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Date: December 14, 2005
Subject: T10/06-019r0 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.

References

SAS2r01, Serial Attached SCSI - 2 (SAS-2)
T10/05-144r9 SAS-2 zoning

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.

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Suggested changes

3 Definitions, symbols, abbreviations, keywords, and conventions

3.1 Definitions

[start of new definitions]

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

3.1.259 zone device : A SAS expander device or an end device that is an SMP initiator and an SMP target and supports all SMP zoning commands.

3.1.260 zone group: A set of expander phys in a ZSDS that all have the same access permission.

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

3.1.262 zone service delivery subsystem (ZSDS): A group of zoning expanders that cooperate to control phy access. The zone service delivery subsystem may include all or part of the service delivery subsystem. (See section 4.1.6)

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

3.1.264 zone supervisor device: A zoning device that has its zone supervising priority greater than zero.

[end of new definitions]

3.2 Symbols and abbreviations

[start of new abbreviations]

Abbreviation	Meaning
ZSDS	Zone Service Delivery Subsystem.

[end of new abbreviations]

…

4. General

…

. 4.9 Zoning

4.9.1 Zoning overview

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

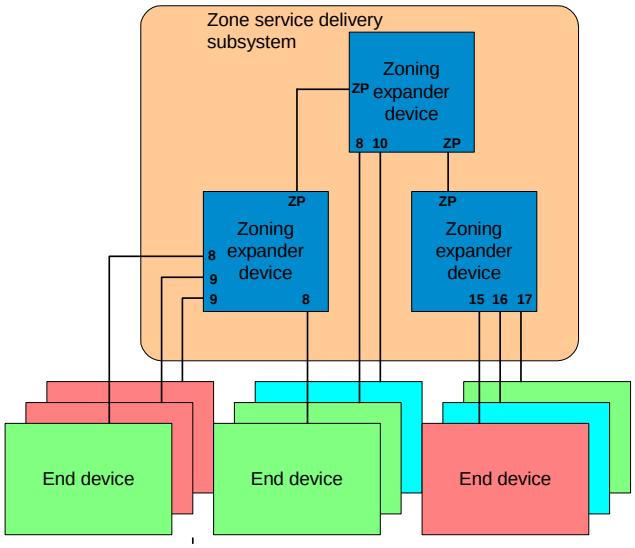
Every phy of a ZSDS belongs to a zone group. All phys in a wide port shall belong to the same zone group. Each zoning expander contains a zone permission table that controls whether a connection is allowed between the source and target zone group. There are 128 zone groups.

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

The zone route table is an extended version of the expander route table (See Section 4.6.7.3) extended to include zone phy information. The zone permission table and zone route table are configured by the active zone supervisor device.

Expander devices that do not support zoning may be part of the service delivery subsystem, but remain outside the boundary of the ZSDS. All phys of the non-zoning expander belong to the zone group that attaches the non-zoning expander device to the ZSDS.

Figure 1 shows an example of a ZSDS.



Zone Groups
ZP = zone participant (Zone group 1).
8 = zone group 8.
9 = zone group 9.
10 = zone group 10.
15 = zone group 15.
16 = zone group 16.
17 = zone group 17.

Zone group table permissions
Zone group 1 has access permission for all zone groups.
Zone group 15 has access permission for zone group 9.
Zone group 16 has access permission for zone group 10.
Zone group 17 has access permission for zone group 8.

Figure 1 - ZSDS

4.9.2 Zoning expander device model overview

A zoning expander device shall support the following attributes:

a) an SMP initiator and SMP target (See SAS2-r01 section 4.6.1); and
b) allows or denies connection requests following the zoning permissions; and
c) self-configuring; and
d) all zoning related SMP functions; and
e) contain a zone permission table that supports 128 zone groups; and
f) contain a zone expander zone route table.

4.9.3 Zone Operation

... 4.9.3.1 Zone permission table

The zone permission table specifies access permission for a connection zone groups. If the zone permission table entry is set to one then connection requests shall be permitted between phys in the zone groups.

Zoning expander SMP initiator 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	…	0
1	Ignored	1	1	1	1	1	…	1
2	Ignored	Ignored	Reserved	Reserved	Reserved	Reserved	…	Reserved
…	…	…	…	…	…	…	…	…
7	Ignored	Ignored	Ignored	Ignored	Reserved	Reserved	…	Reserved
8	Ignored	Ignored	Ignored	Ignored	Ignored	ZP[8, 8]	…	ZP[127, 8]
…	…	…	…	…	…	…	…	…
127	Ignored	Ignored	Ignored	Ignored	Ignored	Ignored	…	ZP[127, 127]
Notes	The shaded area shows ignored permissions . ZP[X ,Y] has the same value as ZP[Y, X]. 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 (Y) has no access zone group (X).							

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

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

Zone groups 2 through 7 are reserved zone groups. All reserved bits shall be set to zero. (i.e. ZP[2..7, 2..127] shall be set to zero).

... 4.9.3.2 Zoning Expander zone route table

Zoning expander devices shall be self-configuring. Zoning expander devices in the ZSDS cooperate to complete the zone route tables. The zone route table shall contain zone phy information in addition to the expander phy information.

The zone phy information fields are:

a) ZONE PARTICIPATING bit; and
b) ZONE SUPERVISING PRIORITY field; and
c) ZONE GROUP field.

The ZONE PARTICIPATING bit shall be set to one when the phy is attached to a zoning device. SMP zoning functions operate on connections between phys with the ZONE PARTICIPATING bit set to one. The ZONE PARTICIPATING bit shall be set to zero when the phy is attached to a device that does not support zoning. This indicated the boundary of the ZSDS.

The ZONE SUPERVISING PRIORITY field indicates the active zone supervisor election priority of the device attached to the phy. (See Section 4.9.4)
The ZONE GROUP field has a value in the range 0 to 127 that indicates the zone group that the phy is contained in.

Figure 2 (SAS2r01 Figure 45) shows a representation of a zoning expander zone route table.

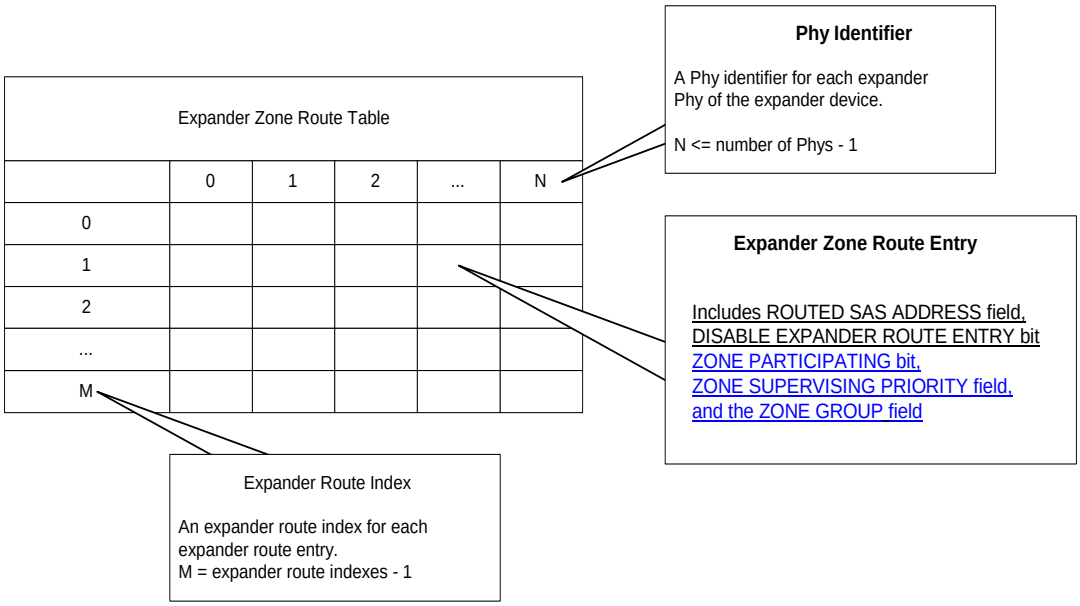


Figure 2 - Figure 45 - Zone route table example

When the zone route table is complete, the zoning expander devices shall elect the active zone supervisor device. (See section..).

... 4.9.3.3 Zone routing

When a zoning expander device receives an OPEN request, the zoning permission table shall check the access permission between the source zone group and the target zone group. If the zone permission table entry is set to one then access between the phys is allowed and the zoning expander shall continue with the normal ECM arbitration procedure. If the zone permission table entry is set to zero then access between the phys is not permitted and the OPEN_REJECT (ZONE VIOLATION) response shall be sent for the OPEN request and the ZONE VIOLATION bit for the source phy shall be set to one.

When an OPEN request on a phy with the ZONE PARTICIPATING bit set to zero (e.g. the initiator device resides outside the ZSDS) the zone group of the receiving phy is used for the SOURCE ZONE GROUP field.

The zoning expander device uses the rules in Table 2 to check the zone group access permission of the DESTINATION SAS ADDRESS field from the OPEN request.

Table 2 - Routed zone group

Destination device expander routing	Target zone group permission
Direct attached route	Zone group of the destination phy.
Indirectly attached table route	Zone group stored in the zone route table for the destination SAS address.
Indirectly attached subtractive route	Zone group of the subtractive phy.

4.9.4 Zone supervisor devices

... 4.9.4.1 Zone supervisor priority

When a SAS device is attached to a phy that reports a ZONE SUPERVISING PRIORITY field value greater than zero, the device is eligible for active zone supervisor device. A device that reports a ZONE SUPERVISING PRIORITY field value greater than zero, shall set the ACCESS ZONE MANAGEMENT bit set to one in the OPEN request frame. (See section 7.8.3)

If a phy is attached to a device that is not a zone supervisor device then the ZONE SUPERVISING PRIORITY field shall be set to zero. If the ZONE SUPERVISING PRIORITY field is zero, the device does not participate in the active zone supervisor device election process.

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

Table 3 - Zone supervising priority values

ZONE SUPERVISING PRIORITY	Description
1111b	Highest priority
1110b	second highest priority
…	…
0010b	second lowest priority
0001b	lowest priority
0000b	Cannot be elected and does not process zone SMP functions.

... 4.9.4.2 Active zone supervisor device election process

There is one active zone supervisor device in a ZSDS. The zoning expander devices elect a device to be the active zone supervisor device based on the value of its ZONE SUPERVISING PRIORITY field. The highest non-zero value of all the zone supervisor priority entries shall be elected to be the active zone supervisor device. If there are two or more non-zero supervisor priority entries with the same zone supervising priority value then the device with the highest SAS address shall be elected to be the active zone supervisor device.

When the self configuration process has completed the zone route table then the zoning expander device shall elect the active zone supervisor device.

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.

4.9.5 Zone configuration

The zoning expander device holds zone configuration information in the zone route table and the zone permission table that includes direct attached devices.

SMP CONFIGURE ZONE PERMISSION and SMP CONFIGURE PHY ZONE requests shall only be issued by the active zone supervisor device. SMP functions for zoning configuration shall only be accepted by the other zoning expander devices if the SMP function has originated from the active zone supervisor device. (See Table 9)

The SMP CONFIGURE ZONE PERMISSION function requests change to entries in the zone permission table. (See Section 10.4.3.14). The active zone supervisor device shall send a CONFIGURE ZONE PERMISSION request to all zoning expanders in the ZSDS.

The SMP CONFIGURE PHY ZONE function requests change to entries in the zone route table. (See Section 10.4.3.13).

4.9.6 Phy reset event

After a phy reset event, such as hot swap of an end device, the zone permission table shall be maintained according to the rules defined in the phy reset event behavior table. (See 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, Initial phy zone configuration assigned.	Phy exits the SP15: SAS_PHY_Ready state, and later re-enters the SP15 state, 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 restores the phy to the zone group that contained the phy 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 state, 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 assigns the phy to zone group 0.
SATA device attached, phy in the SP22: SATA_PHY_Ready state, Initial phy zone configuration assigned.	Phy exits the SP22: SATA_PHY_Ready state, and later re-enters the SP22: SATA_PHY_Ready state without having an expander Hot-Plug Timeout timer expiration event in-between.	The zoning expander device restores the phy to the zone group that contained the phy 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 assigns the phy to zone group 0.

4.9.7 PHY and EXPANDER CHANGE COUNT reporting

Zoning expanders shall increment the EXPANDER CHANGE COUNT as defined in Section 10.4.3.5.

The PHY CHANGE COUNT field counts the number of BROADCAST (CHANGE) events originated by an expander phy as defined in Section 10.4.3.5.

4.9.8 ZONE BROADCAST address frames

Zoning expander devices should propagate broadcast events using the ZONE BROADCAST address frame within the ZSDS. (i.e., the zoning expander shall generate a broadcast primitive on phys that have the ZONE PARTICIPATING bit set to zero.) The BROADCAST primitive shall be sent to devices outside the ZSDS.

The SMP IDENTIFY response specifies the ZONE BROADCAST address frame type supported by each zoning device. (See Table 7). The type of broadcast used one each phy connection is defined by the following rules:

1) If either the source or the target device only supports primitives then the broadcast primitive shall be used.

2) If both the source and the target devices support 32-byte zone broadcast frames then 32-byte broadcast frames shall be used.

3) If both the source and the target devices support 8-byte zone broadcast frames then 8-byte broadcast frames shall be used.

ZONE BROADCAST address frames shall only be sent to expander phys with zone permission to access the initiating phy.

The ZONE BROADCAST address frame shall be transmitted three times to provide redundancy against bit errors during the transmission of the broadcast frame. The reception of one ZONE BROADCAST address frame is sufficient for detection of the broadcast event.

If the zoning expander device has a queue to hold ZONE BROADCAST address frames and if the queue overflows, the BPP may remove entries from the queue and send BROADCAST primitives to all ports scheduled to receive the zone broadcast address frame. If additional identical ZONE BROADCAST requests are received before the first broadcast event notify has been processed by the BPP then the identical ZONE BROADCAST address frames may be ignored.

When the BPP receives a ZONE BROADCAST address frame with SOURCE ZONE GROUP field set to one, BROADCAST primitives may be sent in place of a ZONE BROADCAST address frame.

[start of suggested changes to existing sections]

7 Link layer…

7.2.5.11 OPEN_REJECT

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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 which contains the target phy. The ZONE VIOLATION field of the phy that received the request shall be set to one. The ZONE VIOLATION field shall be reset to zero when an SMP PHY CONTROL function with an operation code of CLEAR ERROR LOG for the specified phy is received.

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7.8 Address frames

7.8.1 Address frames overview

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The ADDRESS FRAME TYPE field is defined in Table 5. This field determines the definition of the frame type dependent bytes.

Table 5 – Table 91 – Address frame type

Code	Frame Type	Description
0h	Identify	Identification sequence
1h	Open	Connection request
2h	Broadcast	32-byte zone broadcasts within zones
3h	Short broadcast	8-byte zone broadcasts within zones
All others	Reserved	

7.8.2 IDENTIFY address frame

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Table 6- IDENTIFY address frame format

Byte\Bit	7	6	5	4	3	2	1	0
0	Restricted (for OPEN address frame)	DEVICE TYPE			ADDRESS FRAME TYPE (0h)			
1	Restricted (for OPEN address frame)							
2	Reserved				SSP INITIATOR PORT	STP INITIATOR PORT	SMP INITIATOR PORT	Restricted (for OPEN address frame)
3	Reserved				SSP TARGET PORT	STP TARGET PORT	SMP TARGET PORT	Restricted (for OPEN address frame)
4	Restricted (for OPEN address frame)							
11								
12	SAS ADDRESS							
19								
20	PHY IDENTIFIER							
21	Reserved				ZONE DEVICE	ZONE BROADCAST SIZE		
22	Reserved							
27								
28	(MSB) CRC							
31	LSB)							

…

A ZONE DEVICE bit set to one specifies that the device is a zoning device. A ZONE DEVICE bit set to zero specifies that the device does not support zone functions.

The ZONE BROADCAST LENGTH field specifies the type of ZONE BROADCAST address frames supported by the device. (See Table 7)

Table 7- Zone broadcast length support

ZONE BROADCAST LENGTH field	Description
000	A zoning device that only supports BROADCAST primitives.
001	A zoning device that supports 32-byte ZONE BROADCAST address frames
010	A zoning device that supports 32-byte ZONE BROADCAST address frames and 8-byte SHORT ZONE BROADCAST address frames
All others	Reserved

…

7.8.3 OPEN address frame

Table 8 defines the OPEN address frame format used for connection requests.

Table 8 - 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						
3								(LSB)
4		DESTINATION SAS ADDRESS						
11								
12		SOURCE SAS ADDRESS						
19								
20	ACCESS ZONE MANAGEMENT	SOURCE ZONE GROUP						
21	PATHWAY BLOCK COUNT							
22	(MSB)	ARBITRATION WAIT TIME						
23								(LSB)
24		MORE COMPATIBLE FEATURES						
27								
28	(MSB)	CRC						
31								LSB)

…

An ACCESS ZONE MANAGEMENT bit set to one specifies that the OPEN request is from a zone supervisor device and shall respond a defined in Table 9. If the ACCESS ZONE MANAGEMENT bit is set to zero then all zone type SMP functions shall return a FUNCTION RESULT of UNKNOWN SMP FUNCTION.

Table 9 - Zone SMP function response

Active zone supervisor	ACCESS ZONE MANAGEMENT bit	Zone permission table entry	Report General	Report Mfr Info	Discover	Report Route Info	Report Zone Permission	Report Zone Route Table	Configure zone permission	Configure phy zone
YES	1	1 or 0	Full Response							
NO	0	0	Full Response		PHY VACANT (16h)		UNKNOWN SMP FUNCTION (01h)			
NO	0	1	Full Response				UNKNOWN SMP FUNCTION (01h)			
NO	1	0	Full Response		PHY VACANT (16h)		Full Response		SMP FUNCTION FAILED (02h)	
NO	1	1	Full Response						SMP FUNCTION FAILED (02h)	

The SOURCE ZONE GROUP field identifies the zone group that contains the phy making the connection request. A connection may be opened if the zone permission table indicates that the zone group of the phy attached to the destination SAS address has permission to access the source zone group (See 4.9.3.3).

…
[end of suggested changes to existing sections]

7.8.4 ZONE BROADCAST address frame

Table 10 defines the address frame format for ZONE BROADCAST address frame.

Table 10 - ZONE BROADCAST address frame format

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved	ZONE BROADCAST TYPE			ADDRESS FRAME TYPE (2h)			
1	Reserved							
2								
3	Reserved	SOURCE ZONE GROUP						
4	Reserved							
27								
28	(MSB)	CRC						
31								(LSB)

The ZONE BROADCAST TYPE field is defined in **Table 11**.

Table 11 – Zone broadcast type

Code	ZONE BROADCAST Primitive Represented
0h	ZONE BROADCAST (CHANGE)
1h	ZONE BROADCAST (SES)
2h	ZONE BROADCAST (RESERVED 1)
3h	ZONE BROADCAST (RESERVED 2)
4h	ZONE BROADCAST (RESERVED 3)
5h	ZONE BROADCAST (RESERVED 4)
6h	ZONE BROADCAST (RESERVED CHANGE 0)
7h	ZONE BROADCAST (RESERVED CHANGE 1)

The ADDRESS FRAME TYPE field shall be set to 2h. (See Table 5)

The SOURCE ZONE GROUP field specifies the zone group that contains the phy that originated the ZONE BROADCAST request. The ZONE BROADCAST shall only be sent to phys with permission to access the zone group that contains the source phy.

The CRC field is defined in 7.8.1.

7.8.5 Short ZONE BROADCAST address frame

The SHORT ZONE BROADCAST address frame shall be used when a connection is made to another device that supports the SHORT ZONE BROADCAST address frame.

If the zoning expander device is attached to a zoning expander device that does not support the SHORT ZONE BROADCAST address frame then it should send the ZONE BROADCAST address frame, or it shall send the BROADCAST primitive to all phys.

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Table 12 - SHORT ZONE BROADCAST address frame format

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved	ZONE BROADCAST TYPE			ADDRESS FRAME TYPE (3h)			
1	Reserved							
2								
3	Reserved	SOURCE ZONE GROUP						
4	(MSB)	CRC						
7								(LSB)

The ZONE BROADCAST TYPE field is defined in **Table 11**.

The ADDRESS FRAME TYPE field shall be set to 3h. (See Table 5)

The SOURCE ZONE GROUP field specifies the zone group that contains the phy that originated the ZONE BROADCAST request.

The CRC field is defined in 7.8.1.

[start of suggested changes to existing sections]

10 Application layer…

10.4.3 SMP functions

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... 10.4.3.3 REPORT GENERAL function

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Table 13 defines the response format.

Table 13 - REPORT GENERAL response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (00h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (08h)							
4	(MSB)	EXPANDER CHANGE COUNT						
5								(LSB)
6	(MSB)	EXPANDER ROUTE INDEXES						
7								(LSB)
8	Reserved							
9	NUMBER OF PHYS							
10	Reserved						CONFIGURING	CONFIGURABLE ROUTE TABLE
11	ACTIVE ZONE SUPERVISOR PRIORITY				ZONE SUPERVISING PRIORITY			
12	ENCLOSURE LOGICAL IDENTIFIER							
19								
20	ACTIVE ZONE SUPERVISOR SAS ADDRESS							
27								
28	Reserved							
29								
30	(MSB)	STP BUS INACTIVITY TIME LIMIT						
31								(LSB)
32	(MSB)	STP MAXIMUM CONNECT TIME LIMIT						
33								(LSB)
34	(MSB)	STP SMP I_T NEXUS LOSS TIME						
35								(LSB)
36	(MSB)	CRC						
39								(LSB)

…

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

The ZONE SUPERVISING PRIORITY field indicates the supervising priority of the responding device.

…

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

…

... 10.4.3.5 DISCOVER function

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Table 14 defines the DISCOVER request format.

Table 14 - DISCOVER request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (10h)							
2	Reserved							
3	REQUEST LENGTH (02h)							
4	Reserved							
7								
8	Reserved							NO ZONE MASK
9	PHY IDENTIFIER							
10	Reserved							
11	Reserved							
12	(MSB)			CRC				
15								(LSB)

…

When the NO ZONE MASK bit is set to zero from a source phy that does not have zone access permission to the zone group that contains the phy indicated by the PHY INDENTIFER field then the DISCOVER response FUNCTION RESULT field shall report PHY VACANT (16h). (See Table 191) Performing SAS domain discovery with the NO ZONE MASK bit set to zero returns the logical SAS topology for the port performing the discovery.

When the NO ZONE MASK bit is set to one from a source phy, the SMP target shall ignore the zone permission and the DISCOVER response FUNCTION RESULT field may report SMP FUNCTION ACCEPTED (00h). Performing SAS domain discovery with the NO ZONE MASK bit set to one returns the physical SAS topology.

…

Table 15 defines the response format.

Table 15 - DISCOVER response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (10h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (0Ch)							
4	Reserved							
8								
9	PHY IDENTIFIER							
10	Reserved							
11								
12	Reserved	ATTACHED DEVICE TYPE			Reserved			
13	Reserved				NEGOTIATED PHYSICAL LINK RATE			
14	Reserved				ATTACHED SSP INITIATOR	ATTACHED STP INITIATOR	ATTACHED SMP INITIATOR	ATTACHED SATA HOST
15	ATTACHED SATA PORT SELECTOR	Reserved			ATTACHED SSP TARGET	ATTACHED STP TARGET	ATTACHED SMP TARGET	ATTACHED SATA DEVICE
16	SAS ADDRESS							
23								
24	ATTACHED SAS ADDRESS							
31								
32	ATTACHED PHY IDENTIFIER							
33	Reserved							
39								
40	PROGRAMMED MINIMUM PHYSICAL LINK RATE				HARDWARE MINIMUM PHYSICAL LINK RATE			
41	PROGRAMMED MAXIMUM PHYSICAL LINK RATE				HARDWARE MAXIMUM PHYSICAL LINK RATE			
42	PHY CHANGE COUNT							
43	VIRTUAL PHY	Reserved			PARTIAL PATHWAY TIMEOUT VALUE			
44	Reserved				ROUTING ATTRIBUTE			
45	Reserved	CONNECTOR TYPE						
46	CONNECTOR ELEMENT INDEX							
47	CONNECTOR PHYSICAL LINK							
48	Reserved		ZONE VIOLATION	ZONE PARTICIPATING	ZONE SUPERVISING PRIORITY			
49	Reserved	ZONE GROUP						
50	(MSB)	Vendor Specific						
51								(LSB)
52	(MSB)	CRC						
55								(LSB)

…

A ZONE VIOLATION bit set to one indicates that the phy sent an OPEN_REJECT (ZONE VIOLATION) response to a prior SMP DISCOVER command.

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

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

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

The CRC field is defined in 7.8.1.

[end of suggested changes to existing sections]

... 10.4.3.13 CONFIGURE PHY ZONE function

The CONFIGURE PHY ZONE function sets a phy entry within the zone route table of a zoning expander. This function shall be supported by all zoning devices and shall only be issued by the active zone supervisor device. The ACCESS ZONE MANAGEMENT bit shall be shall be used to determine the function result as shown in Table 9.

Table 16 defines the CONFIGURE PHY ZONE request format.

Table 16 - 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	UPDATE COMPLETE	START PHY INDEX						
7	NUMBER OF ZONE PHY ENTRIES							
8	First phy zone configuration entry descriptor (see Table 17)							
9								
...	...							
m -1	Last phy zone configuration entry descriptor (see Table 17)							
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).

An UPDATE COMPLETE bit set to one specifies that the current request is the last of a sequence. The zoning expander device shall issue a broadcast change notification after the CONFIGURE PHY ZONE response.

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. Table 17 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 17 - Phy zone configuration entry descriptor

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

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

The ZONE SUPERVISING PRIORITY field is defined in ..10.4.3.5

The ZONE GROUP field is defined in ..10.4.3.5

Table 18 defines the CONFIGURE PHY ZONE response format.

Table 18 - 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 is defined in 10.4.3.2.

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 and the zoning expander device zone supervising priority. This function shall be supported by all zoning devices and shall only be issued by the active zone supervisor device. The value of the ACCESS ZONE MANAGEMENT bit shall be used to determine the function result as shown in Table 9.

a) A single entry update that uses the SOURCE ZONE GROUP and the TARGET ZONE GROUP fields to identify the table entry bit to be written. The BATCH bit shall be set to zero; and

b) A batch mode that allows multiple table row entries of a zone group field to be updated. In this mode the BATCH bit shall be set to one.

An update to zone group 0 or zone group 1 shall be ignored. An update to a reserved group shall be undefined.

Table 19 defines the CONFIGURE ZONE PERMISSION request format.

Table 19 - 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	SOURCE ZONE GROUP						
7	NEW VALUE	TARGET ZONE GROUP						
8	Reserved							
9	ZONE SUPERVISING PRIORITY				Reserved	UPDATE PRIORITY	BATCH	UPDATE COMPLETE
10	Reserved	START SOURCE ZONE GROUP INDEX						
11	NUMBER OF ZONE PERMISSION ENTRIES							
12	First zone permission entry descriptor (See Table 20)							
27								
...	...							
n - 20	Last zone permission entry descriptor (See Table 20)							
n - 4								
n - 3	(MSB)	CRC						
n								(LSB)

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 SOURCE ZONE GROUP field specifies the source zone group of the zone permission table entry. This field is ignored when the BATCH bit is set to one.

The NEW VALUE bit specifies the new access permission to be updated between the two zone groups specified in the SOURCE ZONE GROUP and TARGET ZONE GROUP fields. This field is ignored when the BATCH bit is set to one.

The TARGET ZONE GROUP field specifies the target zone group of the zone permission entry. This field is ignored when the BATCH bit is set to one.

The ZONE SUPERVISING PRIORITY field specifies the new zone supervisor device election priority to be written to the zoning device. This field shall be ignored if the UPDATE PRIORITY bit is set to zero.

When the UPDATE PRIORITY bit is set to one the device shall update its zone supervisor priority to the value contained in the ZONE SUPERVISING PRIORITY field.

A BATCH bit set to zero specifies that the CONFIGURE ZONE PERMISSION request is being use in single entry update mode. A BATCH bit set to one specifies that the CONFIGURE ZONE PERMISSION request is being use in batch mode, allowing updates to multiple access permission entries.

An UPDATE COMPLETE bit set to one specifies that the current request is the last of a sequence of requests. The zoning expander device shall issue ZONE BROADCAST to affected zone groups after the CONFIGURE ZONE PERMISSION response.

The START SOURCE ZONE GROUP INDEX specifies the first source zone group to be written with the first zone permission entry descriptor. If the BATCH bit is set to zero the START ZONE ENTRY INDEX field shall be ignored.

The NUMBER OF ZONE PERMISSION ENTRIES field specifies how many zone permission entry descriptors follow. The maximum size an SMP frame is 1032 bytes, making the maximum number of zone permission entries 63.

Table 20 defines the zone permission entry descriptor format.

Table 20 - 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]	zone permission entries						ZP [8,Y]
…	…							…
15	ZP [127,Y]							ZP [120,Y]
Note	Zone permission entries shall be ignored for ZP[X, Y] where X < Y. Zone permission entries shall be ignored special groups ZP[1, Y] and ZP[0, Y]. Zone permission entries are undefined for reserved groups ZP[7..2, Y].							

The zone permission entry descriptor contains access permission for a zone group (Y) as defined in Table 1. Y is the source zone group.

The CRC field is defined in 7.8.1.

Table 21 defines the CONFIGURE ZONE PERMISSION response format.

Table 21 - 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						
7								(LSB)

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

The FUNCTION field shall be set to 83h.

The FUNCTION RESULT field is defined in Section 10.4.3.2.

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 shall only be issued by zone supervisor devices. The value of the ACCESS ZONE MANAGEMENT bit in the OPEN shall be used to determine the function result as shown in Table 9.

Table 22 defines the REPORT ZONE PERMISSION request format.

Table 22 - 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						
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 01h.

The START SOURCE ZONE GROUP INDEX field specifies the first source zone group being requested.

The NUMBER OF ZONE PERMISSION ENTRIES field specifies the number of zone permission entries being requested. Contiguous zone permission table entries starting with the source zone group specified by the START SOURCE ZONE GROUP INDEX field shall be reported.

The CRC field is defined in 7.8.1.

Table 23 defines the REPORT ZONE PERMISSION response format.

Table 23 - 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 - 8) / 4)							
4	Reserved							
5								
6	START SOURCE ZONE GROUP INDEX							
7	NUMBER OF ZONE PERMISSION ENTRIES							
8	First ZONE PERMISSION entry descriptor (See Table 20)							
23								
...	...							
n - 19	Last ZONE PERMISSION entry descriptor (See Table 20)							
n - 4								
n - 3	(MSB)	CRC						
n								(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 Section 10.4.3.2.

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

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

The NUMBER OF ZONE PERMISSION ENTRIES field indicates the number of zone permission entry descriptors being returned. The maximum size an SMP frame is 1032 bytes, making the maximum number of zone permission entries 63.

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 shall only be issued by zone supervisor devices. The value of the ACCESS ZONE MANAGEMENT bit in the OPEN shall be used to determine the function result as shown in Table 9.

Table 24 defines the REPORT ZONE ROUTE TABLE request format.

Table 24 - 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						
7								(LSB)
8		Reserved						
11								
12	(MSB)	CRC						
15								(LSB)

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.

Table 25 defines the REPORT ZONE ROUTE TABLE response format.

Table 25 - 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	NUMBER OF ZONE ROUTE TABLE ENTRIES							
5	PHY IDENTIFIER							
6	(MSB)	STARTING PHY ROUTE INDEX						
7								(LSB)
8	Reserved							
10								
11	Reserved							END OF ENTRIES
12	First ZONE ROUTE TABLE entry descriptor (see Table 26)							
23								
…	…							
n - 15	Last ZONE ROUTE TABLE entry descriptor (see Table 26)							
n - 4								
n - 3	(MSB)	CRC						
n								(LSB)

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 NUMBER OF ZONE ROUTE TABLE ENTRIES field indicates the number of zone route table entry descriptors being returned.

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.

An END OF ENTRIES bit set to zero indicates that the zone route table descriptors being returned do not contain the last zone route table descriptor for the specified phy identifier.

An END OF ENTRIES field set to one indicates that the last zone route table descriptor for the specified phy identifier is being returned.

Table 26 defines the ZONE ROUTE TABLE ENTRY DESCRIPTOR format.

The CRC field is defined in 7.8.1.

Table 26 - 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 SUPERVISING PRIORITY			
2	Reserved	ZONE GROUP						
3	Reserved							
7								
8	ROUTED SAS ADDRESS							
15								

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 Section 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 ...

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

The ZONE SUPERVISING PRIORITY field is defined in ...

The ZONE GROUP field is defined in ...

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