servers in expander devices shall support this field. management device servers in other device types (e.g., end devices) shall set this field to 0000h. This field shall be set to at least 0001h at power on. If the expander device has originated Broadcast (Change) for any reason described in 7.11 since transmitting a REPORT GENERAL response, it shall increment this field at least once from the

value in the previous REPORT GENERAL response. It shall not increment this field when forwarding a Broadcast (Change). This field shall wrap to at least 0001h after the maximum value (i.e., FFFFh) has been reached.

NOTE 79 - Application clients that use the EXPANDER CHANGE COUNT field should read it often enough to ensure that it does not increment a multiple of 65 536 times between reading the field.

NOTE 80 - Management device servers in expander devices compliant with previous versions of this standard may return an EXPANDER CHANGE COUNT field set to 0000h.

The EXPANDER ROUTE INDEXES field contains the maximum number of expander route indexes per phy for the expander device (see 4.6.7.3). Management device servers in externally configurable expander devices containing phy-based expander route tables shall support this field. Management device servers in other device types (e.g., end devices, externally configurable expander devices with expander-based expander route tables, and self-configuring expander devices) shall set the EXPANDER ROUTE INDEXES field to zero. Not all phys in an externally configurable expander device are required to support the maximum number indicated by this field.

The NUMBER OF PHYS field contains the number of phys in the device, including any virtual phys and any vacant phys.

A TABLE TO TABLE SUPPORTED bit set to one indicates the expander device is a self-configuring expander device that supports its table routing phys being attached to table routing phys in other expander devices. The TABLE TO TABLE SUPPORTED bit shall only be set to one if the EXTERNALLY CONFIGURABLE ROUTE TABLE bit is set to zero. A TABLE TO TABLE SUPPORTED bit set to zero indicates the expander device is not a self-configuring expander device that supports its table routing phys being attached to table routing phys in other expander devices.

A CONFIGURES OTHERS bit set to one indicates that the expander device is a self-configuring expander device that performs the configuration subprocess defined in 4.8. A CONFIGURES OTHERS bit set to zero indicates the expander device may or may not perform the configuration subprocess. Self-configuring expander devices compliant with this standard shall set the CONFIGURES OTHERS bit to one.

NOTE 81 - If the CONFIGURES OTHERS bit is set to zero, the expander device may configure all externally configurable expander devices in the SAS domain.

A CONFIGURING bit set to one indicates that either:

a) the management device server is in a self-configuring expander device, the self-configuring expander device's management application client is currently performing the discover process (see 4.7), and it has identified at least one change to its expander routing table; or
b) the zoning expander device is locked and the zoning expander shadow values differ from the zoning expander active values.

A CONFIGURING bit set to zero indicates that the management device server is not in a self-configuring expander device currently performing the discover process and changing its expander routing table. Changes in this bit from one to zero result in a Broadcast (Change) being originated (see 7.11). Management device servers in self-configuring expander devices shall support this bit. Management device servers in externally configurable expander devices and in other device types shall set the CONFIGURING bit to zero.

An EXTERNALLY CONFIGURABLE ROUTE TABLE bit set to one indicates that the management device server is in an externally configurable expander device that has a phy-based expander route table that is required to be configured with the SMP CONFIGURE ROUTE INFORMATION function (see 4.6.7.3). An EXTERNALLY CONFIGURABLE ROUTE TABLE bit set to zero indicates that the management device server is not in an externally configurable expander device (e.g., it is in an end device, in a self-configuring expander device, or in an expander device with no phys with table routing attributes).

The ENCLOSURE LOGICAL IDENTIFIER field identifies the enclosure, if any, in which the device is located, and is defined in SES-2. The ENCLOSURE LOGICAL IDENTIFIER field shall be set to the same value reported by the enclosure services process, if any, for the enclosure. An ENCLOSURE LOGICAL IDENTIFIER field set to zero indicates no enclosure information is available.

The STP BUS INACTIVITY TIME LIMIT field contains the bus inactivity time limit for STP connections which is set by the CONFIGURE GENERAL function (see 10.4.3.15).

The STP MAXIMUM CONNECT TIME LIMIT field contains the maximum connect time limit for STP connections which is set by the CONFIGURE GENERAL function (see 10.4.3.15).

The STP SMP I_T NEXUS LOSS TIME field contains the time that an STP target port and an SMP initiator port retry certain connection requests which is set by the CONFIGURE GENERAL function (see 10.4.3.15).

A ZONE LOCKED bit set to one indicates that the zoning expander device is locked (see 4.9.6.2). A ZONE LOCKED bit set to zero indicates that the zoning expander device is not locked.

A PHYSICAL PRESENCE SUPPORTED bit set to one indicates that the expander device supports physical presence as a mechanism for allowing zoning to be enabled or disabled from phys in zone groups without access to zone group 2. A PHYSICAL PRESENCE SUPPORTED bit set to zero indicates that the expander device does not support physical presence as a mechanism for allowing zoning to be enabled or disabled.

A PHYSICAL PRESENCE ASSERTED bit set to one indicates that the expander device is currently detecting physical presence. A PHYSICAL PRESENCE ASSERTED bit set to zero indicates that the expander device is not currently detecting physical presence. The PHYSICAL PRESENCE ASSERTED bit shall be set to zero if the PHYSICAL PRESENCE SUPPORTED bit is set to zero.

A ZONING SUPPORTED bit set to one indicates that zoning is supported by the expander device (i.e., it is a zoning expander device). A ZONING SUPPORTED bit set to zero indicates that zoning is not supported by the expander device.

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 ZONING ENABLED bit shall be set to zero if the ZONING SUPPORTED bit is set to zero.

The MAXIMUM NUMBER OF ROUTED SAS ADDRESSES field contains the number of routed SAS addresses in an expander-based expander route table (see 4.6.7.3 and 4.9.3.4). Management device servers in expander devices containing expander-based expander route tables shall support this field. Management device servers in other device types (e.g., end devices and expander devices with phy-based expander route tables) shall set this field to 0000h.

The ACTIVE ZONE MANAGER SAS ADDRESS field indicates the SAS address of the zone manager that last locked the zoning expander device. If the zoning expander device is currently being configured by a vendor-specific sideband method then the ACTIVE ZONE MANAGER SAS ADDRESS field shall be set to zero. This field shall be set to zero at power on.

The ZONE LOCK INACTIVITY TIME LIMIT field indicates the minimum time between any SMP ZONE LOCK requests, SMP zone configuration function requests, or SMP ZONE ACTIVATE requests from the active zone manager that the locked expander device allows and is set in the SMP ZONE LOCK request (see 10.4.3.18).

The FIRST ENCLOSURE CONNECTOR ELEMENT INDEX field indicates the lowest CONNECTOR ELEMENT INDEX field of all the expander phys in all the expander devices in the enclosure that have CONNECTOR TYPE fields set to 20h through 2Fh (i.e., an internal connector to an end device) in their SMP DISCOVER responses.

The NUMBER OF ENCLOSURE CONNECTOR ELEMENT INDEXES field indicates the number of expander phys in all the expander devices in the enclosure that have CONNECTOR TYPE fields set to 20h through 2Fh (i.e., an internal connector to an end device) in their SMP DISCOVER responses.

NOTE 82 - The NUMBER OF ENCLOSURE CONNECTOR ELEMENT INDEXES field assumes that all internal connectors to end devices are assigned to a contiguous range of CONNECTOR ELEMENT INDEX field values.

A REDUCED FUNCTIONALITY bit set to one indicates that:

a) the expander device is scheduled to reduce its functionality (see 4.6.8) in the time indicated in the TIME TO REDUCED FUNCTIONALITY field; or
b) that the expander device is currently operating with reduced functionality (see 4.6.8).

A REDUCED FUNCTIONALITY bit set to zero indicates the expander device is not scheduled to reduce functionality and that the contents of the TIME TO REDUCED FUNCTIONALITY field shall be ignored.

If the REDUCED FUNCTIONALITY bit set to one, then the TIME TO REDUCED FUNCTIONALITY field contains the time, in 100 ms increments, remaining until the expander device is scheduled to reduce functionality. The expander device starts the reduced functionality delay timer after originating a Broadcast (Expander) (see 4.6.8).

The INITIAL TIME TO REDUCED FUNCTIONALITY field contains the minimum period of time, in 100 ms increments, that an expander device waits from originating a Broadcast (Expander) to reducing functionality. The expander device should set the default value for the INITIAL TIME TO REDUCED FUNCTIONALITY field to at least 2 000 ms (i.e., 14h).

The MAXIMUM REDUCED FUNCTIONALITY TIME field contains the maximum time, in seconds, that the expander device responds with OPEN_REJECT (RETRY) to connection requests that map to an expander phy or an SMP target port that is not accessible during expander device reduced functionality. This timer starts after the reduced functionality delay timer expires.

The LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field is defined in the REPORT SELF-CONFIGURATION STATUS response (see 10.4.3.5).

The MAXIMUM NUMBER OF STORED SELF-CONFIGURATION STATUS DESCRIPTORS field indicates the maximum number of self-configuration status descriptors, of the length specified in the SELF-CONFIGURATION DESCRIPTOR LENGTH field of the REPORT SELF-CONFIGURATION STATUS response, that the management device server supports.

The CRC field is defined in 10.4.3.2.

9.4.5.4 REPORT SELF-CONFIGURATION STATUS function

9.4.5.4.1 REPORT SELF-CONFIGURATION STATUS function overview

The REPORT SELF-CONFIGURATION STATUS function returns self-configuration expander device status. This SMP function shall be implemented by the management device server in self-configuring expander devices and shall not be implemented by any other management device servers.

9.4.5.4.2 REPORT SELF-CONFIGURATION STATUS request

Table 181 defines the request format.

Table 181 — REPORT SELF-CONFIGURATION STATUS request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (03h)							
2	Reserved							
3	REQUEST LENGTH (02h)							
4	Reserved							
5								
6	(MSB)	STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX						
7								(LSB)
8	(MSB)	CRC						
11								(LSB)

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

The FUNCTION field shall be set to 03h.

The REQUEST LENGTH field shall be set to 02h.

The STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field specifies the first self-configuration status descriptor that the management device server returns in the SMP response frame. If the specified index does not contain a valid descriptor, then the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX in the response may differ from specified index.

The CRC field is defined in 10.4.3.1.

9.4.5.4.3 REPORT SELF-CONFIGURATION STATUS response

Table 182 defines the response format.

Table 182 — REPORT SELF-CONFIGURATION STATUS response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (03h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (n-3)							
4	(MSB)							
5				EXPANDER CHANGE COUNT				(LSB)
~~6~~	~~Reserved~~							
6	(MSB)							
7				STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX				(LSB)
8	(MSB)							
9				TOTAL NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS				(LSB)
10	(MSB)							
11				LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX				(LSB)
12	SELF-CONFIGURATION STATUS DESCRIPTOR LENGTH							
13	Reserved							
14								
18	Reserved							
19	NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS							
Self-configuration status descriptor list								
20								
	Self-configuration status descriptor (first)(see table 183)							
	...							
n - 4	Self-configuration status descriptor (last)(see table 183)							
n - 3	(MSB)							
n				CRC				(LSB)

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

The FUNCTION field shall be set to 03h.

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 EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response (see 10.4.3.3). If the SMP initiator port detects a change in the value of this field while retrieving multiple response frames, it should start again because the status information returned is incomplete and inconsistent.

The STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field indicates the index of the first self-configuration status descriptor being returned~~, and is set to the same value as the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field in the SMP request frame~~. If the specified STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX in the SMP request is 0000h, then the management device server shall set the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX in the response to 0000h, the TOTAL NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS to 0000h, and no descriptors will be returned. If the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX specified in the REPORT SELF-CONFIGURATION STATUS request does not contain a valid descriptor, then the device management server shall set the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX of the REPORT SELF-CONFIGURATION STATUS response to the next index, in ascending order wrapping from FFFFh to 0001h, that contains a valid descriptor. Otherwise this field shall be set to the same value as the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX in the SMP request frame.

The SELF-CONFIGURATION DESCRIPTOR LENGTH field indicates the length, in dwords, of the REPORT SELF_CONFIGURATION STATUS descriptor (see Table 182).

The TOTAL NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS field indicates how many self-configuration status descriptors are available at this time from the management device server.

The LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field indicates the last recorded self-configuration status descriptor index.

The NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS field indicates how many self-configuration status descriptors follow in this SMP response frame.

~~The management device server shall return all the self-configuration status descriptors that fit in one SMP response frame starting with the descriptor specified by the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field and in ascending order based on the descriptor index.~~

The CRC field is defined in 10.4.3.2.

9.4.5.4.4 Self-configuration status descriptor

Each self-configuration status descriptor follows the format defined in table 183.

Table 183 — Self-configuration status descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	STATUS TYPE							
1	Reserved							FINAL
2	Reserved							
3	PHY IDENTIFIER							
4	Reserved							
7								
8	(MSB)							
15	SAS ADDRESS							(LSB)

The STATUS TYPE field indicates the type of status being reported and is defined in table 184.

Table 184 — STATUS TYPE field (part 1 of 2)

Code	Description
00h	Reserved
01h	Error not related to a specific layer
02h	The expander device currently has a connection or is currently attempting to establish a connection with the SMP target port with the indicated SAS address.
03h	Expander route table is full. The expander device was not able to add the indicated SAS address to the expander route table.
04h	Expander device is out of resources (e.g., it discovered too many SAS addresses while performing the discover process through a subtractive port). This does not affect the expander route table.
05h - 1Fh	Reserved for status not related to specific layers
Status reported by the phy layer	
20h	Error reported by the phy layer
21h	All phys in the expander port containing the indicated phy lost dword synchronization
22h - 3Fh	Reserved for status reported by the phy layer
Status reported by the link layer	
40h	Error reported by the link layer
41h	Connection request failed: Open Timeout timer expired
42h	Connection request failed: Received an abandon-class OPEN_REJECT (e.g., BAD DESTINATION, PROTOCOL NOT SUPPORTED, ZONE VIOLATION, STP RESOURCES BUSY, WRONG DESTINATION)
43h	Connection request failed: Received a vendor-specific number of retry-class OPEN_REJECTs (e.g. RETRY, PATHWAY BLOCKED)
44h	Connection request failed: I_T nexus loss occurred (e.g., OPEN_REJECT (NO DESTINATION) for longer than the time specified by the STP SMP I_T NEXUS LOSS TIME field in the CONFIGURE GENERAL function
45h	Connection request failed: Received BREAK
46h	Connection established: SMP response frame had a CRC error
47h - 5Fh	Reserved for status reported by the link layer
Status reported by the port layer	
60h	Error reported by the port layer
61h	During an SMP connection, there was no SMP response frame within the maximum SMP connection time
62h - 7Fh	Reserved for status reported by the port layer
Status reported by the transport layer	
80h	Error reported by the transport layer
81h - 9Fh	Reserved for status reported by the transport layer

Table 184 — STATUS TYPE field (part 2 of 2)

Code	Description
Status reported by the application layer	
A0h	Error reported by the application layer
A1h	SMP response frame is too short
A2h	SMP response frame contains field(s) with unsupported values
A3h	SMP response frame contains results inconsistent with other SMP response frames (e.g., the DISCOVER response ATTACHED SAS ADDRESS field does not contain the SAS address the expander device expected)
A4h	The SAS ADDRESS field contains the SAS address of a self-configuring expander device that returned a REPORT GENERAL response with the CONFIGURING bit set to one. Accesses to SAS addresses two levels beyond this expander device may not succeed until the indicated expander device completes configuration. This is not necessarily an error.
A5h - BFh	Reserved for status reported by the application layer
Other status	
C0h - DFh	Reserved
E0h - FFh	Vendor-specific

A FINAL bit set to one indicates that the expander device is no longer attempting to establish connections to the SMP target port with the indicated SAS address as part of the discover process because of the error indicated by the descriptor. A FINAL bit set to zero indicates that the expander device is still attempting to access the SMP target port with the indicated SAS address as part of the discover process.

The PHY IDENTIFIER field indicates the phy (see 4.2.7) that was used to request a connection with the SMP target port with the indicated SAS address.

Editor's Note 49: Define that phy identifier FFh means "unknown phy"

The SAS ADDRESS field indicates the SAS address of the SMP target port to which the expander device established a connection or attempted to establish a connection.

9.4.5.5 DISCOVER LIST function

9.4.5.5.1 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 10.4.3.7)). This SMP function shall be implemented by all management device servers. 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.

9.4.5.5.2 DISCOVER LIST response

Table 185 defines the response format.

Table 185 — DISCOVER LIST response

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)							
5	EXPANDER CHANGE COUNT							(LSB)
6								
7	Reserved							
8	STARTING PHY IDENTIFIER							
9	NUMBER OF DISCOVER LIST DESCRIPTORS							
10	Reserved				PHY FILTER			
11	Reserved				DESCRIPTOR TYPE			
12	DESCRIPTOR LENGTH							
13								
15	Reserved							
16	ZONING SUPPORTED	ZONING ENABLED	Reserved				CONFIGURING	CONFIGURABLE ROUTE TABLE
17	(MSB)							
18	LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX							(LSB)
19								
31	Reserved							
32								
47	Vendor specific							
DISCOVER LIST descriptor list								
48								
	DISCOVER LIST descriptor (first)(see table 182 in 9.4.5.5.1, and table 237 in 10.4.3.7 or table 261 in 10.4.3.13.4)							
	...							
n - 4	DISCOVER LIST descriptor (last)(see table 182 in 9.4.5.5.1, and table 237 in 10.4.3.7 or table 261 in 10.4.3.13.4)							
n - 3	(MSB)							
n	CRC							(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 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.

NOTE 83 - The STARTING PHY IDENTIFIER field may be different than the STARTING PHY IDENTIFIER field in the request frame (see 10.4.3.13.2) due to the filter specified by the PHY FILTER field in the request frame.

The NUMBER OF DISCOVER LIST DESCRIPTORS field indicates the number of DISCOVER LIST descriptors returned in the DISCOVER LIST descriptor list.

The DESCRIPTOR LENGTH field indicates the length of the DISCOVER LIST descriptor (see table 182 in 10.4.3.13.2).

The ZONING SUPPORTED bit is defined in the SMP REPORT GENERAL response (see 10.4.3.3).

The ZONING ENABLED bit is defined in the SMP REPORT GENERAL response (see 10.4.3.3).

The CONFIGURING bit is defined in the SMP DISCOVER response (see 10.4.3.7).

The CONFIGURABLE ROUTE TABLE bit is defined in the SMP DISCOVER response (see 10.4.3.7).

The LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field is defined in the REPORT SELF-CONFIGURATION STATUS response (see 10.4.3.5).

The DISCOVER LIST descriptor list contains DISCOVER LIST descriptors for each phy:

a) starting with the phy whose phy identifier is specified in the STARTING PHY IDENTIFIER field in the request (see 10.4.3.13.2);
b) satisfying the filter specified in the PHY FILTER field in the request (see table 258 in 10.4.3.13.2); and
c) that is able to be included in the response frame without being truncated.

Each DISCOVER LIST descriptor shall use the format specified in the DESCRIPTOR TYPE field in the request (see table 182 in 10.4.3.13.2)

The management device server shall not include DISCOVER LIST descriptors for phys with phy identifiers greater than or equal to the NUMBER OF PHYS field reported in the SMP REPORT GENERAL response (see 10.4.3.3). The management device server shall not include partial DISCOVER LIST descriptors.

The CRC field is defined in 10.4.3.2.

9.4.6 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. A management application client performs a discover process to discover all the SAS devices and expander devices in the SAS domain (i.e., determining their device types, SAS addresses, and supported protocols). A SAS initiator device uses this information to determine SAS addresses to which it is able to establish connections. A self-configuring expander device uses this information to fill in its expander route table.

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.

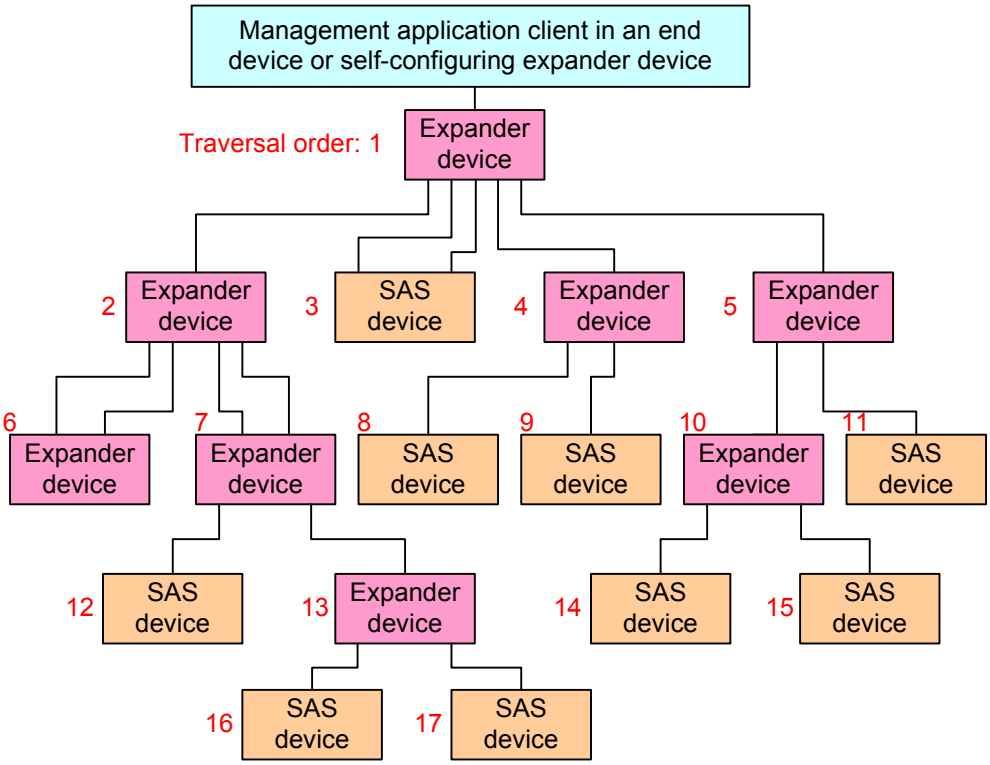
This order is repeated until all expander devices have been traversed. If the management application client discovers an externally configurable expander device that is not located beyond a self-configuring expander

device with the CONFIGURES OTHERS bit set to one in the REPORT GENERAL response (see 10.4.3.3) it shall perform the configuration subprocess (see 4.8) to configure the expander route table before attempting to establish connections with devices attached two levels (see 4.8.4) beyond that externally configurable expander device.

If an end device is directly attached to a self-configuring expander device with the CONFIGURES OTHERS bit set to one in the REPORT GENERAL response (see 10.4.3.3), then the management application client in that end device is not required to perform the configuration subprocess. If all the expander devices in the SAS domain are self-configuring expander devices, then management application clients in end devices are not required to perform the configuration subprocess.

If the management application client is inside a self-configuring expander device, then the process shall be repeated on each expander port.

Figure 202 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 202 — 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 (see 7.8.2) 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 10.4.3.7) and the SMP DISCOVER LIST response (see 10.4.3.13.3).

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 10.4.3.7) or the SMP DISCOVER LIST function (see 10.4.3.13) 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 EXTERNALLY CONFIGURABLE ROUTE TABLE bit is set to zero in the SMP REPORT GENERAL response, its own management application client shall configure its own expander route table as described in 4.8.

While 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 that would otherwise have returned OPEN_REJECT (NO DESTINATION) return OPEN_REJECT (RETRY) instead (see 4.6.6.3 and 4.7.2).

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 externally 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 expander device is in the process of a link reset sequence resulting from an SMP PHY CONTROL function (see 10.4.3.24) phy operation of LINK RESET or HARD RESET, then the management device server shall set the NEGOTIATED PHYSICAL LINK RATE field (see table 245) to RESET_IN_PROGRESS in any SMP DISCOVER response (see 10.4.3.7) or SMP DISCOVER LIST response (see 10.4.3.13).

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).

The management application client in a self-configuring expander device shall maintain self-configuration status for the last vendor-specific number of errors encountered during self-configuration and should maintain at least one self-configuration status per phy. The management device server shall assign descriptors to the statuses sequentially starting at ~~zero~~ 0001h and shall return the descriptors in the SMP REPORT SELF-CONFIGURATION STATUS response (see 10.4.3.5). The management device server shall return the index of the last self-configuration status descriptor in the SMP REPORT GENERAL response (see 10.4.3.3), the SMP DISCOVER LIST response (see 10.4.3.14), and the SMP REPORT SELF-CONFIGURATION STATUS response (see 10.4.3.5). The management device server shall wrap the index to 0001h when the highest supported descriptor index has been used.

The management device server shall support self-configuration status descriptor indexes from 0001h to FFFFh. The actual number of self-configuration status descriptors that the management device server maintains for retrieval with the REPORT SELF-CONFIGURATION STATUS request is vendor specific and is indicated by the MAXIMUM NUMBER OF STORED SELF-CONFIGURATION STATUS DESCRIPTORS field defined in the REPORT GENERAL response (see 10.4.3.3). The volatility of these stored descriptors is vendor specific. The management device server shall replace the least recently recorded self-configuration status descriptor with a new one once the number of recorded descriptors exceeds the value indicated by MAXIMUM NUMBER OF STORED SELF-CONFIGURATION STATUS DESCRIPTORS.

The management device server shall return either all the self-configuration status descriptors that fit in one SMP response frame or until the index indicated in the LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX is reached. The list shall start with the descriptor specified by the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field in ascending order, wrapping from FFFFh to 0001h, based on the descriptor index. The descriptor list shall not contain any truncated descriptors. If the specified STARTING SELF-CONFIGURATION

STATUS DESCRIPTOR INDEX is the same value as the LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX, then the descriptor at that index shall be returned.

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