To: T10 Technical Committee
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Subject: 06-078r0 SAS-2 Expander Route Table (REPORT EXPANDER ROUTE TABLE)

Revision history
Revision 0 (19 April, 2006) First revision

Related documents
sas2r03 - Serial Attached SCSI 2 revision 3

Overview

In SAS 1.1 each table routing phy has it's own routing table. The tables are required to be programmed on a phy basis in a very specific order to facilitate several initiators reading and writing them at the same time. These rules do not make sense for self configuring expanders.

Some disadvantages of this method are:

1) Expander add and removal (depending on location) can cause the tables to have to be completely rebuilt.
2) To program and build the tables complete discovery must be performed to determine routing phy attributes.
3) All unused entries are required to be zeroed by initiators
4) The exact number of route entries for a given phy route table can only be determined by a process of trial an error requiring each initiator to send the SMP REPORT ROUTE INFORMATION function or the SMP CONFIGURE ROUTE INFORMATION until a status of INDEX DOSE NOT EXIST is returned.

Another way to implement SAS routing tables is to view the routing tables as one single table for all the phys of the expander, where there is a single list of SAS Addresses and phys that the addresses are routed to. This table may be sparse and addresses are not programmed in any particular order.

Some advantages of this method are:

1) The table does not have to be in any specific order.
2) Adding and removing SAS ADDRESSES is independent of order.
3) Allows for partial discoveries.
4) Table does not have to be rebuilt or reordered when expanders (or any device types) are added or removed.
5) No zeroing of table entries.
6) Matches most hardware implementations.
7) The exact table size can be reported.

How self configuring expanders manage their route table or "tables" is vendor specific; A method to report the table that more closely matches the actual implementations is needed.

Note: A method to report zone address resolved addresses and the associated zone groups is also needed. Can we use this to SMP function to report address resolved addresses and zone groups as well?

Suggested changes

Change the EXPANDER ROUTE INDEXES field in SMP REPORT GENERAL function response.

The EXPANDER ROUTE INDEXES field contains the maximum number of route indexes per phy for the expander device (see 4.6.7.3). SMP target ports in expander devices shall support this field. SMP target ports in other

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device types (e.g., end devices) shall set the EXPANDER ROUTE INDEXES field to zero. Not all phys in an edge expander device are required to support the maximum number indicated by this field. A self-configuring expander device shall set this field to the total number of route indexes supported by the expander device.

Add the SMP REPORT EXPANDER ROUTE TABLE function to section 10.4.3.x SMP functions of the SAS-2

The REPORT EXPANDER ROUTE TABLE function is being proposed to report the current expander routing table.

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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	
03h	REPORT ZONE PERMISSION	Return zone permission table entries	
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 for the specified phy	10.4.3.8
14h	REPORT PHY EVENT INFORMATION	Return phy event information for the specified phy	10.4.3.9
15h	REPORT ZONE ROUTE TABLE	Return zone information for each specified phy	
16h	DISCOVER LIST	Return information about the specified list of phys	
17h	REPORT EXPANDER ROUTE TABLE	Return expander route table information	
18h - 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	
83h	CONFIGURE ZONE PERMISSION	Change zone permission table information	
84h	Reserved for general SMP output functions		

Table 1 — SMP functions (FUNCTION **field)**

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

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10.4.3.x REPORT EXPANDER ROUTE TABLE function

The REPORT EXPANDER ROUTE TABLE function assigns or removes a list of SAS ADDRESSES to one or more expander table route phys. The list may be in any order. Other SMP target ports shall not support this SMP function.

Table 2 — REPORT EXPANDER ROUTE TABLE request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (17h)							
2	Reserved							
3	REQUEST LENGTH (06h)							
4	Reserved							
7								
8	MAXIMUM NUMBER OF EXPANDER ROUTE TABLE DESCRIPTORS							
9								
10	STARTING EXPANDER ROUTE INDEX							
15								
16	Reserved							
27								
28	(MSB)							
				CRC				
31								(LSB)

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

The FUNCTION field shall be set to 17h.

The REQUEST LENGTH field shall be set to 06h.

The MAXIMUM NUMBER OF EXPANDER ROUTE TABLE DESCRIPTORS field specifies the maximum number of descriptors contained in the EXPANDER ROUTE TABLE descriptor list.

The STARTING EXPANDER ROUTE INDEX field specifies the first route table index to be returned in the EXPANDER ROUTE TABLE descriptor list.

Table 3 — REPORT EXPANDER ROUTE TABLE response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (17h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH ((n-7) / 4)							
4	Reserved							
7								
8	NUMBER OF EXPANDER ROUTE TABLE DESCRIPTORS							
9								
10	FIRST EXPANDER ROUTE INDEX							
15								
10	LAST EXPANDER ROUTE INDEX							
11								
12	EXPANDER ROUTE TABLE CHANGE COUNT							
13								
14	Reserved							
15								
	EXPANDER ROUTE TABLE descriptor list							
16	EXPANDER ROUTE TABLE descriptor (first)							
31								
...	...							
n - 15	EXPANDER ROUTE TABLE descriptor (last)							
n - 4								
n - 3	(MSB)							
n	CRC							(LSB)

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

The FUNCTION field shall be set to 17h.

The RESPONSE LENGTH field shall be set to ((n - 7) / 4).

The NUMBER OF EXPANDER ROUTE TABLE DESCRIPTORS field specifies the number of EXPANDER ROUTE TABLE descriptors contained in the EXPANDER ROUTE TABLE descriptor list.

The FIRST EXPANDER ROUTE INDEX field specifies the route table index of the first EXPANDER ROUTE TABLE descriptor reported in the EXPANDER ROUTE TABLE descriptor list.

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The LAST EXPANDER ROUTE INDEX field specifies the route table index of the last EXPANDER ROUTE TABLE descriptor reported in the EXPANDER ROUTE TABLE descriptor list. This value of this field may be used in the EXPANDER ROUTE TABLE request as the STARTING EXPANDER ROUTE INDEX.

The ROUTE TABLE CHANGE COUNT field counts the number of times the routing table has been modified by the self configuring expander device. Self configuring expander devices shall support this field. This field shall be set to 0000h at power on. If the self configuring expander device modified the expander route table since responding to a previous EXPANDER ROUTE TABLE request, it shall increment this field at least once from the value in the previous EXPANDER ROUTE TABLE response. This field shall wrap to zero after the maximum value (i.e., FFFFh) has been reached.

Table 4 defines the EXPANDER ROUTE TABLE descriptor format.

Table 4 — EXPANDER ROUTE TABLE descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0								
				PHY IDENTIFIER BIT FIELD				
5								
6	ZONE GROUP							
7	Reserved							
8								
				ROUTED SAS ADDRESS				
15								

The PHY IDENTIFIER BIT FIELD specifies the phy identifiers the ROUTED SAS ADDRESS is routed to. This field is a bit array where each bit position indicates a corresponding phy identifier (e.g. bit zero set to one specifies that phy identifier zero).

The zone group field is defined in 4.8.3.1

The ROUTED SAS ADDRESS field contains the SAS address in the expander route entry (see 4.6.7.3).