

To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
Date: 15 June 2006
Subject: 06-281r0 SAS-2 Enable and disable zoning

Revision history

Revision 0 (15 June 2006) First revision

Related documents

sas2r04 - Serial Attached SCSI - 2 (SAS-2) revision 4
06-213 SAS-2 REPORT GENERAL additions for zoning and self configuration (Steve Johnson, LSI Logic)
06-260 SAS-2 zone management use cases (Rob Elliott, HP)
06-279 SAS-2 Allow more than one ZPSDS in a SAS domain (Rob Elliott, HP)

Overview

There are cases where the zone manager may want to add additional expander devices into a zoned portion of a service delivery subsystem (ZPSDS) using only in-band communication over SAS.

If the new expander device has zoning disabled, the zone manager needs a way to enable it and add it to the ZPSDS. However, this cannot be accepted from any SMP initiator port, or any rogue software could enable zoning and block communication through it.

If the new expander device already has zoning enabled and configured (perhaps because it was already a member of a different ZPSDS), probably with incompatible zone group assignments and permissions, then those existing settings need to be removed and reconfigured before it is added to the ZPSDS. If zoning is enabled, then any SMP initiator port with access to zone group 2 is allowed to perform any zoning configuration changes, including disabling zoning. This access must be carefully limited to trusted components. Note that all expanders inside the ZPSDS are in zone group 1 and thus have access to zone group 2.

One mechanism that can be used to address this problem is physical presence. If an expander knows that a user is physically present, it can allow zoning to be enabled or disabled.

Figure 1 shows an enclosure (e.g., a JBOD) being added to an existing ZPSDS.

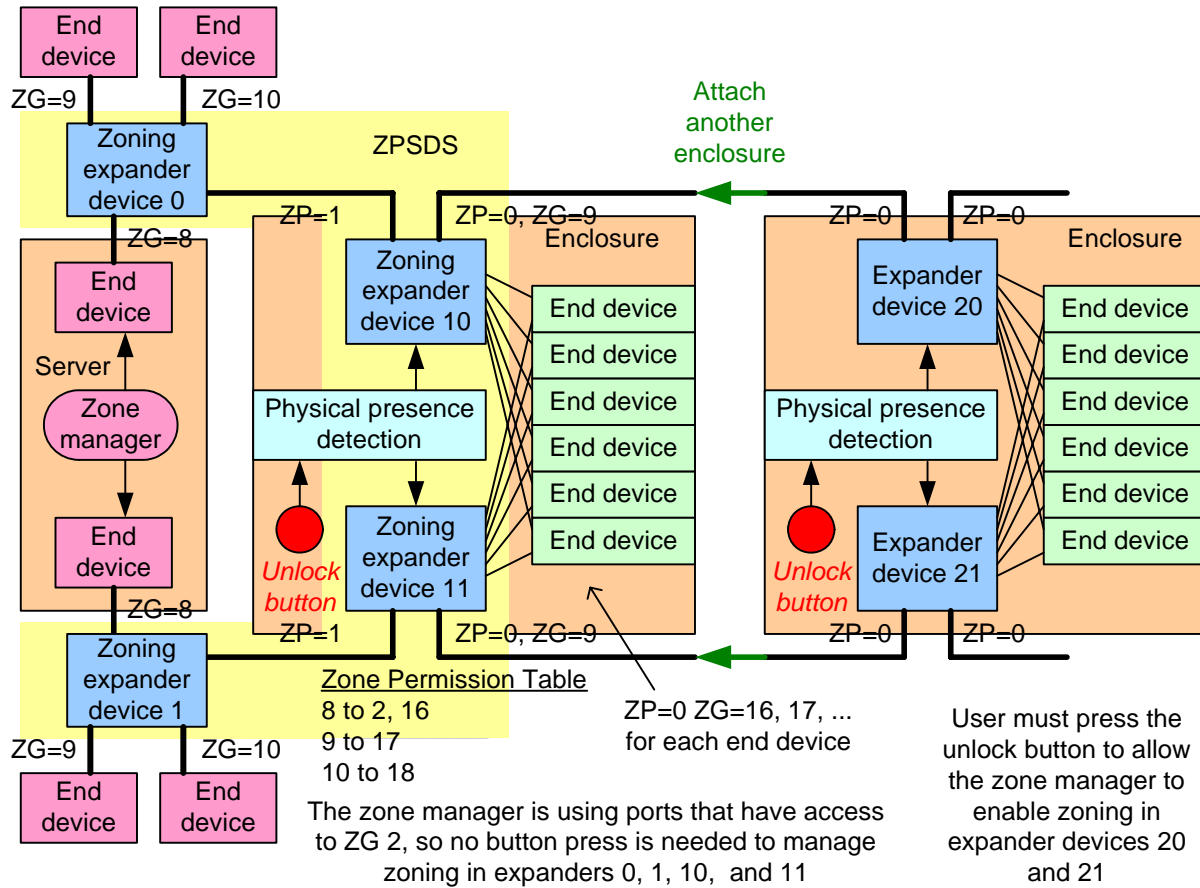


Figure 1 — Physical presence detection introduction

Fibre Channel zoning comparison

In Fibre Channel, FC-SW-4's Zone Merge Protocol allows two fabrics using zoning to be merged. There are two zoning Protocols - Basic and Enhanced Zoning. There are two Merge Control settings, Allow and Restrict. If the Merge Control is set to Restrict, the switches will join together if their zoning configuration information is identical; if not, they will place their ports in an Isolated state. (there are also hard zones vs. soft zones, and other options)

For FC-SP compliant switches, the Zoning Check Protocol is used instead of the Zone Merge Protocol. The switches compare hashes of their zoning configuration values rather than the raw zoning configuration information.

In SAS, sideband management of the expanders is not as likely to be available as in Fibre Channel to be able to pre-configure them before a merge. The approach of sending the expander ports to an "Isolated" state seems sufficient for SAS - keep the newly attached expander outside the ZPSDS with restricted permissions, let the zoning manager configure it (i.e., set up all the zone groups and the permission tables) with values appropriate to its new ZPSDS, then enable zoning and add it to the ZPSDS.

Physical presence

The definition of physical presence is vendor-specific. Possible mechanisms include:

- a) set a jumper on a board to an override position;
- b) press a button (causing physical presence to be asserted for some time, e.g., seconds or minutes);
- c) open a door;
- d) enter a password/PIN on a keypad;
- e) attach or remove a USB device (causing physical presence to be asserted for some time); or
- f) attach a specific USB device (e.g. a memory stick containing a key file or a SmartCard).

The expander includes a hardware input that indicates a user is physically present.

Future enhancements - passwords and secure authentication

Although it is reasonable to require a user to assert physical presence one time for a new piece of hardware, repeated demands are often unacceptable as many systems are managed remotely. To solve this, the user typically enters a password while physically present to install the hardware; later, if software is able to present that password to the device, it lets management occur without requiring physical presence.

As seen with Wireless Ethernet, default passwords created by the manufacturer are generally a bad idea.

The password could be configured through a sideband mechanism (e.g., serial port, Ethernet port, USB key) or in-band if physical presence is asserted.

The password could be configured via a first-come-first-served mechanism. The ATA Security feature set allows the ATA device passwords to be established at any time if they have not previously been established, so the first software that makes the attempt will succeed. If rogue software rather than trusted BIOS software manages to be the first, it could set the passwords to random values, rendering the device unusable.

The definition of the password sent to the expander is vendor-specific. Possible values include:

- a) simple text string. This is susceptible to snooping.
- b) hash value of a simple text string. This makes what transfers on the wire differ from what the user types on a keyboard, but is susceptible to snooping.
- c) secure authentication. Use an authentication method to authorize the zone manager to the expander in an encrypted exchange that is neither snoopable nor subject to reply attacks. FC-SP defines three authentication protocols:
 - A) DH-CHAP (Diffie-Hellman Challenge Handshake Authentication Protocol), a secret-based scheme;
 - B) FCPAP (Fibre Channel Password Authentication Protocol), a password-based scheme; and
 - C) FCAP (Fibre Channel Certification Authentication Protocol), a digital certificate-based scheme.

Even after authentication has been performed, careful design to ensure there are no security holes. For example, a trusted SMP initiator port could present the correct password, but then a rogue SMP initiator port could send SMP requests using the SAS address of the trusted SMP initiator port unless zoning expanders are validating incoming source SAS addresses. It may end up that all management traffic needs to be encrypted.

This proposal does not tackle a password/authentication mechanism. There are several related efforts underway which should be leveraged when complete:

- a) T10 tape WG on secure delivery of data encryption keys to tape drives
- b) Trusted Computing Group (TCG) work on authentication and secure delivery of data encryption keys to disk drives
- c) Fibre Channel FC-SP standard

Suggested changes to sas2r04 as modified by 06-279

4.8 Zoning

4.8.1 Zoning overview

SAS zoning is implemented by a set of zoning expander devices that define a zoned portion of a service delivery subsystem (ZPSDS). The zoning expander devices control whether a phy is permitted to participate in a connection to another phy.

Figure 2 shows an example of one ZPSDS in a SAS domain.

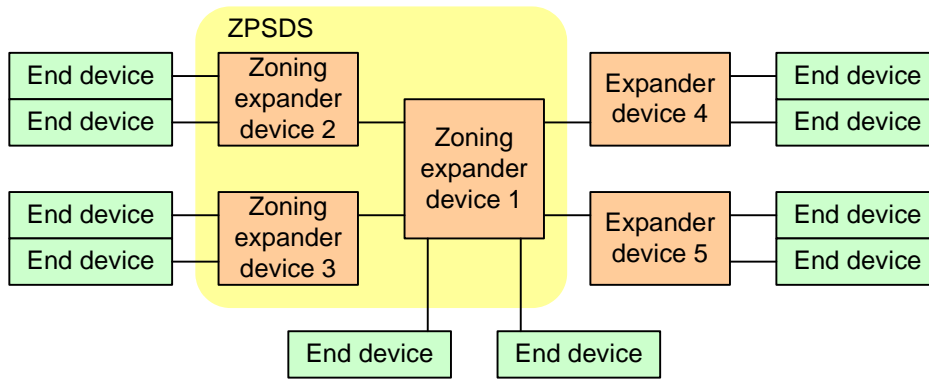
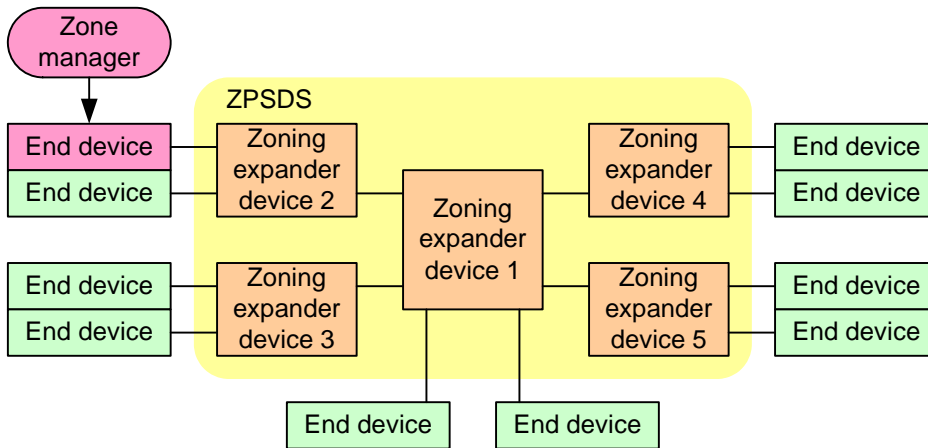


Figure 2 — One ZPSDS example

A ZPSDS has a zone manager responsible for its configuration. The zone manager may have access to an end device with a SAS port whose zone group has access to zone group 2, or may be attached to one or more zoning expander devices through a mechanism outside the scope of this standard.

Figure 3 shows examples of zone manager locations in a SAS domain.

Zone manager attached to an end device with a SAS port whose zone group has access to zone group 2



Zone manager attached directly to a zoning expander device

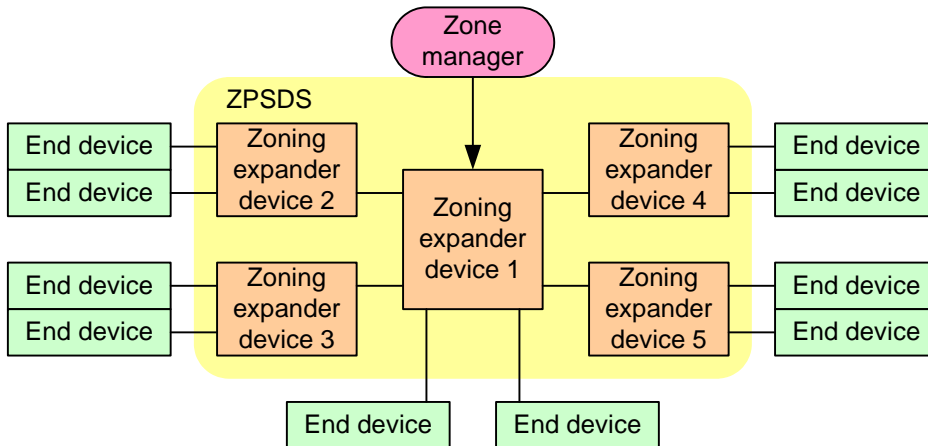


Figure 3 — Zone manager location examples

There may be any number of non-overlapping ZPSDSes in a service delivery subsystem. A ZPSDS may encompass some or all of the service delivery subsystem.

Figure 4 shows an example of three ZPSDSes in a SAS domain.

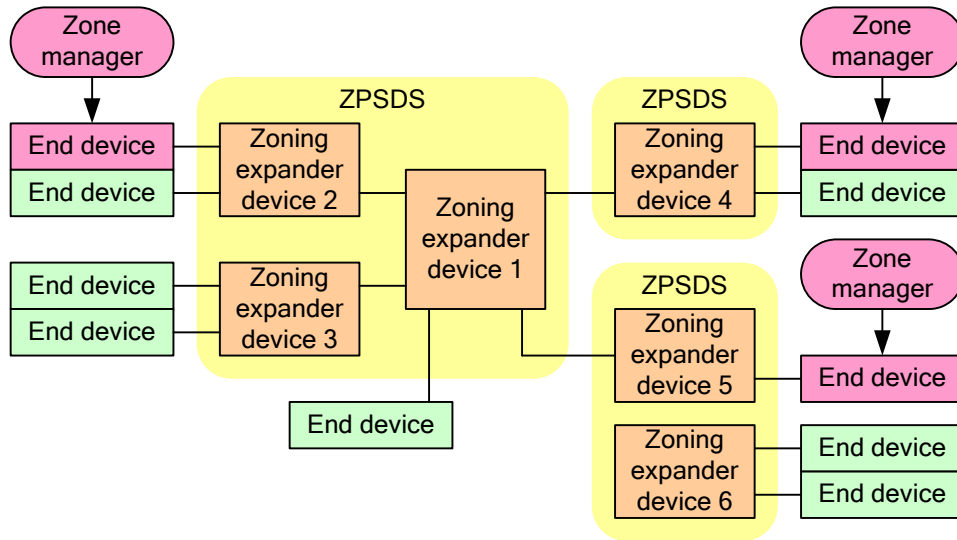


Figure 4 — Three ZPSDSes example

The zone manager assigns zone groups (see 4.8.3.2) to all phys that are capable of participating in connections through the ZPSDS. There are 128 zone groups numbered 0 through 127. All phys in a wide port shall be assigned to the same zone group. Zone group numbers are assigned to zoning expander phys as part of the zone phy information (see 4.8.3.1) and assigned to SAS addresses in the zoning expander route table (see 4.8.3.4). [new paragraph break]

Each zoning expander device contains a zone permission table (see 4.8.3.3) that controls whether a connection is allowed between phys based on their zone groups. As defined in 4.8.3.5, a requested connection shall only be established 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 zoning expander route table (see 4.8.3.4) is an extended version of the expander route table (see 4.6.7.3) that also includes the zone group number of each SAS address.

4.8.2 Zoning expander device requirements

In addition to the requirements for expander devices described in 4.6, a zoning expander device shall:

- contain a zoning expander route table (see 4.8.3.4);
- contain a zone permission table that supports 128 zone groups (see 4.8.3.3);
- allow or deny connection requests based on the zone permission table (see 4.8.3.5);
- set the ZONE DEVICE bit to one in its SMP REPORT GENERAL response (see 10.4.3.3);
- be self-configuring;
- contain an SMP initiator port (see 4.6.1); and
- support all zoning-related SMP functions.

[A zoning expander device may include physical presence detection to enable access to certain zoning configuration functions.](#)

4.8.3 Zone operation

4.8.3.1 Zone phy information

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

- ZONE PARTICIPATING bit;

- b) ZONE ADDRESS RESOLVED bit;
- c) ZONE GROUP PERSISTENT bit; and
- d) ZONE GROUP field.

The ZONE PARTICIPATING bit indicates a 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 outside the ZPSDS. The ZONE PARTICIPATING bit shall be set to one when the phy is attached to a zoning expander device inside the ZPSDS.

The ZONE ADDRESS RESOLVED bit indicates the method used to determine the source zone group for a connection request received by a phy at the boundary of the ZPSDS as specified in table 25 (see 4.8.3.5).

The ZONE ADDRESS RESOLVED bit may be set to one when:

- a) the phy is contained within a zoning expander device; and
- b) the ZONE PARTICIPATING bit for the phy is set to zero.

The ZONE ADDRESS RESOLVED bit shall be set to zero when:

- a) the phy is contained within a non-zoning expander device; or
- b) the phy is contained within a zoning expander device and the ZONE PARTICIPATING bit for the phy is set to one.

The ZONE GROUP field has a value in the range of 0 to 127 that indicates the zone group to which the phy belongs. If the ZONE PARTICIPATING bit of the phy is set to one, the ZONE GROUP field shall be set to 1. The zone group of the SMP initiator port and SMP target port in a zoning expander device shall be 1. 4.8.3.2 defines more about zone groups.

The ZONE GROUP PERSISTENT bit indicates the method of determining the zone group value of the phy after a link reset sequence (see 4.8.4). If the ZONE PARTICIPATING bit is set to one, the ZONE GROUP PERSISTENT bit shall be set to one.

All phys in an expander port shall have the same zone phy information (see 4.8.3.1). The default (e.g., power on) values for the zone phy information fields are vendor-specific.

4.8.3.2 Zone groups

Zone groups function in different ways based on zone group number as shown in table 23. A zone group with configurable zone permission table entries is able to be changed with the SMP CONFIGURE ZONE PERMISSION function.

Table 23 — Zone groups

Zone group	Configurable zone permission table entries	Description
0	No	Phys in zone group 0 have access to no other phys except phys in zone group 1.
1	No	Phys in zone group 1 have access to other phys in all zone groups.
2	Yes	Phys in zone group 2 have access to other phys based on the zone permission table. Phys in zone groups with access to zone group 2 are allowed to perform SMP zoning configuration functions. Phys in zone groups without access to zone group 2 are prohibited from performing SMP zoning configuration functions.
3	Yes	Phys in zone group 3 have access to other phys based on the zone permission table. Phys in zone groups with access to zone group 3 are allowed to perform certain SMP zoning related functions (i.e., ZONED BROADCAST). Phys in zone groups without access to zone group 3 are prohibited from performing certain SMP zoning related functions (i.e., ZONED BROADCAST).
4 to 7	Reserved	
8 to 127	Yes	Phys in zone groups 8 through 127 have access to other phys based on the zone permission table.

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 and the source zone group of the SMP initiator port requesting the function (see 4.8.3.5). If the SMP request is CONFIGURE PHY ZONE or CONFIGURE ZONE PERMISSION:

- a) if the ZP[s, 2] bit is set to one, the management device server shall process the function request; and
- b) if the ZP[s, 2] bit is set to zero, the management device server shall not process the function request and shall return a function result of SMP ZONE VIOLATION in the response frame (see 10.4.3.2).

Use of the SMP ZONED BROADCAST function shall be restricted based on the zone group 3 permission bits and the source zone group of the SMP initiator port requesting the function (see 4.8.3.5). If the SMP request is ZONED BROADCAST:

- a) if the ZP[s, 3] bit is set one, the management device server shall process the function request; and
- b) if the ZP[s, 3] bit is set to zero, the management device server shall not process the function request and shall return a function result of SMP ZONE VIOLATION in the response frame (see 10.4.3.2).

4.8.3.3 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 between phys in the zone groups shall be rejected with OPEN_REJECT (ZONE VIOLATION) as described in 4.8.3.5.

The zone permission table structure is shown in table 24.

Table 24 — Zone permission table

Destination zone group d	Source zone group s				
	0	1	2 to 3	4 to 7	8 to 127
0	0	1	0	0	0
1	1	1	1	1	1
2 to 3	0	1	ZP[s = 2 to 3, d = 2 to 3]	Reserved	ZP[s = 8 to 127, d = 2 to 3]
4 to 7	0	1	Reserved	Reserved	Reserved
8 to 127	0	1	ZP[s = 2 to 3, d = 8 to 127]	Reserved	ZP[s = 8 to 127, d = 8 to 127]

Note: Shading identifies configurable zone groups.

A ZP[s, d] bit set to one specifies that zone group s has permission to access zone group d. A ZP[s, d] bit set to zero specifies that zone group s does not have permission to access zone group d.

If ZP[s, d] is set to a value, ZP[d,s] shall be set to the same value.

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

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

Zone groups 4 through 7 are reserved zone groups. All reserved ZP bits shall be set to zero (e.g., bits ZP[4 to 7, 4 to 127] are set to zero).

If an expander phy has the ZONE ADDRESS RESOLVED METHOD bit set to one, then the zone group of that phy shall be configured to have permission to access all the zone groups to which the SAS addresses in the zoning expander route table for that expander phy have access.

4.8.3.4 Zoning expander route table

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

Figure 5 shows a representation of a zoning expander route table.

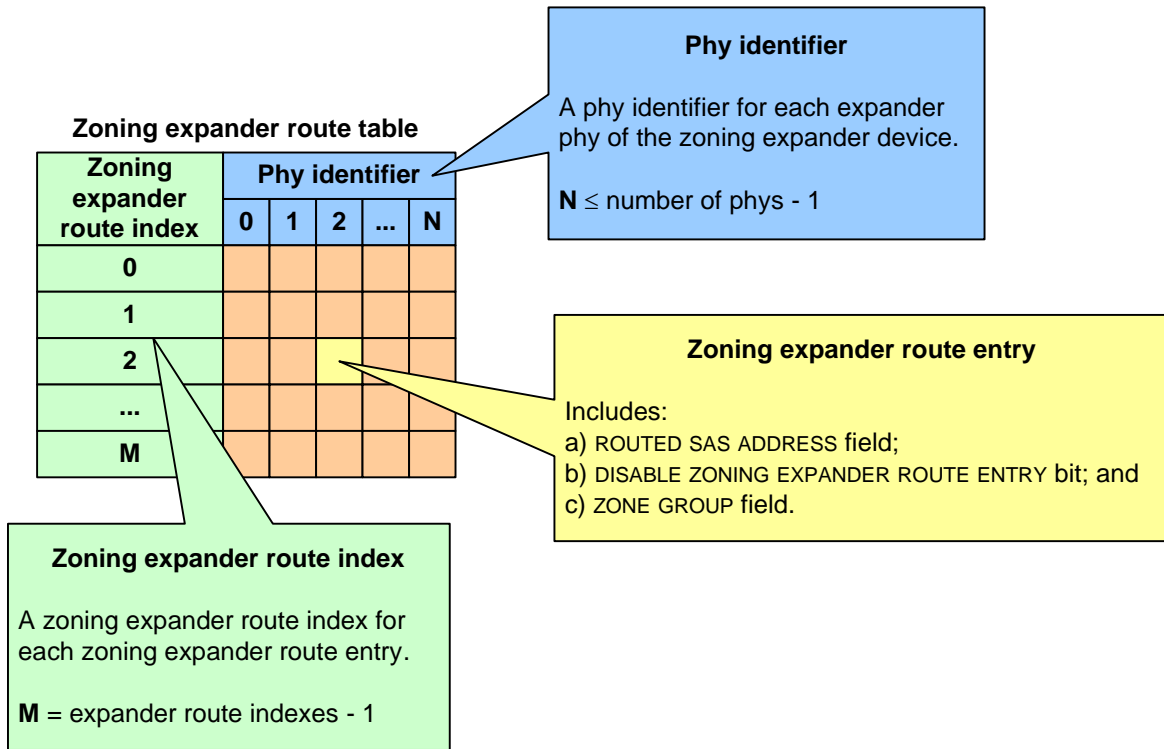


Figure 5 — Zoning expander route table example

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

4.8.3.5 Source zone group and destination zone group determination

When a zoning expander device receives an OPEN address frame (see 7.8.3):

- a) the zone group of the source port (i.e., s) is identified as defined in table 25; and
- b) the zone group of the destination port (i.e., d) is identified as defined in table 26.

If the ZP[s, d] bit is set to one then access between the phys shall be permitted and the zoning expander device shall perform the ECM arbitration procedure. If the ZP[s, d] bit is set to zero then access between the phys is not permitted and the zoning expander device shall transmit OPEN_REJECT (ZONE VIOLATION) in response to the connection request.

Zoning expander devices shall follow the rules in table 25 to determine the zone group of the source port.

Table 25 — Source zone group determination

Attribute of the expander phy that received the OPEN address frame			Source zone group
ZONE ADDRESS RESOLVED bit	Routing method	ZONE PARTICIPATING bit	
Zero	Any	Zero	Zone group of the receiving expander phy
		One	Source zone group specified by the SOURCE ZONE GROUP field in the received OPEN address frame
One	Direct	Zero	Zone group of the receiving expander phy
		One	Not applicable
	Subtractive	Zero	Zone group of the receiving expander phy
		One	Not applicable
	Table	Zero	Zone group stored in the zoning expander route table for the source SAS address. If the source SAS address is not found in the zoning expander route table then the zone group of the receiving expander phy.
		One	Not applicable

Zoning expander devices shall follow the rules in table 26 to determine the zone group of the destination port.

Table 26 — Destination zone group determination

Routing method of the destination expander phy	Destination zone group
Direct	Zone group of the destination expander phy
Subtractive	Zone group of the destination expander phy (i.e., the subtractive expander phy)
Table	Zone group stored in the zoning expander route table for the destination SAS address

Figure 6 shows an example of a ZPSDS in which the ZONE ADDRESS RESOLVED bit of the expander port of zoning expander device C that is attached to non-zoning expander device D is set to zero.

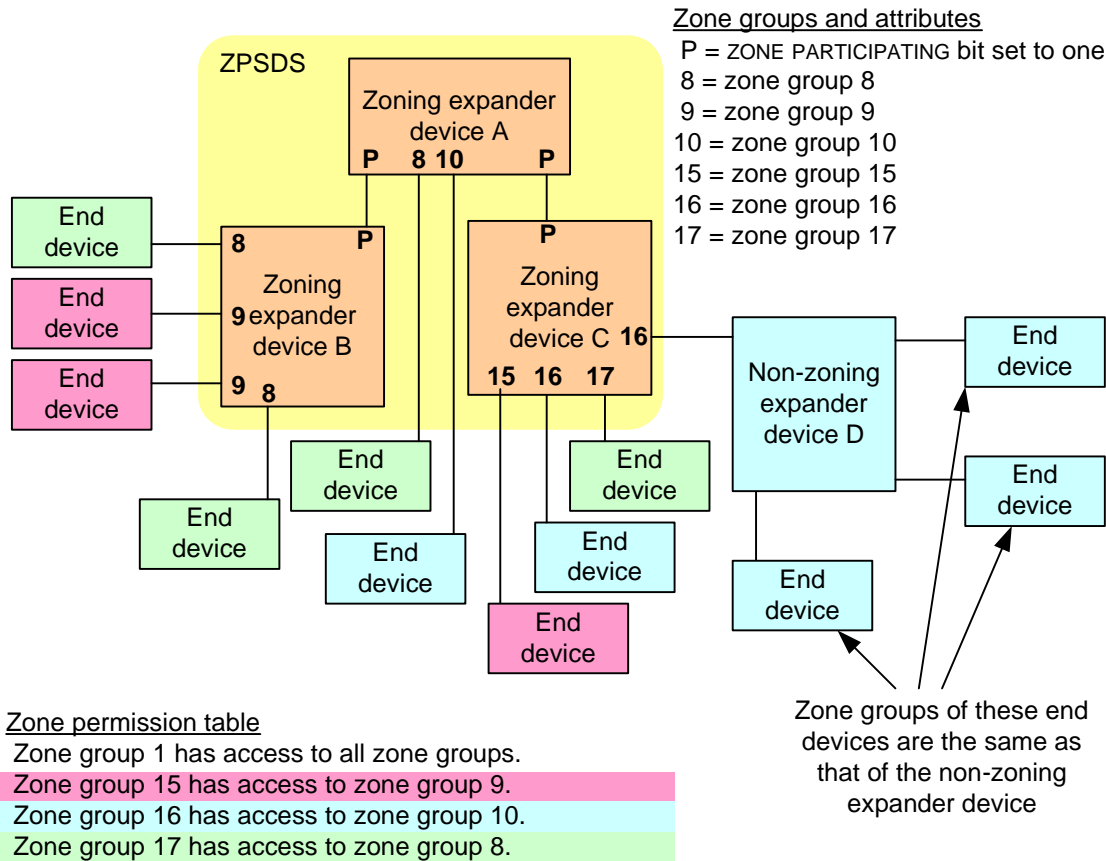


Figure 6 — Example of a ZPSDS with the ZONE ADDRESS RESOLVED bit set to zero

Figure 7 shows an example of a ZPSDS in which the ZONE ADDRESS RESOLVED bit of the expander port of zoning expander device C that is attached to non-zoning expander device D is set to one.

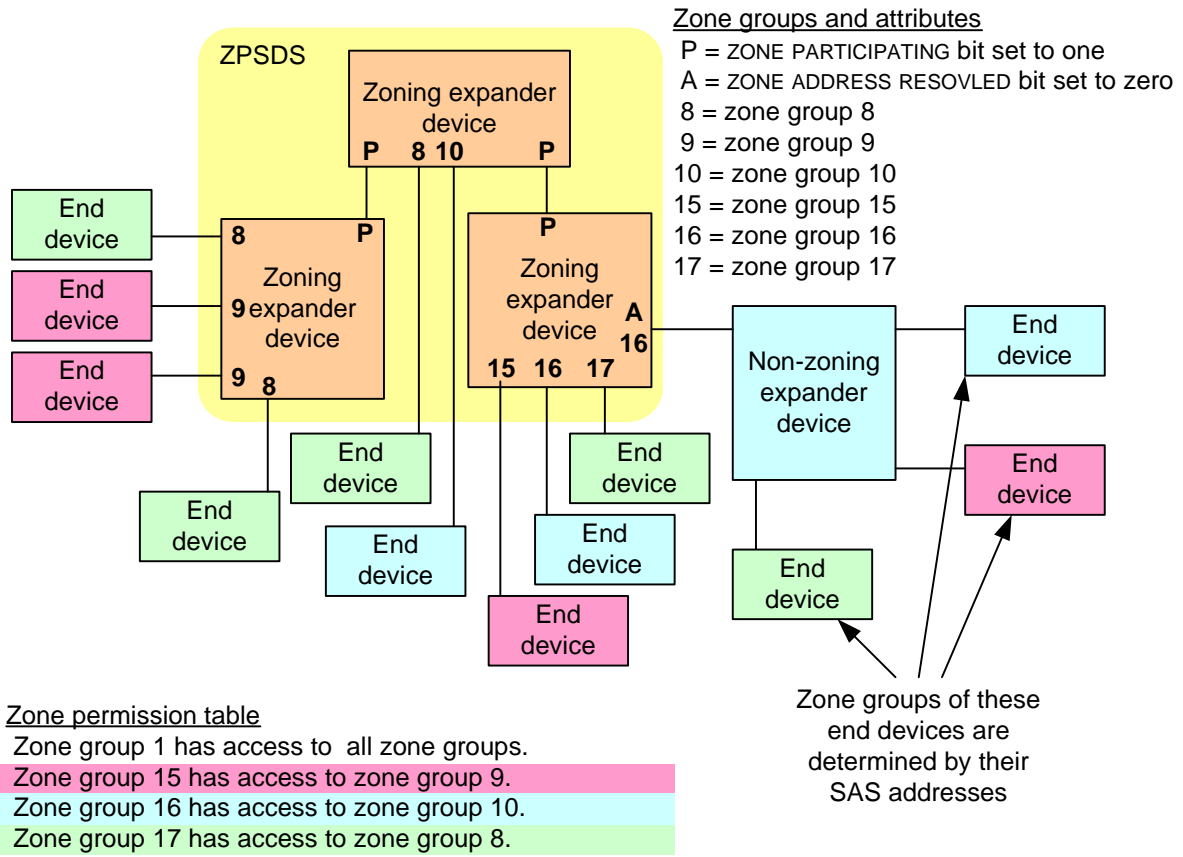


Figure 7 — Example of a ZPSDS with the ZONE ADDRESS RESOLVED bit set to one

4.8.4 Zone groups and link reset sequences

If the ZONE GROUP PERSISTENT bit is set to one, then a link reset sequence (see 4.4) shall not cause the zone group value of an expander phy to change. If the ZONE GROUP PERSISTENT bit is set to zero, then table 27 specifies events based on the initial condition of the expander phy that shall cause the zoning expander device to change the ZONE GROUP field of the expander phy to its default value (e.g., zero).

Table 27 — Events that cause the ZONE GROUP field to be set to its default value when the ZONE GROUP PERSISTENT bit set to zero

Initial condition	Event after the initial condition is established
Completed link reset sequence with a SAS device attached	A subsequent link reset sequence completes and: <ol style="list-style-type: none"> a) the SAS address received in the IDENTIFY address frame (see 7.8.2) during the identification sequence is different from the SAS address prior to the completion of the link reset sequence; or b) a SATA device is attached.
Completed link reset sequence with a SATA device attached	Either: <ol style="list-style-type: none"> a) A subsequent link reset sequence completes and: <ol style="list-style-type: none"> A) a hot-plug timeout (see 6.7.5) occurred between the time of the initial condition and the time the link reset sequence completed; B) the zoning expander device has detected the possibility that a new SATA device has been inserted. The method of detection is outside the scope of this standard (e.g., an enclosure services process reports a change in the ELEMENT STATUS CODE field in the Device or Array Device element (see SES-2), or a change in the WORLD WIDE NAME field in the attached SATA device's IDENTIFY DEVICE or IDENTIFY PACKET DEVICE data (see ATA8-ACS)); or C) a SAS device is attached; or b) The expander phy is disabled with the SMP PHY CONTROL function (see 10.4.3.14) DISABLE phy operation.

4.8.5 Broadcast processing in a zoning expander device

The BPP determines the source zone group(s) of the Broadcast as follows:

- a) if the BPP receives a Broadcast Event Notify message from an expander phy (i.e., a zoning expander phy received a BROADCAST), the Broadcast has a single source zone group set to the zone group of that expander phy; and
- b) if the BPP receives a message from the management device server indicating that it received an SMP ZONED BROADCAST request from an SMP initiator port that has access to zone group 3, the Broadcast has each of the source zone groups specified in the SMP ZONED BROADCAST request.

The BPP forwards the Broadcast to each expander port other than the one on which the Broadcast was received (i.e., the expander port that received the BROADCAST or SMP ZONED BROADCAST request) if any of the source zone groups have access to the zone group of the expander port.

To forward a Broadcast to an expander port:

- a) if the expander port's ZONE PARTICIPATING bit is set to one, the BPP shall request that the SMP initiator port establish a connection on at least one phy in the expander port to the SMP target port of the attached expander device and transmit an SMP ZONED BROADCAST request specifying the source zone group(s); and
- b) if the expander port's ZONE PARTICIPATING bit is set to zero, the BPP shall send a Transmit Broadcast message to at least one phy in the expander port, causing it to transmit a BROADCAST.

[Figure 8 shows an example of two enclosures, each containing two expander devices that share physical presence detection. Zoning is enabled in the expander devices in the left enclosure, but is not enabled in the](#)

expander devices in the right enclosure. The zone manager is able to configure zoning in zoning expander device 1 and zoning expander device 2 because the zone group of each SMP initiator port has access to zone group 2. However, it is not able to configure zoning in expander device 3 and expander device 4 unless physical presence is asserted.

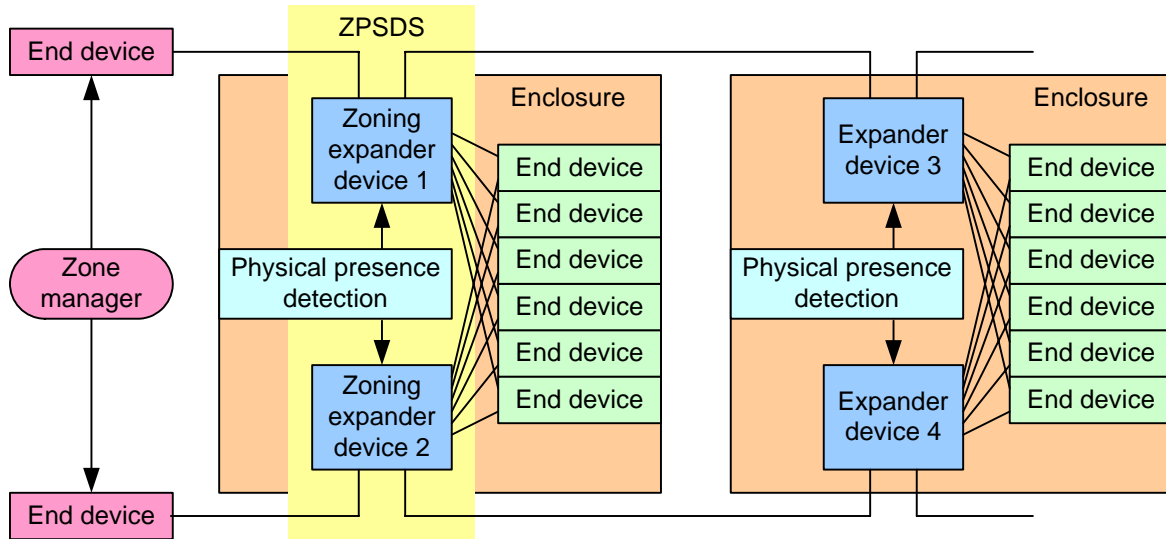


Figure 8 — Physical presence detection example

10.4.3 SMP functions

10.4.3.1 SMP function request frame format

An SMP request frame is sent by an SMP initiator port to request an SMP function be performed by a management device server. Table 28 defines the SMP request frame format.

Table 28 — SMP request frame format

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION								
2	Reserved								
3	REQUEST LENGTH ((n - 7) / 4)								
4	ADDITIONAL REQUEST BYTES								
m	ADDITIONAL REQUEST BYTES								
	Fill bytes, if needed								
n - 3	(MSB)	CRC							
n								(LSB)	

The SMP FRAME TYPE field is included in each frame format defined in this clause, although that field is parsed by the SMP transport layer (see 9.4). The SMP FRAME TYPE field is set to 40h.

The FUNCTION field specifies which SMP function is being requested and is defined in table 29. 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 31.

Table 29 — 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 - 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	10.4.3.7
13h	REPORT ROUTE INFORMATION	Return route table information	10.4.3.8
14h	REPORT PHY EVENT INFORMATION	Return phy event information for the specified phy	10.4.3.9
15h	REPORT PHY BROADCAST COUNTS	Return Broadcast counts	10.4.3.10
16h - 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	10.4.3.4
81h	Reserved for a general SMP output function		
82h	WRITE GPIO REGISTER	See SFF-8485	
83h - 84h	Reserved for general SMP output functions		
85h	ZONED BROADCAST	Transmit the specified Broadcast on the expander ports in the specified zone group(s)	10.4.3.12
86h - 8Fh	Reserved for general SMP output functions		
90h	CONFIGURE ROUTE INFORMATION	Change route table information	10.4.3.13
91h	PHY CONTROL	Request actions by the specified phy	10.4.3.14
92h	PHY TEST FUNCTION	Request a test function by the specified phy	10.4.3.15
93h	CONFIGURE PHY EVENT INFORMATION	Configure phy event information for the specified phy	10.4.3.16
94h - 9Fh	Reserved for phy-based SMP output functions		
A0h - BFh	Reserved for SMP output functions		
C0h - FFh	Vendor specific		

The REQUEST LENGTH field specifies the number of dwords that follow, not including the CRC field. For compatibility with previous versions of this standard, a REQUEST LENGTH field set to 00h sometimes specifies a non-zero number of dwords; this is defined in the function description.

The ADDITIONAL REQUEST BYTES field definition and length are based on the SMP function. The maximum size of the ADDITIONAL REQUEST BYTES field is 1 024 bytes, making the maximum size of the frame 1 032 bytes (i.e., 1 024 bytes of data + 4 bytes of header + 4 bytes of CRC).

Fill bytes shall be included after the ADDITIONAL REQUEST BYTES field so the CRC field is aligned on a four byte boundary. The contents of the fill bytes are vendor specific.

The CRC field is included in each request frame format defined in this clause, although that field is defined by the SMP transport layer (see 9.4.1) and parsed by the SMP link layer (see 7.18).

10.4.3.2 SMP function response frame format

An SMP response frame is sent by an SMP target port in response to an SMP request frame. Table 30 defines the SMP response frame format.

Table 30 — SMP response frame format

Byte/Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION								
2	FUNCTION RESULT								
3	RESPONSE LENGTH $((n - 7) / 4)$								
4	ADDITIONAL RESPONSE BYTES								
m									
	Fill bytes, if needed								
n - 3	(MSB)	CRC							
n								(LSB)	

The SMP FRAME TYPE field is included in each frame format defined in this clause, although that field is parsed by the SMP transport layer (see 9.4). The SMP FRAME TYPE field is set to 41h.

The FUNCTION field indicates the SMP function to which this frame is a response, and is defined in table 29 in 10.4.3.1.

The FUNCTION RESULT field is defined in table 31.

Table 31 — FUNCTION RESULT field (part 1 of 2)

Code	Name	SMP function(s)	Description
00h	SMP FUNCTION ACCEPTED	All	The SMP target port supports the SMP function. The ADDITIONAL RESPONSE BYTES field contains the requested information.
01h	UNKNOWN SMP FUNCTION	Unknown	The SMP target port does not support the requested SMP function. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
02h	SMP FUNCTION FAILED	All	The SMP target port supports the SMP function, but the requested SMP function failed. The ADDITIONAL RESPONSE BYTES may be present but shall be ignored.
03h	INVALID REQUEST FRAME LENGTH	All	The SMP target port supports the SMP function, but the SMP request frame length was invalid (i.e., did not match the frame size defined for the function). The ADDITIONAL RESPONSE BYTES may be present but shall be ignored.
10h	PHY DOES NOT EXIST	DISCOVER, REPORT PHY ERROR LOG, REPORT PHY SATA, REPORT ROUTE INFORMATION, REPORT PHY EVENT INFORMATION, CONFIGURE ROUTE INFORMATION, PHY CONTROL, PHY TEST FUNCTION, CONFIGURE PHY EVENT INFORMATION	The phy specified by the PHY IDENTIFIER field in the SMP request frame does not exist (e.g., the value is not within the range of zero to the value of the NUMBER OF PHYs field reported in the REPORT GENERAL response). The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
11h	INDEX DOES NOT EXIST	REPORT ROUTE INFORMATION, CONFIGURE ROUTE INFORMATION	The phy specified by the PHY IDENTIFIER field in the SMP request frame does not have the table routing attribute (see 4.6.7.1), or the expander route index specified by the EXPANDER ROUTE INDEX field does not exist (i.e., the value is not in the range of 0000h to the value of the EXPANDER ROUTE INDEXES field in the REPORT GENERAL response). The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
12h	PHY DOES NOT SUPPORT SATA	REPORT PHY SATA and PHY CONTROL (TRANSMIT SATA PORT SELECTION SIGNAL)	The phy specified by the PHY IDENTIFIER field in the SMP request frame is not part of an STP target port. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.

Table 31 — FUNCTION RESULT field (part 2 of 2)

Code	Name	SMP function(s)	Description
13h	UNKNOWN PHY OPERATION	PHY CONTROL	The operation specified by the PHY OPERATION field in the SMP request frame is unknown. The SMP function had no affect. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
14h	UNKNOWN PHY TEST FUNCTION	PHY TEST FUNCTION	The operation specified by the PHY TEST FUNCTION field in the SMP request frame is unknown. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
15h	PHY TEST FUNCTION IN PROGRESS	PHY TEST FUNCTION	The specified phy is already performing a phy test function. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
16h	PHY VACANT	DISCOVER, REPORT PHY ERROR LOG, REPORT PHY SATA, REPORT ROUTE INFORMATION, REPORT PHY EVENT INFORMATION, CONFIGURE ROUTE INFORMATION, PHY CONTROL, CONFIGURE PHY EVENT INFORMATION	The SMP target port processing the SMP request frame does not have access to the phy (e.g., because of zoning or vendor-specific reasons), although the value is within the range of zero to the value of the NUMBER OF PHYs field reported in the REPORT GENERAL response. The ADDITIONAL RESPONSE BYTES field may be present but shall be ignored.
17h	PHY EVENT INFORMATION SOURCE NOT SUPPORTED	CONFIGURE PHY EVENT INFORMATION	The phy event information source specified by a PHY EVENT INFORMATION SOURCE field is not supported.
20h	SMP ZONE VIOLATION	ZONED BROADCAST, CONFIGURE ZONING	The SMP target port supports the function, but the application applicable zone permission table bit is set to zero (e.g., the ZP[s, 3] bit is set to zero and the request was ZONED BROADCAST)(see 4.8.3.2).
21h	PHYSICAL PRESENCE NOT ASSERTED	CONFIGURE ZONING	Physical presence was required but was not detected by the expander device when the SMP function was requested.
22h	UNKNOWN ENABLE DISABLE ZONING VALUE	CONFIGURE ZONING	The ENABLE DISABLE ZONING field is set to 11b (i.e., Reserved).
All others	Reserved		

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10.4.3.3 REPORT GENERAL function

The REPORT GENERAL function returns general information about the SAS device (e.g., a SAS device contained in an expander device). This SMP function shall be implemented by all SMP target ports.

Table 32 defines the request format.

Table 32 — REPORT GENERAL request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (00h)								
2	Reserved								
3	REQUEST LENGTH (00h)								
4	(MSB)								
7		CRC							(LSB)

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

The FUNCTION field shall be set to 00h.

The REQUEST LENGTH field shall be set to 00h.

The CRC field is defined in 10.4.3.1.

Table 33 defines the response format.

Table 33 — REPORT GENERAL response (part 1 of 2)

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (00h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (09h)								
4	(MSB)								
5		EXPANDER CHANGE COUNT							(LSB)
6	(MSB)								
7		EXPANDER ROUTE INDEXES							(LSB)
8	Reserved								
9	NUMBER OF PHYS								
10	Reserved						CONFIGURING	CONFIGURABLE ROUTE TABLE	
11	Reserved								
12									
19	ENCLOSURE LOGICAL IDENTIFIER								

Table 33 — REPORT GENERAL response (part 2 of 2)

Byte/Bit	7	6	5	4	3	2	1	0
20	Reserved							
29	Reserved							
30	(MSB)	STP BUS INACTIVITY TIME LIMIT						(LSB)
31								
32	(MSB)	STP MAXIMUM CONNECT TIME LIMIT						(LSB)
33								
34	(MSB)	STP SMP I_T NEXUS LOSS TIME						(LSB)
35								
(bytes 36-39 are being added by 06-213)								
36	Reserved				PHYSICAL PRESENCE ASSERTED	PHYSICAL PRESENCE SUPPORTED	ZONING ENABLED	ZONING ENABLED ZONING SUPPORTED
37	Reserved							
38	(MSB)	NUMBER OF EXPANDER ROUTE TABLE ENTRIES						(LSB)
39								
40	(MSB)	CRC						(LSB)
43								

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

The FUNCTION field shall be set to 00h.

The FUNCTION RESULT field is defined in 10.4.3.2.

The RESPONSE LENGTH field shall be set to 09h. For compatibility with previous versions of this standard, a RESPONSE LENGTH field set to 00h specifies that there are 6 dwords before the CRC field.

The EXPANDER CHANGE COUNT field counts the number of Broadcast (Change)s originated by an expander device (see 7.11). SMP target ports in expander devices shall support this field. SMP target ports in other device types (e.g., end devices) shall set the EXPANDER CHANGE COUNT field to 0000h. This field shall be set to 0000h at power on. If the expander device has originated Broadcast (Change) for any reason described in 7.11 since transmitting a REPORT GENERAL response, it shall increment this field at least once from the value in the previous REPORT GENERAL response. It shall not increment this field when forwarding a Broadcast (Change). This field shall wrap to zero after the maximum value (i.e., FFFFh) has been reached.

NOTE 1 - Application clients that use the EXPANDER CHANGE COUNT field should read it often enough to ensure that it does not increment a multiple of 65 536 times between reading the field.

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 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.

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

A CONFIGURING bit set to one indicates that a self-configuring expander device has not completed configuring its expander route table. A CONFIGURING bit set to zero indicates that configuration is complete and the expander device is ready for connection requests. Changes in this bit from one to zero result in a Broadcast (Change) being originated. SMP target ports in self-configuring expander devices shall support this bit. SMP target ports in configurable expander devices and in other device types shall set the CONFIGURING bit to zero.

The CONFIGURABLE ROUTE TABLE bit indicates whether the expander device has an expander route table that is required to be configured with the SMP CONFIGURE ROUTE INFORMATION function (see 4.6.7.3). An expander device with a configurable route table shall set the CONFIGURABLE ROUTE TABLE bit to one. An expander device without a configurable route table or a device with any other device type shall set the CONFIGURABLE ROUTE TABLE bit to zero.

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

The STP BUS INACTIVITY TIME LIMIT field contains the bus inactivity time limit for STP connections which is set by the CONFIGURE GENERAL function (see 10.4.3.4).

The STP MAXIMUM CONNECT TIME LIMIT field contains the maximum connect time limit for STP connections which is set by the CONFIGURE GENERAL function (see 10.4.3.4).

The STP SMP I_T NEXUS LOSS TIME field contains the time that an STP target port and an SMP initiator port retry certain connection requests which is set by the CONFIGURE GENERAL function (see 10.4.3.4).

A PHYSICAL PRESENCE ASSERTED bit set to one indicates that the expander device is currently detecting physical presence. A ZONING ENABLED bit set to zero indicates that the expander device is not currently detecting physical presence.

Editor's Note 1: This bit is not strictly needed - an application would not rely on it for anything. However, it could help the user confirm that the physical presence mechanism has been triggered. For example, if it's a jumper, the zone management software could display a warning that zoning is unprotected as long as this bit remains reported as set to one.

A PHYSICAL PRESENCE SUPPORTED bit set to one indicates that the expander device supports physical presence as a mechanism for allowing access to zoning configuration. A PHYSICAL PRESENCE SUPPORTED bit set to zero indicates that the expander device does not support physical presence as a mechanism for allowing access to zoning configuration.

Editor's Note 2: If this bit is set to one, zone management software should instruct the user to "press a button (or do whatever the JBOD or switch vendor said to do) to enable zoning overrides." If this bit is set to zero, some other mechanism is needed to take control (like a future in-band authentication scheme, or a completely sideband mechanism).

A ZONING ENABLED bit set to one indicates that zoning is enabled in the expander device. A ZONING ENABLED bit set to zero indicates that zoning is disabled in the expander device.

A ZONING SUPPORTED bit set to one indicates that zoning is supported by the expander device. A ZONING SUPPORTED bit set to zero indicates that zoning is not supported by the expander device.

The NUMBER OF EXPANDER ROUTE TABLE ENTRIES field contains the number of route indexes in the expander route table. A management device server that does not support the REPORT EXPANDER ROUTE TABLE and the CONFIGURE EXPANDER ROUTE TABLE functions shall set this field to zero.

The CRC field is defined in 10.4.3.2.

10.4.3.4 CONFIGURE ZONING function [\[all new\]](#)

The CONFIGURE ZONING function requests actions by the device containing the SMP target port. This SMP function shall be supported by SMP target ports in zoning expander devices (see 4.8). Other SMP target ports shall not support this SMP function. This SMP function shall only be processed if:

- a) the SMP initiator port has access to zone group 2 (see 4.8.3.2); or
- b) the request is received from any SMP initiator port while physical presence is asserted.

Table 34 defines the request format.

Table 34 — CONFIGURE ZONING request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (81h)							
2	Reserved							
3	REQUEST LENGTH (02h)							
4	(MSB)	EXPECTED EXPANDER CHANGE COUNT						(LSB)
5								
6	Reserved							
7								
8	Reserved						ENABLE DISABLE ZONING	
9	Reserved							
11								
12	(MSB)	CRC						(LSB)
15								

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

The FUNCTION field shall be set to 81h.

The REQUEST LENGTH field shall be set to 02h.

The EXPECTED EXPANDER CHANGE COUNT field is defined in the CONFIGURE GENERAL request (see 10.4.1.10).

The ENABLE DISABLE ZONING field is defined in table 34.

Table 35 — ENABLE DISABLE ZONING field

Code	Description
00b	No change
01b	Enable zoning
10b	Disable zoning
11b	Reserved

[Editor's Note 3: This function could be expanded to carry other fields \(e.g., password\) later.](#)

The CRC field is defined in 10.4.3.1.

Table 34 defines the response format.

Table 36 — CONFIGURE ZONING response

Byte/Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (81h)								
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 81h.

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 10.4.3.2.

[\[End of all-new section\]](#)