

To: T10 Technical Committee  
From: Steve Johnson LSI Logic (steve.johnson@lsil.com), Brad Besmer LSI Logic  
Date: 21 June 2006  
Subject: 06-037r7 SAS-2 SMP Lists (DISCOVER LIST)

**Revision history**

Revision 0 (9 January 2006) First revision  
Revision 1 (7 April 2006) Revised from January 9 and CC meeting discussions.  
Revision 2 (19 April 2006).  
Revision 3 (19 April 2006). Revised from various feedback  
Revision 4 (28 April 2006). Revised from April 20 meeting discussions.  
Revision 5 (1 May 2006) Fixed descriptor size  
Revision 6 (23 May 2006) Revised from May 17 call discussion.  
Revision 7 (21 May 2006) Revised from June 20 meeting, accepted for inclusion.

**Related documents**

sas2r03 - Serial Attached SCSI 2 revision 3  
SAS-2 06-176  
SAS-2 06-213  
SAS-2 06-215

**Revision Overview r6 to r7**

PHY DOES NOT EXIST definition, add STARTING PHY IDENTIFIER.  
Cleanup text on a bunch of reserved fields.  
Add ZONING ENABLED bit and ZONING SUPPORTED bit to DISCOVER LIST response (table 6).  
Remove ZONING ENABLED from descriptor.  
Add Editors notes to add more Requested LOCK SAS ADDRESS and Kevin bits.

**Overview**

SMP DISCOVER, requires a separate SMP request and response per PHY identifier. In typical SAS-1.1 topologies the overhead of discovering and configuring the topology can become a significant hindrance to active I/O and fail-over scenarios. Self discovery, zoning, supervisor elections, table to table links, all using 1.1 discovery and routing procedures would add a "boat load" more of SMPs to the SMP storm. The discussion (or requirement) of very large SAS-2 topologies containing 1000's of end devices, dozens of self configuring expanders and initiators necessitates the need to dramatically improved the discovery and configuration mechanisms.

Part of the solution is to reduce the number of SMP request and responses by combining multiple highly used SMP operations into single requests and responses.

The descriptor format provides the necessary information for each phy (up to 40 phys) in a single SMP request and response for a self configuring expander to perform self configuration of routing tables, zoning route tables, and zoning election for the requested expander.

**Suggested changes**

Add new SMP DISCOVER LIST function to section 10.4.3.x SMP functions of SAS-2. The DISCOVER LIST provides all the necessary data for a self configuring expander to program it's zoning and route tables along with supervisor election information if included into the spec.

Table 1 — SMP functions (FUNCTION field)

Code	SMP function	Description	Reference
00h	REPORT GENERAL	Return general information about the device	10.4.3.3
01h	REPORT MANUFACTURER INFORMATION	Return vendor and product identification	10.4.3.4
02h	READ GPIO REGISTER	See SFF-8485	
<u>03h</u>	<u>REPORT ZONE PERMISSION</u>	<u>Return zone permission table entries</u>	
04h - 0Fh	Reserved for general SMP input functions		
10h	DISCOVER	Return information about the specified phy	10.4.3.5
11h	REPORT PHY ERROR LOG	Return error logging information about the specified phy	10.4.3.6
12h	REPORT PHY SATA	Return information about a phy currently attached to a SATA phy	
13h	REPORT ROUTE INFORMATION	Return route table information	10.4.3.8
14h	REPORT PHY EVENT INFORMATION	Return phy event information for the specified phy	10.4.3.9
<u>15h</u>	<u>REPORT ZONE ROUTE TABLE</u>	<u>Return zone information for each specified phy</u>	
<u>16h</u>	<u>DISCOVER LIST</u>	<u>Return information about the specified list of phys</u>	
17h - 1Fh	Reserved for phy-based SMP input functions		
20h - 3Fh	Reserved for SMP input functions		
40h - 7Fh	Vendor specific		
80h	CONFIGURE GENERAL	Configure the device	10.4.3.10
81h	Reserved for a general SMP output function		
82h	WRITE GPIO REGISTER	See SFF-8485	
<u>83h</u>	<u>CONFIGURE ZONE PERMISSION</u>	<u>Change zone permission table information</u>	
84h	Reserved for general SMP output functions		
85h	ZONED BROADCAST	Transmit the specified BROADCAST on the expander ports in the specified zone group(s)	10.4.3.11
86h - 8Fh	Reserved for general SMP output functions		
90h	CONFIGURE ROUTE INFORMATION	Change route table information	10.4.3.11
91h	PHY CONTROL	Request actions by the specified phy	10.4.3.12
92h	PHY TEST FUNCTION	Request a test function by the specified phy	10.4.3.13
93h	CONFIGURE PHY EVENT INFORMATION	Configure phy event information for the specified phy	10.4.3.14

Table 1 — SMP functions (FUNCTION field)

Code	SMP function	Description	Reference
94h	<u>CONFIGURE PHY ZONE</u>	<u>Change phy entries within a zone route table</u>	
95h - 9Fh	Reserved for phy-based SMP output functions		
A0h - BFh	Reserved for SMP output functions		
C0h - FFh	Vendor specific		

The FUNCTION RESULT field is defined in table 197.

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

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.
10h	PHY DOES NOT EXIST	DISCOVER, <a href="#">DISCOVER LIST</a> , 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 REPORT GENERAL function). The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
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 REPORT GENERAL function). 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.

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

Code	Name	SMP function(s)	Description
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, 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 REPORT GENERAL function. 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.
20h	SMP ZONE VIOLATION	ZONED BROADCAST	The SMP target port supports the function, but the application zone permission table bit is set to zero (e.g., the ZP[s, 3] bit is set to zero and the request was ZONED BROADCAST)(see 4.8.3.2).
<a href="#">21h</a>	<a href="#">UNKNOWN PHY FILTER</a>	<a href="#">DISCOVER LIST</a>	<a href="#">The management device server does not support the requested filter operation specified by the PHY FILTER field.</a>
<a href="#">22h</a>	<a href="#">UNKNOWN DESCRIPTOR TYPE</a>	<a href="#">DISCOVER LIST</a>	<a href="#">The management device server does not support the requested descriptor type specified by the DESCRIPTOR TYPE field.</a>
All others	Reserved		

## 10.4.3.x DISCOVER LIST function

The DISCOVER LIST function returns a list of phy descriptors. This SMP function shall be implemented by all SMP target ports. This function is intended to provide the necessary information in a single SMP request and response for a self configuring expander to perform self configuration of routing tables and zoning route tables.

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[Editor's Note 1: Reminder to add comment above about proxy information when that gets approved](#)

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Table 3 defines the request format.

**Table 3 — 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	Reserved							
8	STARTING PHY IDENTIFIER							
9	MAXIMUM NUMBER OF DESCRIPTORS							
10	IGNORE ZONE GROUP	Reserved			PHY FILTER			
11	Reserved			DESCRIPTOR TYPE				
12	Reserved							
15	Reserved							
16	Vendor Specific							
27	Vendor Specific							
28	(MSB)	CRC						(LSB)
31	(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 in the list of descriptors being requested.

The MAXIMUM NUMBER OF DESCRIPTORS field specifies the maximum number of descriptors requested starting with the value specified by the STARTING PHY IDENTIFIER field.

The PHY FILTER field is defined in Table 4 and specifies which PHY IDENTIFIER shall be returned in the DISCOVER LIST of descriptors.

**Table 4 — PHY FILTER field**

Code	Description
0h	The management device server shall return in the list of descriptors all phy identifiers beginning with the value specified in the STARTING PHY IDENTIFIER field subject to the IGNORE ZONE GROUP bit (see 10.4.3.5).
1h	The management device server shall return in the list of descriptors only phy identifiers with the ATTACHED DEVICE TYPE (see 10.4.3.5) field set to 010b or 011b (i.e., an expander device) beginning with the value specified in the STARTING PHY IDENTIFIER field.
2h	The management device server shall return in the list of descriptors only phy identifiers with the ATTACHED DEVICE TYPE (see 10.4.3.5) field set to a value other than zero (i.e., end devices and expander devices) beginning with the value specified in the STARTING PHY IDENTIFIER field.
All others	Reserved.

The IGNORE ZONE GROUP bit is defined in 10.4.3.5.

The DESCRIPTOR TYPE field is defined in Table 5 and specifies the descriptor format and length.

**Table 5 — DESCRIPTOR TYPE field**

Code	Descriptor Length	Description
0h	Defined in the DISCOVER response, RESPONSE LENGTH field in 10.4.3.5 not including the CRC field.	The descriptor shall contain a DISCOVER response as defined in 10.4.3.5 not including the CRC field.
1h	06h	The descriptor shall contain a SHORT FORMAT descriptor (see table 7)
All others		Reserved.

The CRC field is defined in 10.4.3.2.

**Table 6 — 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-3)/4)							

Table 6 — DISCOVER LIST response (part 2 of 2)

Byte/Bit	7	6	5	4	3	2	1	0
4	(MSB) EXPANDER CHANGE COUNT (LSB)							
5	Reserved							
6	Reserved							
7	Reserved							
8	STARTING PHY IDENTIFIER							
9	NUMBER OF DESCRIPTORS							
10	Reserved				PHY FILTER			
11	Reserved				DESCRIPTOR TYPE			
12	DESCRIPTOR LENGTH							
13	Reserved							
15	Reserved							
16	ZONING ENABLED	ZONE SUPPORTED	Reserved			CONFIGURING	CONFIGURABLE ROUTE TABLE	
17	Reserved							
22	Reserved							
23	Reserved				Reserved			
24	Reserved							
31	Reserved							
32	Vendor specific							
47	Reserved							
<b>DISCOVER LIST descriptor list</b>								
48	DISCOVER LIST descriptor (first)							
m	...							
y	DISCOVER LIST descriptor (last)							
n - 4	Reserved							
n - 3	(MSB) CRC (LSB)							
n	Reserved							

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Editor's Note 2: Need to add in the LOCKED SAS ADDRESS in bytes 24-31.

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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 10.4.3.3.

The STARTING PHY IDENTIFIER field indicates the phy identifier of the first phy in the list of descriptors being returned.

The NUMBER OF DESCRIPTORS field indicates the number of descriptors returned in the descriptor list. A descriptor shall be returned for each phy that satisfies the phy filter (see table 4). If the value of the STARTING PHY IDENTIFIER field plus the value of the MAXIMUM NUMBER OF DESCRIPTORS FIELD exceeds the value of the NUMBER OF PHYS field reported in the REPORT GENERAL response (see 10.4.3.3) then the management device server shall return a list with the last descriptors PHY IDENTIFIER set to (NUMBER OF PHYS -1) subject to the PHY FILTER. No partial descriptors shall be included in the descriptor list.

The PHY FILTER field from the request frame (see table 4).

The DESCRIPTOR TYPE field is defined in the DISCOVER LIST request.

The DESCRIPTOR LENGTH field indicates the length of the descriptor as specified in Table 5.

The CONFIGURABLE ROUTE TABLE field is defined in 10.4.3.3.

The CONFIGURING field is defined in 10.4.3.3.

The ZONE ADDRESS RESOLVE DEVICE field is defined in 10.4.3.3.

The ZONE DEVICE field is defined in 10.4.3.3.

The ZONE PROXY PRIORITY field is defined in 10.4.3.3.

The ACTIVE ZONE PROXY PRIORITY field is defined in 10.4.3.3.

The ACTIVE ZONE PROXY SAS ADDRESS field is defined in 10.4.3.3.

The CRC field is defined in 10.4.3.2.

Table 7 defines the descriptor format.

**Table 7 — SHORT FORMAT descriptor (part 1 of 2)**

Byte\Bit	7	6	5	4	3	2	1	0
0	PHY IDENTIFIER							
1	FUNCTION RESULT							
2	Reserved	ATTACHED DEVICE TYPE		Restricted for DISCOVER response				
3	Restricted for DISCOVER response			NEGOTIATED PHYSICAL LINK RATE				
4	Restricted for DISCOVER response			ATTACHED SSP INITIATOR	ATTACHED STP INITIATOR	ATTACHED SMP INITIATOR	ATTACHED SATA HOST	
5	ATTACHED SATA PORT SELECTOR	Restricted for DISCOVER response		ATTACHED SSP TARGET	ATTACHED STP TARGET	ATTACHED SMP TARGET	ATTACHED SATA DEVICE	
6	VIRTUAL PHY	Reserved		ROUTING ATTRIBUTE				
7	Reserved							
8	ZONE GROUP							

Table 7 — SHORT FORMAT descriptor (part 2 of 2)

Byte\Bit	7	6	5	4	3	2	1	0	
9	Reserved				ZONE ADDRESS RESOLVED	ZONE GROUP PERSISTENT	ZONE PARTICIPATING	ZONING ENABLED	
10	ATTACHED PHY IDENTIFIER								
11	PHY CHANGE COUNT								
12	(MSB)	ATTACHED SAS ADDRESS							
19								(LSB)	
20	Reserved								
23	Reserved								

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[Editor's Note 3: Add in some "Kevin" bits.](#)

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The PHY IDENTIFIER field is defined in 10.4.3.5.

The FUNCTION RESULT field is defined in 10.4.3.2.

The ATTACHED DEVICE TYPE field is defined in 10.4.3.5.

The NEGOTIATED PHYSICAL LINK RATE field is defined in 10.4.3.5.

The ATTACHED SATA HOST bit is defined in 10.4.3.5.

The ATTACHED SMP INITIATOR bit is defined in 10.4.3.5.

The ATTACHED STP INITIATOR bit is defined in 10.4.3.5.

The ATTACHED SSP INITIATOR bit is defined in 10.4.3.5.

The ATTACHED SATA DEVICE bit is defined in 10.4.3.5.

The ATTACHED SMP TARGET bit is defined in 10.4.3.5.

The ATTACHED STP TARGET bit is defined in 10.4.3.5.

The ATTACHED SSP TARGET bit is defined in 10.4.3.5.

The ATTACHED SATA PORT SELECTOR bit is defined in 10.4.3.5.

The ROUTING ATTRIBUTE field is defined in 10.4.3.5.

The VIRTUAL PHY bit is defined in 10.4.3.5.

The ZONE GROUP field is defined in 10.4.3.5.

The ZONE PARTICIPATING bit is defined in 10.4.3.5.

The ZONE GROUP PERSISTENT bit is defined in 10.4.3.5.

The ZONE ADDRESS RESOLVED bit is defined in 10.4.3.5.

The ZONE GROUP bit is defined in 10.4.3.5.

The ATTACHED PHY IDENTIFIER field is defined in 10.4.3.5.

The PHY CHANGE COUNT field is defined in 10.4.3.5.

The ATTACHED SAS ADDRESS field is defined in 10.4.3.5.