

To: T10 Technical Committee  
 From: Tim Symons, PMC-Sierra (Tim\_Symons@pmc-sierra.com)  
 Heng Liao, PMC-Sierra (liaoheng@pmc-sierra.com),  
 Date: December 23, 2005  
 Subject: T10/06-019r5 SAS-2 zoning

## Revision Information

- Revision 0 (Dec 14, 2005) Revised from 05-144r9 document. Addition of short broadcast frame support, enforced symmetry of zone permission table and improved formatting.
- Revision 1 (Dec 29, 2005) Editorial update.
- Revision 2 (Jan 12, 2006) Removed support for broadcast address frame. Addition of support for SMP ORIGINATE BROADCAST PRIMITIVESS in place of the BROADCAST FRAME. Revised SMP CONFIGURE ZONE PERMISSION to remove BATCH command and support only zone permission entry descriptors. An update to permission entry ZP[ X, Y] shall update ZP[ Y, X] automatically. Section 10.4.3.14.
- Revision 3 (Feb 1, 2006) Editorial changes advised on SAS zone management conference call. Removed LAST REQUEST bit from SMP CONFIGURE ZONE PERMISSION request and SMP CONFIGURE PHY ZONE request, as these contain change lists, and so sending a BROADCAST (CHANGE) notification event after each request does not significantly increase traffic as opposed to having a mechanism to identify a sequence of requests and only making a notification on the last one. Rewrite definitions for access zone management bit and zoning SMP function result field responses.
- Revision 4 (Feb10, 2006) : This revision addresses the issues around ZPSDS management, specifically relating to the AZM bit. The revisions provide more flexibility for zone supervisor devices, and allows zone management from any supervisor device attached to the ZPSDS. This re-aligns the definition to the original concept.
  - Table 22: ACCESS ZONE MANAGEMENT bit redefined to ZONE SUPERVISOR bit and added to phy zone route table to enable management control.
  - Tables 19 & 21: ZONE PERMISSION CONFIGURING bit & ZONE ROUTE TABLE CONFIGURING bit added for notification purposes.
  - SMP REPORT ZONE PERMISSION and SMP REPORT ZONE ROUTE TABLE functions revised to allow any device to make the request.
  - ACCESS ZONE MANAGEMENT control removed from the SMP DISCOVER: NO ZONE MASK bit. This is not a management function.
  - Moved zone supervisor priority field update from the SMP ZONE PERMISSION functions to the CONFIGURE GENERAL function to support non-AZSD supervisor management functions.
- Revision 5 (Feb 21, 2006) : Prompt revision to align with the recommendation made at the Denver face to face meeting.
  - Greyed out text that is included in 06-107r1. All grey text should be identical to 06-107r1 and there is no intentional deviation from this.
  - rename ZPSDS to ZPSDS
  - Text revisions to align with T10 language style.
  - Removed the ZONE SUPERVISOR bit in favour of the GROUP 2 functionality for managing supervisor devices. (This may require further text).

Changes between r4 and r5 are indicated by red text. Text included in 06-107r1 is grey.

## References

SAS2r02, Serial Attached SCSI - 2 (SAS-2)  
 T10/05-144r9 SAS-2 Zoning  
 T10/06-082r1 SAS-2 Zoning related SMP functions

## Introduction

This proposal defines the interfaces, functions and operations necessary to implement zoning for Serial Attached SCSI (SAS) systems. Conforming implementations may employ any design technique that does not violate interoperability. Where possible this standard uses existing SMP commands, employing reserved fields for zoning data requirements.

## Table of contents

<b>3</b>	<b>Definitions, symbols, abbreviations, keywords, and conventions .....</b>	<b>4</b>
3.1	Definitions .....	4
3.2	Symbols and abbreviations .....	5
<b>4</b>	<b>General .....</b>	<b>5</b>
..	4.9 Zoning .....	5
..	4.9.1 Zoning overview .....	5
..	4.9.2 Zoning expander device requirements.....	7
..	4.9.3 Zone Operation .....	7
...	4.9.3.1 Zone phy information .....	7
...	4.9.3.2 Zone group types.....	7
...	4.9.3.4 Zone permission table .....	8
...	4.9.3.5 Zoning expander zone route table.....	9
...	4.9.3.6 Zone routing.....	9
..	4.9.4 ZPSDS Management .....	10
...	4.9.4.1 SMP zoning functions .....	10
...	4.9.4.2 Zone supervisor device.....	10
...	4.9.4.3 Zone supervisor priority .....	10
...	4.9.4.4 Active zone supervisor device (AZSD) .....	11
..	4.9.5 Active zone supervisor device election .....	11
..	4.9.6 Phy reset event .....	12
..	4.9.7 BROADCAST events .....	12
<b>7</b>	<b>Link layer.....</b>	<b>13</b>
...	7.2.5.11 OPEN_REJECT.....	13
..	7.8 Address frames.....	13
..	7.8.3 OPEN address frame .....	14
<b>10</b>	<b>Application layer.....</b>	<b>14</b>
..	10.4.3 SMP functions.....	14
...	10.4.3.1 SMP function request frame format.....	14
...	10.4.3.2 SMP function response frame format .....	15
...	10.4.3.3 REPORT GENERAL function .....	15
...	10.4.3.5 DISCOVER function .....	16
...	10.4.3.10 CONFIGURE GENERAL function .....	17
...	10.4.3.13 CONFIGURE PHY ZONE function .....	17
...	10.4.3.14 CONFIGURE ZONE PERMISSION function.....	19
...	10.4.3.15 REPORT ZONE PERMISSION function .....	21
...	10.4.3.16 REPORT ZONE ROUTE TABLE function.....	23

**Table of Figures**

**Figure 1 – Example of a ZPSDS ..... 6**  
Figure 2 - Figure 45 - Zone route table example ..... 9

## Table of Tables

Table 1 - Zone permission table .....	8
Table 2 - Routed zone group .....	10
Table 3 - Zone supervisor priority values .....	11
Table 4 - Phy reset event behavior.....	12
Table 5 - Table 83 – OPEN REJECT abandon primitives.....	13
Table 6 – Table 95 OPEN address frame format .....	14
Table 7 - Table 190 – SMP functions (FUNCTION field) .....	15
Table 8 - Table 192 – FUNCTION RESULT field.....	15
Table 9 – Table 194 - REPORT GENERAL response .....	16
Table 10 – Table 197 - DISCOVER request .....	16
Table 11 – Table 198 - DISCOVER response.....	17
Table 12 – Table 214 – CONFIGURE GENERAL request .....	17
Table 13 – CONFIGURE PHY ZONE request .....	18
Table 14 - Phy zone configuration entry descriptor.....	18
Table 15 – CONFIGURE PHY ZONE response.....	19
Table 16 – CONFIGURE ZONE PERMISSION request .....	20
Table 17 - Zone permission entry descriptor.....	20
Table 18 – CONFIGURE ZONE PERMISSION response .....	21
Table 19 – REPORT ZONE PERMISSION request.....	21
Table 20 – REPORT ZONE PERMISSION response .....	22
Table 21 –REPORT ZONE ROUTE TABLE request .....	23
Table 22 –REPORT ZONE ROUTE TABLE response.....	24
Table 23 - Zone route table entry descriptor .....	25

### Suggested changes

## 3 Definitions, symbols, abbreviations, keywords, and conventions

### 3.1 Definitions

#### [Start of new definitions]

**3.1.4 active zone supervisor device:** The **zone** supervisor device that has been elected to configure all zoning expander zone permission tables in the ZPSDS.

**3.1.211 SMP zone management functions:** SMP functions used for ZPSDS configuration (see [9.4.3.1.](#))

**3.1.260 zone group:** A set of expander phys in a ZPSDS all of which have the same access permission.

**3.1.261 zone permission table:** The table that defines access permission between the zone group of a source phy and the zone group of the destination phy.

**3.1.262 zoned portion of a service delivery subsystem (ZPSDS):** A group of zoning expanders that control phy access **based on zone group permissions**. The ZPSDS may include all or part of the service delivery subsystem (see 4.1.6).

**3.1.263 zone supervisor priority:** The **configurable** priority of a zone supervisor device for election to active zone supervisor device.

**3.1.264 zone supervisor device:** A zoning expander device or a zoning device attached to a phy with the ZONE PARTICIPATING bit set to one.

**3.1.265 zoning device:** A SAS expander device or an end device that is an SMP initiator and an SMP target and supports all SMP zone management functions.

**3.1.266 zoning expander device:** A SAS expander device that is an SMP initiator and an SMP target and supports all SMP zone management functions (see [4.9.2](#)).

[\[End of new definitions\]](#)

## 3.2 Symbols and abbreviations

[\[Start of new abbreviations\]](#)

Abbreviation	Meaning
ZPSDS	Zoned Portion of a Service Delivery Subsystem
AZSD	Active Zone Supervisor Device

[\[End of new abbreviations\]](#)

...

## 4. General

### 4.6.5 Broadcast primitive processor (BPP)

The BPP receives broadcast primitive requests from each expander phy and requests transmission of those requests on all expander ports except the expander port from which the broadcast primitive request was received.

In a self-configuring expander device (see 4.1.5), the BPP requests transmission of a BROADCAST (CHANGE) when it completes configuration (see 10.4.3.3).

In a zoning expander device (see 4.9.6), receipt of a broadcast primitive may be translated into a SMP ORIGINATE BROADCAST PRIMITIVES request or vice versa.

#### 4.6.6.5 BPP interface

Table 15 describes the requests from an expander phy to the BPP. See 7.11 for more information on broadcasts. See 4.9.6 for more information on how zoning expander devices handle broadcasts.

[\[No other changes in 4.6.6.5\]](#)

[\[New Section\]](#)

## . 4.9 Zoning

### .. 4.9.1 Zoning overview

SAS zoning is implemented by a set of zoning expander devices that define the zoned portion of a service delivery subsystem (ZPSDS). The zoning expander devices control whether a phy is permitted to open a connection to another phy. [End devices may support zone features.](#)

There shall be at most one ZPSDS in a SAS domain. The ZPSDS may encompass some or all of the SAS domain.

Every phy in a ZPSDS belongs to a zone group. All phys in a wide port shall belong to the same zone group. Each zoning expander contains a zone permission table that controls whether a connection is allowed between the zone group of a source port and the zone group of a target port. There are 128 zone groups.

A requested connection shall only be opened if the zone permission table indicates that access between the zone group of the source port and the zone group of the target port is allowed.

The zone route table is an extended version of the expander route table (see 4.6.7.3) that includes zone phy information. **The zone permission table and zone route table are configured by the active zone supervisor device (AZSD).**

Expander devices that do not support zoning may be part of the service delivery subsystem, but they are treated as being outside the boundary of the ZPSDS (i.e., non-zoning expander devices are treated in the same manner as end devices). All phys in a non-zoning expander device belong to the zone group specified for the phy that attaches the non-zoning expander device to the ZPSDS.

The ZPSDS shall be managed and configured by zone supervisor devices. SMP zone management functions shall only be processed if originated by a zone supervisor device. One supervisor device shall be elected to be the AZSD. The AZSD shall be the only device to propagate zone access permission changes throughout the ZPSDS.

The proper configuration of the ZPSDS depends on the election of an AZSD. This dependency may be satisfied by setting a value greater than zero in the zone priority field of one or more supervisor devices in the ZPSDS.

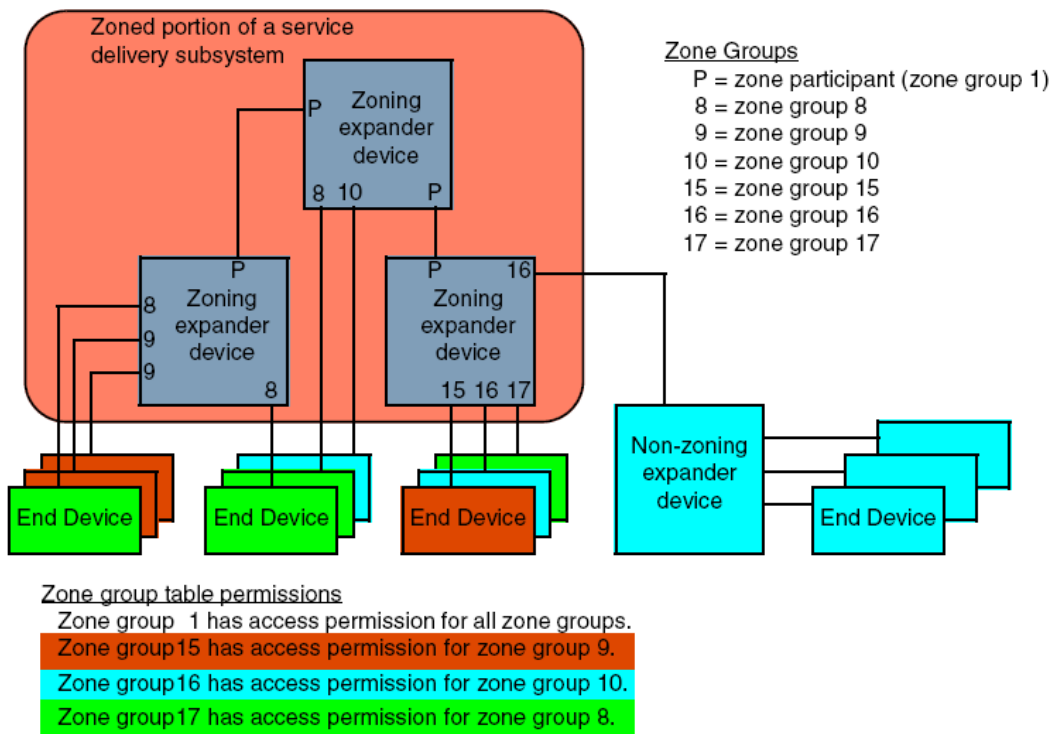


Figure 1 – Example of a ZPSDS

## .. 4.9.2 Zoning expander device requirements

A zoning expander device shall have the following attributes:

- a) contain a zone expander zone route table (see [4.9.3.5](#)).
- b) contain a zone permission table that supports 128 zone groups (see [4.9.3.4](#));
- c) allow or deny connection requests based on the zoning permissions;
- d) set the ZONE DEVICE bit to one in its SMP REPORT GENERAL response.
- e) be self-configuring;
- f) contain an SMP initiator and SMP target (see 4.6.1); and
- g) support all zoning related SMP functions;

## .. 4.9.3 Zone Operation

### ... 4.9.3.1 Zone phy information



Each phy of a zoning expander device shall support the following zone phy information fields:

- a) ZONE PARTICIPATING bit; and
- b) ZONE GROUP field.

The ZONE PARTICIPATING bit indicates the boundary of the ZPSDS. The ZONE PARTICIPATING bit shall be set to zero when the phy is attached to an end device or an expander device that does not support zoning. The ZONE PARTICIPATING bit shall be set to one when the phy is attached to a zoning expander device. **The ZONE PARTICIPATING bit should be set to one when the phy is attached to a zoning end device.** If the ZONE PARTICIPATING bit is set to zero then zoning information shall not be sent on the phy and any zoning information received on the phy shall be ignored.

The ZONE GROUP field has a value in the range 0 to 127 that indicates the zone group to which the phy belongs.

### ... 4.9.3.2 Zone group types

#### 4.9.3.2.1 Overview

Zone groups function in different ways based on zone group number as shown in table n1.

Zone group	User configurable	Link layer tested	Description
0,1	No	Yes	This standard defines zone group 0 as prohibiting all accesses and zone group 1 as allowing all accesses (see 4.9.3.4).
2	Yes	No	Zone group 2 is used by the SMP application layer to restrict processing of SMP zoning configuration commands to the source phys specified by the zone permission table.
3..7	<b>Reserved</b>		
8..127	Yes	Yes	Zone groups 8 through 127 restrict access to phys.

#### 4.9.3.3 Link layer tested zone groups

Link layer tested zone groups have their zone permission bits validated as part of processing and forwarding the OPEN frame. Violations of the zone permission are reported using the OPEN\_REJECT (ZONE VIOLATION) primitive.

**4.9.3.3.1 Zone group 2, SMP zoning configuration testing**

Use of the SMP CONFIGURE PHY ZONE function and SMP CONFIGURE ZONE PERMISSION function shall be restricted based on the zone group 2 permission bits. A SMP target shall retain the contents of the SOURCE ZONE GROUP field from the OPEN frame until the SMP request is received. If the SMP request is CONFIGURE PHY ZONE or SMP CONFIGURE ZONE PERMISSION and the ZP[source zone group,2] bit is set to zero, then the function request shall not be processed and an SMP response frame with the FUNCTION RESULT field set to SMP ZONE VIOLATION shall be returned.

... **4.9.3.4 Zone permission table**

The zone permission table specifies access permission between zone groups. If a bit in the zone permission table is set to one then connection requests shall be permitted between phys in the zone groups. If a bit in the zone permission table is set to zero then connection requests shall be rejected (see 4.9.3.6).

Zoning expander SMP source and target ports shall belong to zone group 1.

The zone permission table is shown in Table 1

**Table 1 - Zone permission table**

Zone group (X) \ Zone group (Y)	0	1	2	...	7	8	...	127
0	0	1	0	...	0	0	...	0
1	1	1	1	...	1	1	...	1
2	0	1	ZP[2,2]	...	Reserved	ZP[8,2]	...	ZP[127,2]
...	...	...	...	...	...	...	...	...
7	0	1	Reserved	...	Reserved	Reserved	...	Reserved
8	0	1	ZP[2,8]	...	Reserved	ZP[8, 8]	...	ZP[127, 8]
...	...	...	...	...	...	...	...	...
127	0	1	ZP[2,127]	...	Reserved	ZP[8, 127]	...	ZP[127, 127]

Note: Gray shading identifies user configurable zone groups.

A ZP[ X, Y ] bit set to one specifies that zone group (X) has permission to access zone group (Y). A ZP[ X, Y ] bit set to zero specifies that zone group (X) does not have permission to access zone group (Y).

If ZP[ X, Y ] is set to a value, then ZP[ Y, X ] shall be set to the same value.

Zone group 0 shall not access any other group except zone group 1 (e.g., ZP[0, 0] and bits ZP[2..127, 0] are set to zero).

Zone group 1 shall access all other zone groups (e.g. ZP[0..127, 1] are set to one).

Regardless of the zoning expander phy attributes, OPEN frames addressed to a zoning expander shall be processed as if the destination is zone group 1.

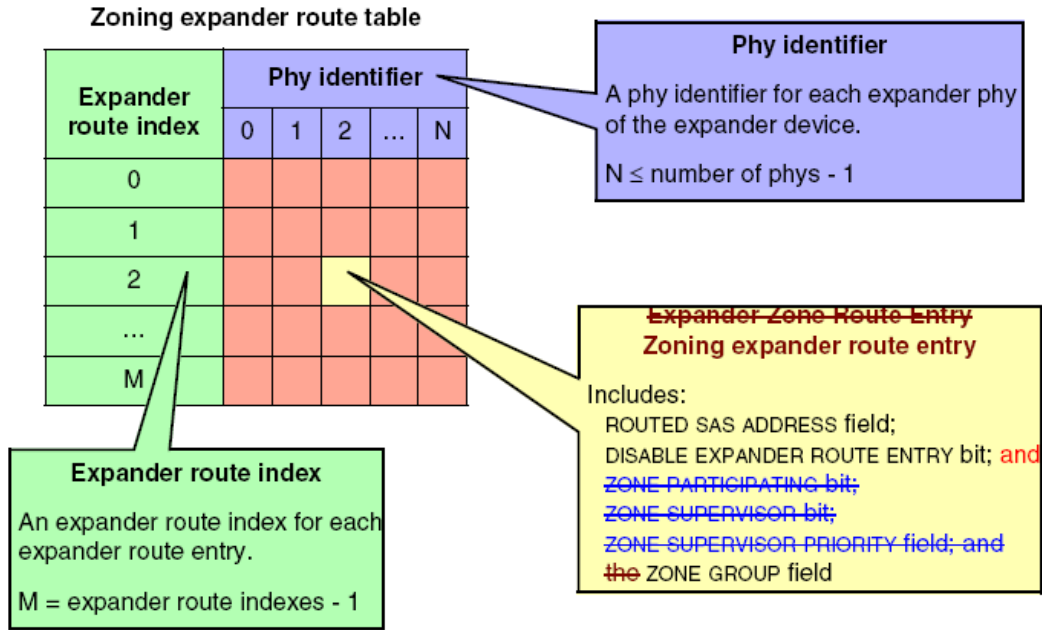
Zone groups 3 through 7 are reserved zone groups. All reserved bits shall be set to zero (e.g. ZP[3..7, 3..127] are set to zero).



... **4.9.3.5 Zoning expander zone route table**

The zone route table in a zoning expander device shall contain zone phy information in addition to the expander phy information.

shows a representation of a zoning expander route table.



**Figure 2 - Figure 45 - Zone route table example**

Some SMP functions may combine information from the zoning expander route table and information from other sources in a single report or configure function.

... **4.9.3.6 Zone routing**

When a zoning expander device receives an OPEN request the zone group of the source port and the destination port is identified as defined in Table 2. If the ZP[source port zone group, destination port zone group] bit is set to one then access between the phys shall be permitted and the zoning expander shall process the ECM arbitration procedure. If the ZP[source port zone group, destination port zone group] bit is set to zero then access between the phys is not permitted and the OPEN\_REJECT (ZONE VIOLATION) response shall be sent to the device that originated the OPEN request (see 7.8.3).

Zoning expander devices shall follow the rules in Table 2 to check the zone group access permission of the DESTINATION SAS ADDRESS field in the OPEN request.

Table 2 - Routed zone group

Expander phy routing attribute (see 4.6.7.1)	Destination zone group determination
direct routing	zone group of the destination phy.
table routing	zone group stored in the zone route table for the destination SAS address.
subtractive routing	zone group of the subtractive phy.

When an OPEN request is originated by a zoning expander device and is sent to a device that is not a zoning expander device, then the phy that has the ZONE PARTICIPATING bit set to zero shall set the SOURCE ZONE GROUP field to zero.

#### .. 4.9.4 ZPSDS Management

##### ... 4.9.4.1 SMP zoning functions

SMP zone management functions shall be supported by all zoning devices. The SMP functions to configure and control the ZPSDS are:

- a) SMP CONFIGURE PHY ZONE (see 10.4.3.13);
- b) SMP CONFIGURE ZONE PERMISSION (see 10.4.3.14);
- c) SMP REPORT ZONE PERMISSION (see 10.4.3.15); and
- d) SMP REPORT ZONE ROUTE TABLE (see 10.4.3.16).

SMP CONFIGURE PHY ZONE and SMP CONFIGURE ZONE PERMISSION functions shall be processed when the requesting device is a zone supervisor device and in all other cases shall result in FUNCTION FAILED.

SMP REPORT ZONE PERMISSION and SMP REPORT ZONE ROUTE PERMISSION functions may be requested by any SMP initiator.

##### ... 4.9.4.2 Zone supervisor device

Zone supervisor devices shall originate SMP zone management function requests to manage and configure the ZPSDS. An SMP CONFIGURE ZONE PERMISSION TABLE request shall only be sent to the AZSD from a zone supervisor device.

If a zone supervisor device receives an SMP CONFIGURE ZONE PERMISSION TABLE request and the SOURCE SAS ADDRESS field value is the AZSD then the zone supervisor device shall process the request. If the SOURCE SAS ADDRESS field value is not the AZSD then the zone supervisor device shall respond SMP FUNCTION FAILED.

##### ... 4.9.4.3 Zone supervisor priority

When a zone supervisor device reports a ZONE SUPERVISOR PRIORITY field value greater than zero in the SMP REPORT GENERAL response, or a phy reports a ZONE SUPERVISOR PRIORITY field value greater than zero in the SMP DISCOVER response, the zone supervisor device is eligible for AZSD.

A zoning expander phy with the ZONE PARTICIPATING bit set to zero shall ignore the ZONE SUPERVISOR PRIORITY field of an attached device and set the ZONE SUPERVISOR PRIORITY field to zero in all zoning functions.

... **4.9.4.4 Active zone supervisor device (AZSD)**

The active zone supervisor device (AZSD) is the elected zone supervisor device.

When the AZSD receives an SMP CONFIGURE ZONE PERMISSION TABLE request and the ZONE SUPERVISOR in the OPEN request is set to one then the AZSD shall process the request. If the ZONE SUPERVISOR in the OPEN request is set to one then the AZSD shall send the response SMP FUNCTION FAILED.

.. **4.9.5 Active zone supervisor device election**

The active zone supervisor device (AZSD) election process shall begin after all zoning expander devices in the ZPSDS complete the self-configuration process. The completion of the self-configuration process is identified when the zoning expander device sets the CONFIGURING bit from one to zero in the SMP REPORT GENERAL response and then sends BROADCAST (CHANGE) (see 4.7.1).

A zoning device shall issue SMP DISCOVER request to each phy in the ZPSDS and evaluate the highest ZONE SUPERVISOR PRIORITY field value (see Table 3). If the same value is reported by two or more phys or devices, then the highest SAS address is elected.

A zoning expander device shall set the ACTIVE ZONE SUPERVISOR PRIORITY and ACTIVE ZONE SUPERVISOR SAS ADDRESS fields in the SMP REPORT GENERAL response to zero until the active zone supervisor election process is complete.

Table 3 indicates the significance of priority values in the ZONE SUPERVISOR PRIORITY field.

**Table 3 - Zone supervisor priority values**

<b>ZONE SUPERVISOR PRIORITY</b>	<b>Description</b>
1111b	Highest priority
1110b	Second highest priority
...	...
0010b	Second lowest priority
0001b	Lowest priority
0000b	Does not participate in the election process

If all zone table entries have the zone supervisor priority set to zero then the election process fails and the ACTIVE ZONE SUPERVISOR PRIORITY field and the ACTIVE ZONE SUPERVISOR SAS ADDRESS field is set to zero in the SMP REPORT GENERAL response frame.

#### .. 4.9.6 Phy reset event

After a phy reset event (e.g., the hot swap of an end device), the zone permission table shall be maintained according to the rules defined Table 4.

**Table 4 - Phy reset event behavior**

Initial Condition	Event	New PHY ZONE Configuration
SAS device attached Phy in the SP15: SAS_PHY_Ready state, with an initial phy zone configuration assigned.	Phy exits the SP15: SAS_PHY_Ready state, and later re-enters the SP15: SAS_PHY_Ready state, as the result of receiving an IDENTIFY frame with the same SAS address as prior to the exit out of SP15: SAS_PHY_Ready state.	The zoning expander device shall set the phy ZONE GROUP field to the value that it contained prior to the phy exiting the SP15: SAS_PHY_Ready state.
	Phy exits the SP15: SAS_PHY_Ready state, and later re-enters the SP15 : SAS_PHY_Ready state as the result of receiving an IDENTIFY frame with a different SAS address as prior to the exit out of SP15: SAS_PHY_Ready state.	The zoning expander device shall set the phy ZONE GROUP field to zero.
SATA device attached Phy in the SP22: SATA_PHY_Ready state, with an initial phy zone configuration assigned.	Phy exits the SP22: SATA_PHY_Ready state, and later re-enters the SP22: SATA_PHY_Ready state before an expander Plug Timeout timer expiration event occurs.	The zoning expander device shall set the phy ZONE GROUP field to the value that it contained prior to the phy exiting the SP22: SATA_PHY_Ready state.
	Phy exits the SP22: SATA_PHY_Ready state, and later re-enters the SP22: SATA_PHY_Ready state with an expander Hot-Plug Timeout timer expiration event in-between.	The zoning expander device shall set the phy ZONE GROUP field to zero.

#### .. 4.9.7 BROADCAST events

If a zoning expander device receives a BROADCAST primitive or an SMP ORIGINATE BROADCAST PRIMITIVES request then the zoning expander device shall process the broadcast notification for all other ports by sending one of the following;

- a) an SMP ORIGINATE BROADCAST PRIMITIVES request on phys with the ZONE PARTICIPATING bit set to one whenever at least one zone permission bit is set to one in;
  - A. any of the zone groups listed in the received SMP ORIGINATE BROADCAST PRIMITIVES request; or
  - B. the zone group associated with the phy on which the BORADCAST primitive was received; or
- b) the relevant BROADCAST primitive as defined in 7.2.5.4. on phys with ZONE PARTICIPATING bit set to zero whenever one of the following conditions is met;
  - A. at least one zone permission bit is set to one for any of the zone groups listed in the received SMP ORIGINATE BROADCAST PRIMITIVES request; or
  - B. the zone group associated with the non-participating phy matches the zone group associated with the phy on which the BROADCAST primitive was received.

[End of new Section]

[Start of suggested changes to existing sections]

## 7 Link layer...

### 7.2.2 Primitive summary

Table 70 defines the primitives not specific to the type of connection.

Primitive	Use <sup>a</sup>	From <sup>b</sup>			To <sup>b</sup>			Primitive sequence type <sup>c</sup>
		I	E	T	I	E	T	
...								
OPEN_REJECT (PATHWAY BLOCKED)	NoConn		E		I		T	Single
OPEN_REJECT (PROTOCOL NOT SUPPORTED)	NoConn	I		T	I		T	Single
OPEN_REJECT (RESERVED ABANDON 0)	NoConn		E		I		T	Single
OPEN_REJECT (ZONE VIOLATION)								
...								

#### ... 7.2.5.11 OPEN\_REJECT

[Start of addition to existing table]

**Table 5 - Table 83 – OPEN REJECT abandon primitives**

Primitive	Originator	Description
...		
OPEN_REJECT (ZONE VIOLATION)	Zoning expander phy	The connection request is from a zone group that does not have permission to access the zone group that contains the destination phy.
...		

[End of addition to existing table]

## . 7.8 Address frames

...

.. **7.8.3 OPEN address frame**

Table 6 defines the OPEN address frame format used for connection requests.

**Table 6 – Table 95 OPEN address frame format**

Byte\Bit	7	6	5	4	3	2	1	0
0	INITIATOR PORT	PROTOCOL			ADDRESS FRAME TYPE (1h)			
1	FEATURES				CONNECTION RATE			
2	(MSB)	INITIATOR CONNECTION TAG						(LSB)
3								
4	DESTINATION SAS ADDRESS							
11	SOURCE SAS ADDRESS							
12	SOURCE ZONE GROUP							
19	PATHWAY BLOCK COUNT							
20								
21	(MSB)	ARBITRATION WAIT TIME						(LSB)
22								
23	MORE COMPATIBLE FEATURES							
24								
27	(MSB)	CRC						(LSB)
28								
31								

...

The SOURCE ZONE GROUP field identifies the zone group that contains the phy making the connection request. If the OPEN request is received on a zoning expander device phy with the ZONE PARTICIPATING bit set to zero (i.e. the source device is outside the ZPSDS), then the SOURCE ZONE GROUP field of the OPEN request shall be set to the zone group that is associated with the zoning expander device phy on which the OPEN request has been received. Zone source group values 128 and 255, inclusive, are reserved.

...

## 10 Application layer...

### .. 10.4.3 SMP functions

#### ... 10.4.3.1 SMP function request frame format

...

[start of unchanged text from SAS2r2, included for context purposes only]

The FUNCTION field specifies which SMP function is being requested and is defined in table 190. If the value in the FUNCTION field is not supported by the SMP target port, it shall return a function result of UNKNOWN SMP FUNCTION as described in table 192.

[end of unchanged text from SAS2r2, included for context purposes only]

Table 7 - Table 190 – SMP functions (FUNCTION field)

Code	SMP function	Description	Reference
...			
02h	READ GPIO REGISTER	See SFF-8485	
03h	REPORT ZONE PERMISSION	Return zone permission table entries	10.4.3.15
04h – 0Fh	Reserved for general SMP input functions		
...			
13h	REPORT ROUTE INFORMATION	Return route table information	10.4.3.8
14h	REPORT ZONE ROUTE TABLE	Return zone information about each phy	10.4.3.16
15h – 1Fh	Reserved for phy-based SMP input functions		
...			
81h	Reserved for a general SMP output function		
82h	WRITE GPIO REGISTER	See SFF-8485	
83h	CONFIGURE ZONE PERMISSION	Change zone permissions table	10.4.3.14
84h	Reserved for a general SMP output function		
85h	ORIGINATE BROADCAST PRIMITIVES	Originate specified BROADCAST primitive on the phy or phys in the specified zone group or zone groups.	Defined in 06-082.r1 10.4.3.cc
86h – 8Fh	Reserved for a general SMP output functions		
...			
92h	PHY TEST FUNCTION	Request a test function by the specified phy	10.4.3.12
93h	CONFIGURE PHY ZONE	Change phy entries within a zone route table	10.4.3.13
94h – 9Fh	Reserved for phy-based SMP output functions		
...			

... **10.4.3.2 SMP function response frame format**

...

[Addition to existing table]

Table 8 - Table 192 – FUNCTION RESULT field

Code	Name	SMP function(s)	Description
...			
04h	SMP ZONE VIOLATION	CONFIGURE PHY ZONE, CONFIGURE ZONE PERMISSION	The SMP target port supports the function, but the applicable zone permission bit is set to zero (e.g., the ZP[source device, 2] bit is set to zero when a CONFIGURE PHY ZONE request is received).
...			
12h	ZONE GROUP INDEX DOES NOT EXIST	REPORT ZONE PERMISSION	The ZONE PERMISSION ENTRY descriptor indexed by the NUMBER OF ZONE ROUTE ENTRIES field in the SMP request frame does not exist (see 10.4.3.15) (i.e., the NUMBER OF ZONE PERMISSION ENTRIES field value added to the START SOURCE ZONE GROUP INDEX field value exceeds 127, the maximum number of zones, in the REPORT ZONE PERMISSION function).
13h	ZONE ROUTE INDEX DOES NOT EXIST	REPORT ZONE ROUTE INFORMATION	The ZONE ROUTE TABLE ENTRY descriptor indexed by the NUMBER OF ZONE ROUTE ENTRIES field in the SMP request frame does not exist (see 10.4.3.16) (i.e., the NUMBER OF ZONE ROUTE ENTRIES field value added to the STARTING PHY ROUTE INDEX field value exceeds 127, the maximum number of zones, in the REPORT ZONE ROUTE TABLE function).
14h	BUSY ZONE PERMISSION TABLE	CONFIGURE ZONE PERMISSION TABLE	The AZSD is processing a previously received CONFIGURE ZONE PERMISSION TABLE request.

... **10.4.3.3 REPORT GENERAL function**

...

Table 9 defines the response format.

**Table 9 – Table 194 - REPORT GENERAL response**

Byte\Bit	7	6	5	4	3	2	1	0	
...	...								
10	ZONE DEVICE	Reserved				CONFIGURING		CONFIGURABLE ROUTE TABLE	
11	ACTIVE ZONE SUPERVISOR PRIORITY				ZONE SUPERVISOR PRIORITY				
12	ENCLOSURE LOGICAL IDENTIFIER								
19	ENCLOSURE LOGICAL IDENTIFIER								
20	ACTIVE ZONE SUPERVISOR SAS ADDRESS								
27	ACTIVE ZONE SUPERVISOR SAS ADDRESS								
...	...								

...

The ZONE DEVICE bit shall be set to one if the device supports zoning (see 4.9). If the expander device does not support zoning, the ZONE DEVICE bit shall be set to zero.

The ACTIVE ZONE SUPERVISOR PRIORITY field indicates the zone supervisor priority of the elected AZSD. This field shall be set to zero if there is no AZSD.

The ZONE SUPERVISOR PRIORITY field indicates the supervising priority of the responding zoning expander device.

...

The ACTIVE ZONE SUPERVISOR SAS ADDRESS field indicates the SAS address of the elected AZSD. This field shall be set to zero if there is no AZSD.

...

**10.4.3.5 DISCOVER function**

...

Table 10 defines the DISCOVER request format.

**Table 10 – Table 197 - DISCOVER request**

Byte\Bit	7	6	5	4	3	2	1	0
...	...							
8	Reserved							NO ZONE MASK
...	...							

...

When the NO ZONE MASK bit is set to one the DISCOVER response shall report all phy connections. Performing SAS domain discovery with the NO ZONE MASK bit set to one returns the physical SAS topology.

If the NO ZONE MASK bit is set to zero the zone group of the source port and the destination port is identified from the zone route table. If the zoning permission table entry ZP[source port zone group , destination port zone group] entry is set to one then access between the phys shall be permitted and the zoning expander shall process normal ECM discovery procedure. If the zone permission table entry is set to zero then access between the phys is not permitted and PHY VACANT response shall be sent to the device that originated the request (see 10.4.3.2).

...



Table 11 defines the response format.

**Table 11 – Table 198 - DISCOVER response**

Byte\Bit	7	6	5	4	3	2	1	0
...	...							
48	Reserved			ZONE PARTICIPATING	ZONE SUPERVISOR PRIORITY			
49	Reserved	ZONE GROUP						
...	...							

...

A ZONE PARTICIPATING bit set to one indicates that the phy is attached to another zoning device.

The ZONE SUPERVISOR PRIORITY field indicates the zone supervisor device election priority of the phy.

The ZONE GROUP field indicates the zone group that contains the phy.

...

... **10.4.3.10 CONFIGURE GENERAL function**

...

**Table 12 – Table 214 – CONFIGURE GENERAL request**

Byte\Bit	7	6	5	4	3	2	1	0
...	...							
8	ZONE SUPERVISOR PRIORITY			UPDATE ZONE SUPERVISOR PRIORITY	UPDATE STP SMP L_T NEXUS LOSS TIME	UPDATE STP MAXIMUM CONNECT TIME LIMIT	UPDATE STP BUS INACTIVITY TIME LIMIT	
...	...							

...

The ZONE SUPERVISOR PRIORITY field specifies the new zone supervisor device election priority to be written to the zoning device.

If the UPDATE ZONE SUPERVISOR PRIORITY bit is set to one the device shall update its zone supervisor priority to the value contained in the ZONE SUPERVISOR PRIORITY field. If the UPDATE ZONE SUPERVISOR PRIORITY bit is set to zero the device shall ignore the ZONE SUPERVISOR PRIORITY field and keep its ZONE SUPERVISOR PRIORITY value unchanged.

...

[End of suggested changes to existing sections]

... **10.4.3.13 CONFIGURE PHY ZONE function**

The CONFIGURE PHY ZONE function sets the zoning attributes for phys in the zoning expander device. This function shall be supported by all zoning devices. A CONFIGURE PHY ZONE request shall only be accepted if the request is originated by the AZSD or from a zone supervisor device. In all other cases the FUNCTION RESULT field shall be set to SMP FUNCTION FAILED.

When a CONFIGURE PHY ZONE function is completed a BROADCAST (CHANGE) shall be sent on all phys.

Table 13 defines the CONFIGURE PHY ZONE request format.

**Table 13 – CONFIGURE PHY ZONE request**

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (93h)								
2	Reserved								
3	REQUEST LENGTH $((n - 7) / 4)$								
4	Reserved								
5									
6	Reserved	START PHY INDEX							
7	NUMBER OF ZONE PHY ENTRIES $((n - 11) / 2)$								
8	First phy zone configuration entry descriptor (see Table 14)								
9									
...	...								
m - 1	Last phy zone configuration entry descriptor (see Table 14)								
m									
	Fill bytes, if needed								
n - 3	(MSB)	CRC							
n								(LSB)	

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

The FUNCTION field shall be set to 93h.

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

The START PHY INDEX field specifies the first phy index to be configured by the CONFIGURE PHY ZONE command.

The NUMBER OF ZONE PHY ENTRIES field specifies the number of phy zone configuration entry descriptors in the request  $((n - 11) / 2)$ . Table 14 defines the phy zone configuration entry descriptor.

Fill bytes shall be included after the last phy zone configuration entry descriptor so the CRC field is aligned on a four-byte boundary. The contents of the fill bytes are vendor specific.

The CRC field is defined in 7.8.1.

**Table 14 - Phy zone configuration entry descriptor**

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved			ZONE PARTICIPATING	ZONE SUPERVISOR PRIORITY			
1	Reserved	ZONE GROUP						

A ZONE PARTICIPATING bit set to one specifies that the phy is attached to another zoning device. A ZONE PARTICIPATING bit set to zero specifies that the phy is not attached to a zoning device.

The ZONE SUPERVISOR PRIORITY field is defined in section [10.4.3.5](#).

The ZONE GROUP field is defined in section [10.4.3.5](#).

Table 15 defines the CONFIGURE PHY ZONE response format.

**Table 15 – CONFIGURE PHY ZONE response**

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (93h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (00h)								
4	(MSB)	CRC							
7							(LSB)		

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

The FUNCTION field shall be set to 93h.

The FUNCTION RESULT field shall contain SMP FUNCTION ACCEPTED if the request is originated by a zone supervisor device. In all other cases the FUNCTION RESULT field shall be set to SMP FUNCTION FAILED.

The RESPONSE LENGTH field shall be set to 00h.

The CRC field is defined in 7.8.1.

#### ... **10.4.3.14 CONFIGURE ZONE PERMISSION function**

The CONFIGURE ZONE PERMISSION function requests a change to the zone permissions table entries. A zone supervisor device may originate a CONFIGURE ZONE PERMISSION request, and shall only send it to the AZSD. When the AZSD receives a CONFIGURE ZONE PERMISSION request and the originating device has zone permission for ZONE GROUP 2 then the AZSD shall originate CONFIGURE ZONE PERMISSION requests to all zone supervisor devices and update their zone permission tables. Zoning expander devices shall only process CONFIGURE ZONE PERMISSION requests originated by the AZSD (see [4.9.4](#))

When a CONFIGURE ZONE PERMISSION request is processed the ZONE PERMISSION CONFIGURING bit in the REPORT ZONE PERMISSION response shall be set to one. When the configuring process is complete the ZONE PERMISSION CONFIGURING bit shall in the REPORT ZONE PERMISSION response change from a one to a zero, and a BROADCAST (CHANGE) shall be sent on all phys. If the AZSD receives a CONFIGURE ZONE PERMISSION request when the ZONE PERMISSION CONFIGURING bit is set to one, then the request shall fail.



A request to change zone permission to zone group 0 or zone group 1 shall return a function result of FUNCTION FAILED in the response frame.

Table 16 defines the CONFIGURE ZONE PERMISSION request format.

**Table 16 – CONFIGURE ZONE PERMISSION request**

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (83h)							
2	Reserved							
3	REQUEST LENGTH $((n - 7) / 4)$							
4	Reserved							
5								
6	Reserved	START SOURCE ZONE GROUP INDEX						
7	Reserved		NUMBER OF ZONE PERMISSION ENTRIES $((n - 15) / 16)$					
8	First zone permission entry descriptor (See Table 17)							
23								
...								
n - 20	Last zone permission entry descriptor (See Table 17)							
n - 4								
n - 3	(MSB)			CRC		(LSB)		
n								

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

The FUNCTION field shall be set to 83h.

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

The START SOURCE ZONE GROUP INDEX specifies the first source zone group to be written with the first zone permission entry descriptor.

The ZONE PERMISSION ENTRIES field specifies how many zone permission entry descriptors follow  $((n - 15) / 16)$ .

Table 17 defines the zone permission entry descriptor format.

**Table 17 - Zone permission entry descriptor format**

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	1	0
1	ZP [15,Y]						ZP [8,Y]	
...	Zone permission entries						...	
15	ZP [127,Y]						ZP [120,Y]	

The zone permission entry descriptor contains access permission for a zone group (Y) as defined in section [4.9.3](#) Table 1. For CONFIGURE ZONE PERMISSION request the following rules apply:

- Zone permission entries shall be ignored for special groups ZP[1, Y] and ZP[0, Y];
- Zone permission entries are undefined for reserved groups ZP[7..2, Y]; and
- Zone permission entries ZP[ X, Y ] shall apply the same value to ZP[ Y, X].

The CRC field is defined in 7.8.1.

**Table 18** defines the CONFIGURE ZONE PERMISSION response format.

**Table 18 – CONFIGURE ZONE PERMISSION response**

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (83h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (00h)								
4	(MSB)	CRC						(LSB)	
7									

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

The FUNCTION field shall be set to 83h.

The FUNCTION RESULT field shall contain SMP FUNCTION ACCEPTED if the request is originated by the AZSD or from a zone supervisor device. If the request originates from any other device the FUNCTION RESULT field shall be set to SMP FUNCTION FAILED. If the AZSD receives a CONFIGURE ZONE PERMISSION request when the ZONE PERMISSION CONFIGURING bit is set to one in the REPORT ZONE PERMISSION response, then the new request shall be rejected and the FUNCTION RESULT field shall be set to BUSY ZONE PERMISSION TABLE.

The RESPONSE LENGTH field shall be set to 00h.

The CRC field is defined in 7.8.1.

... **10.4.3.15 REPORT ZONE PERMISSION function**

The REPORT ZONE PERMISSION function returns a set of zone permission table entries. This function shall be supported by all zoning devices and may be requested by any SMP initiator.

Table 19 defines the REPORT ZONE PERMISSION request format.

**Table 19 – REPORT ZONE PERMISSION request**

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (03h)								
2	Reserved								
3	REQUEST LENGTH (01h)								
4	Reserved								
5									
6	START SOURCE ZONE GROUP INDEX								
7	NUMBER OF ZONE PERMISSION ENTRIES								
8	(MSB)	CRC						(LSB)	
11									

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 01h.

The START SOURCE ZONE GROUP INDEX field specifies the zone group of the first zone permission entry table being requested.

The NUMBER OF ZONE PERMISSION ENTRIES field specifies the number of zone permission entries being requested.

The CRC field is defined in 7.8.1.

Table 20 defines the REPORT ZONE PERMISSION response format.

**Table 20 – REPORT ZONE PERMISSION 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 $((n - 7) / 4)$							
4	Reserved							
5								
6	START SOURCE ZONE GROUP INDEX							
7	ZONE PERMISSION CONFIGURING	Reserved	NUMBER OF ZONE PERMISSION ENTRIES $((n - 11) / 16)$					
8	First ZONE PERMISSION entry descriptor (See Table 17)							
23								
...	...							
n - 19	Last ZONE PERMISSION entry descriptor (See Table 17)							
n - 4								
n - 3	(MSB)	CRC						(LSB)
n								

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 shall be set to  $((n - 7) / 4)$ .

The START ZONE ENTRY INDEX field indicates the zone group of the first zone permission entry being returned in the first zone permission table entry descriptor.

The ZONE PERMISSION CONFIGURING bit set to one indicates that the zoning expander device is in the process of zone permission table update. The ZONE PERMISSION CONFIGURING bit set to zero indicates that configuring is complete.

The NUMBER OF ZONE PERMISSION ENTRIES field indicates the number of zone permission entry descriptors being returned  $((n - 11) / 16)$ .

Table 17 defines the zone permission entry descriptor format. If the zone permission entry indexed from the START SOURCE ZONE GROUP INDEX field does not exist then response shall return

a function result of ZONE GROUP INDEX DOES NOT EXIST in the response frame (see [10.4.3.2](#)).

The CRC field is defined in 7.8.1.

... **10.4.3.16 REPORT ZONE ROUTE TABLE function**

The REPORT ZONE ROUTE TABLE request requires a zoning expander device to respond with zone information about each phy. This function shall be supported by all zoning devices and may be requested by any SMP initiator.

Table 21 defines the REPORT ZONE ROUTE TABLE request format.

**Table 21 –REPORT ZONE ROUTE TABLE request**

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (14h)							
2	REQUEST LENGTH (02h)							
3								
4	NUMBER OF ZONE ROUTE TABLE ENTRIES							
5	PHY IDENTIFIER							
6	(MSB)	STARTING PHY ROUTE INDEX						(LSB)
7								
8	Reserved							
11								
12	(MSB)	CRC						(LSB)
15								

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

The FUNCTION field shall be set to 14h.

The REQUEST LENGTH field shall be set to 02h.

The NUMBER OF ZONE ROUTE TABLE ENTRIES field specifies the number of zone route table entries requested starting from the value specified by the STARTING PHY ROUTE INDEX field for the phy specified by the PHY IDENTIFIER field.

The PHY IDENTIFIER field specifies the phy for which the expander zone route entries are being requested.

The STARTING PHY ROUTE INDEX field specifies the first phy route entry of the zone route table descriptor entry being requested.

The CRC field is defined in 7.8.1.

The REPORT ZONE ROUTE TABLE response provides zone information about each phy. This function shall be supported by all zoning devices.

Table 22 defines the REPORT ZONE ROUTE TABLE response format.

**Table 22 –REPORT ZONE ROUTE TABLE response**

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (14h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH $((n - 7) / 4)$							
4	ZONE ROUTE TABLE CONFIGURING	NUMBER OF ZONE ROUTE TABLE ENTRIES $((n - 15) / 12)$						
5	PHY IDENTIFIER							
6	(MSB)	STARTING PHY ROUTE INDEX						(LSB)
7								
8	Reserved							
11								
12	First ZONE ROUTE TABLE entry descriptor (see Table 23)							
23								
...	...							
n - 15	Last ZONE ROUTE TABLE entry descriptor (see Table 23)							
n - 4								
n - 3	(MSB)	CRC						(LSB)
n								

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

The FUNCTION field shall be set to 14h.

The FUNCTION RESULT field is defined in 10.4.3.2

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

The ZONE ROUTE TABLE CONFIGURING bit set to one indicates that the zoning expander device is in the process of zone route table update. The ZONE ROUTE TABLE CONFIGURING bit set to zero indicates that configuring is complete.

The NUMBER OF ZONE ROUTE TABLE ENTRIES field indicates the number of zone route table entry descriptors being returned  $((n - 15) / 12)$ .

The PHY IDENTIFIER field indicates the phy for which the expander zone route entry is being returned.

The STARTING PHY ROUTE INDEX field indicates the first phy route entry of the zone route table descriptor entry being returned.

Table 23 defines the ZONE ROUTE TABLE ENTRY DESCRIPTOR format. If the zone route table entry does not exist for the phy indexed by the PHY IDENTIFIER field then response shall return a function result of ZONE ROUTE INDEX DOES NOT EXIST in the response frame (see [10.4.3.2](#)).

The CRC field is defined in section 7.8.1.



**Table 23 - Zone route table entry descriptor**

Byte/Bit	7	6	5	4	3	2	1	0
0	DISABLE EXPANDER ROUTE ENTRY	ATTACHED DEVICE TYPE			Reserved			
1	Reserved			ZONE PARTICIPATING	ZONE SUPERVISOR PRIORITY			
2	Reserved	ZONE GROUP						
3	Reserved							
4	ROUTED SAS ADDRESS							
11								

A DISABLE EXPANDER ROUTE ENTRY bit set to one indicates that ECM shall not use the expander zone route entry to route connection requests (see 4.6.7.3).

A DISABLE EXPANDER ROUTE ENTRY bit set to zero indicates that the ECM shall use the expander zone route entry to route connection requests.

The ATTACHED DEVICE TYPE field is defined in section [10.4.3.5](#).

The ZONE PARTICIPATING bit indicates that the phy is attached to another zoning device.

The ZONE SUPERVISOR PRIORITY field is defined in section [10.4.3.5](#).

The ZONE GROUP field is defined in section [10.4.3.5](#).

The ROUTED SAS ADDRESS field contains the routed SAS address for the expander zone route entry being returned (see 4.6.7.3).

## Annex J

...

**Table J.1 – Primitives with Hamming distance of 8 ....**

1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	Assignment
K28.5	D31.4	D02.2	D27.4	OPEN REJECT (RESERVED ABANDON 0) OPEN REJECT (ZONE VIOLATION)