To: T10 Technical Committee
From: Tim Hoglund, LSI Logic (tim.hoglund@lsil.com)
Date: February 24, 2006
Subject: T10/06-048r3 SAS-2 zoning enhancements

Revision Information

- Revision 0 Initial

- Revision 1 Incorporated feedback based on January 9,2006 SAS Protocol Working
  Group discussions

    o   remove management and broadcast references
    o   updated usage model diagram for bridge device (Figure 5)
    o   added example diagram (Figure 6)
    o   update Table 2 and clarify how source group is determined as a function of the
        routing attribute of the receiving phy

- Revision 2 incorporated feedback based on January 26, 2006 SAS2 Supervisor
  Configuration conference call

    o   remove Access Zone Management from this proposal
    o   remove references to CONFIGURE/REPORT ZONE PERMISSION functions
    o   remove references to CONFIGURE/REPORT ZONE ROUTE TABLE functions
    o   added - all phys within an expander port have same zoning properties
    o   added - ZONE ADDRESS RESOLVED bit to per zone phy information

- Revision 3 incorporated feedback from February 23, 2006 SAS2 Supervisor
  Configuration face-face meeting

    o   changes to SAS-2 zoning documented by this proposal are now relative to
        T10/06-107 as opposed to T10/06-019

References

SAS2r02   Serial Attached SCSI - 2 (SAS-2)
T10/06-019r3 019r4   SAS-2 zoning
T10/06-029r2   SAS-2 Expander Configuration Supervisor and SMP CHANGE Request
T10/06-107r1   SAS-2 Zoning sans Management

Introduction

Reference document T10/06-019 provides a baseline view of zoning functionality for a SAS
service delivery subsystem.   However, the proposed view of zoning is not sufficiently broad to
encompass expected usage models for the SAS-2 market timeframe.

This proposal seeks to define zoning methods for SAS-2 which satisfy expected usage models by
building on certain aspects of the method proposed by T10/06-019.

T10/06-019 defines zone groups and a zone permission table to establish access permission
(whether a connection is allowed between source zone group and a destination zone group).
Zone groups and the zone permission table provide a good method of providing zoning
functionality and this proposal uses them as the basis for SAS-2 zoning methods.

In order to satisfy a broader scope of usage models, the primary difference between this proposal and T10/06-019 is how source group assignment is determined. Whereas T10/06-019 assigns zone groups based solely on a phy attribute, this proposal allows the source zone group to be determined via a zone route table lookup. Within this proposal, phy-resolved source zone group mapping shall mean the method provided by T10/06-019 and address-resolved source zone group mapping shall mean the enhanced method offered by this proposal.

Proposal T10/06-107 has recently been offered to separate the hardware aspects of the primary SAS-2 zoning proposal from firmware aspects in order to drive consensus on hardware related issues. As such this proposal will document the suggested changes to T10/06-107 (rather than T10/06-019) which are required to accommodate the address-resolved source zone group mapping method.

Usage model discussion – establish required scope of SAS-2 zoning

Usage model 1: Traffic segregation as illustrated by Figure 1.

Topology/resource partitioning in the manner of VLAN/VSAN
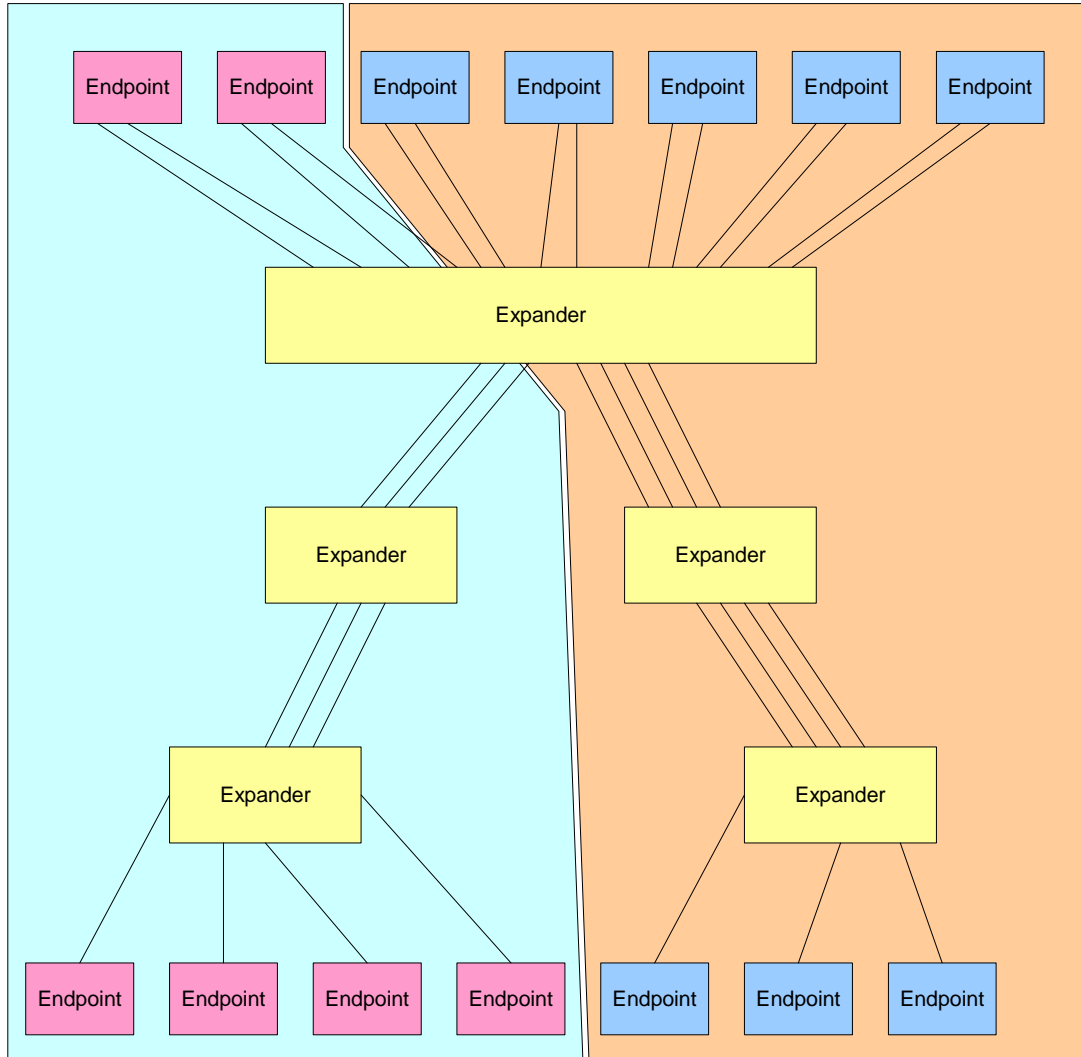
Figure 1: Traffic Segregation

Either phy-resolved or address-resolved source zone group mapping can satisfy the traffic segregation usage model.

However, phy-resolved source zone group mapping cannot differentiate traffic when non-zoned expanders are present within the topology.

Usage model 2: Access control as illustrated by Figure 2.

Allow control of which hosts can access which devices.
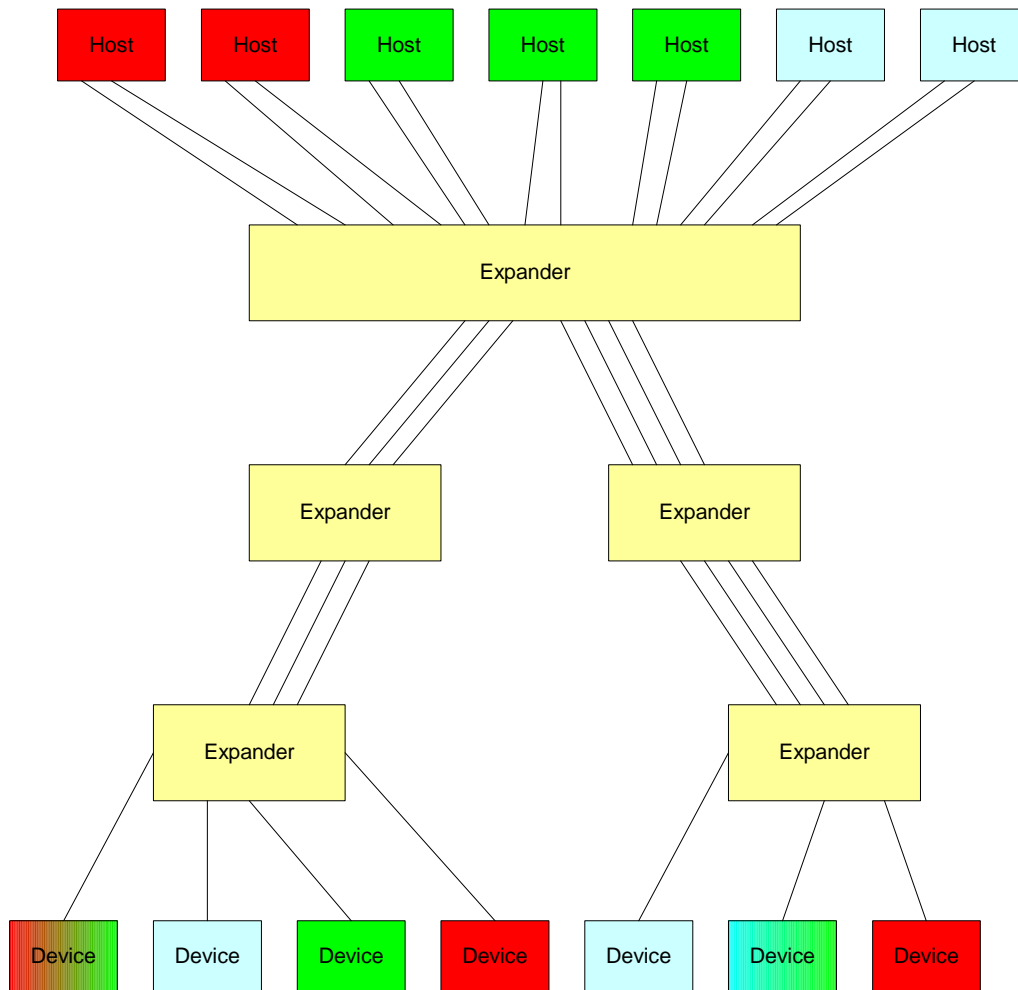
Figure 2: Access control

Either phy-resolved or address-resolved source zone group mapping can satisfy the Access control usage model.

However, phy-resolved source zone group mapping cannot provide full access control when non-zoned expanders are present within the topology.

Usage model 3: Device sharing as illustrated by Figure 3.
Hosts sharing access to devices to not allowed to see or interfere with each other.
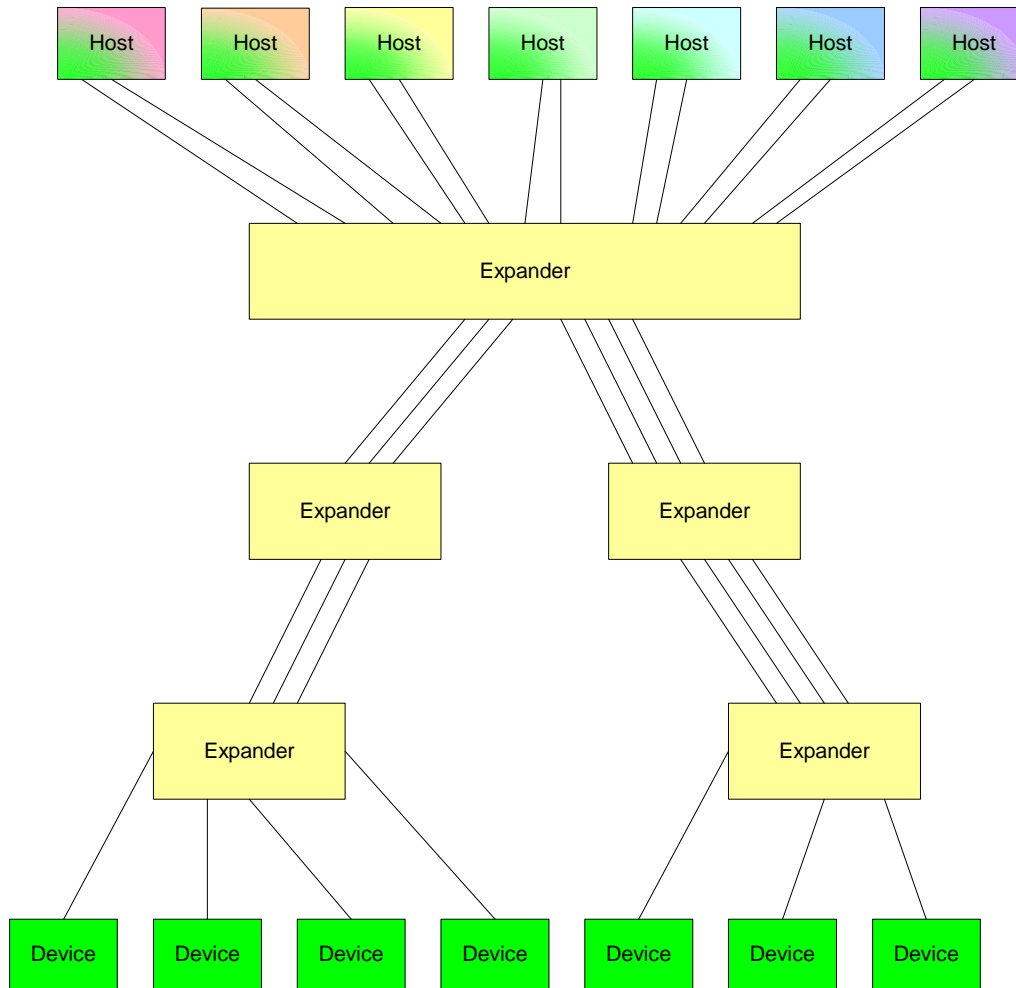
Figure 3: Device sharing

Either phy-resolved or address-resolved source zone group mapping can satisfy the Device sharing usage model.

Usage model 4: Non-zoned JBODs as illustrated by Figure 4.
Adding zoned root expanders that resolve source group information from a SAS address allows complete zoning functionality to be realized without changes to the JBODs.
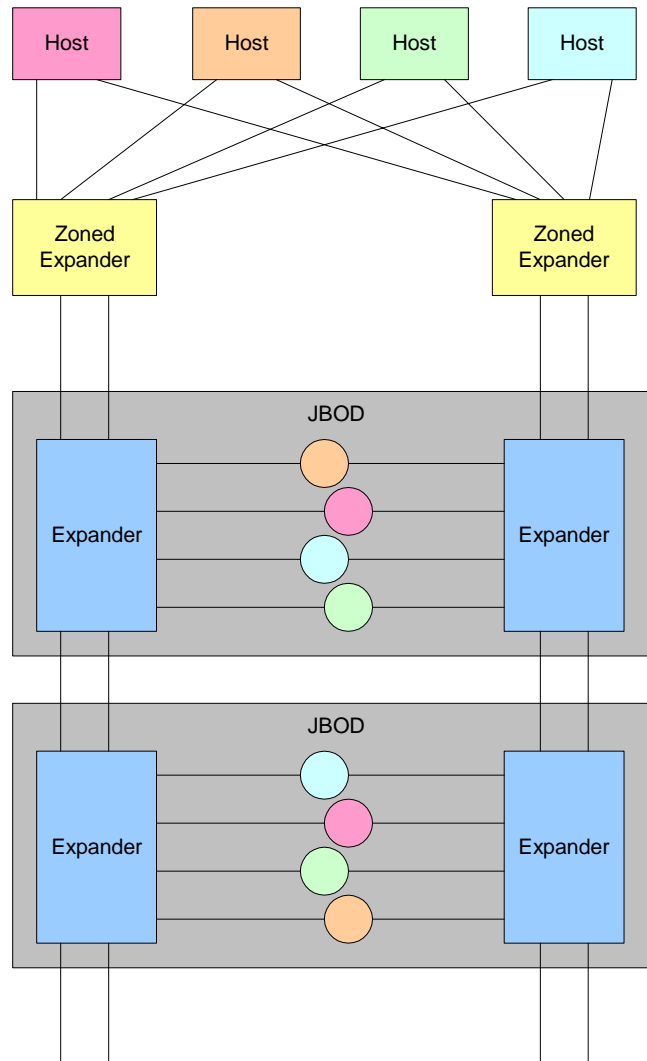
Figure 4: Non-zoned JBODs

This usage model cannot be realized with the phy-resolved source zone group mapping.

Usage model 5 Bridge or Virtual Devices as illustrated by Figure 5.
Providing the ability to properly differentiate zoning information on behalf of bridged devices, e.g.
Fibre Channel to SAS Bridge Device presenting itself as a non-zoning expander with virtual
devices.
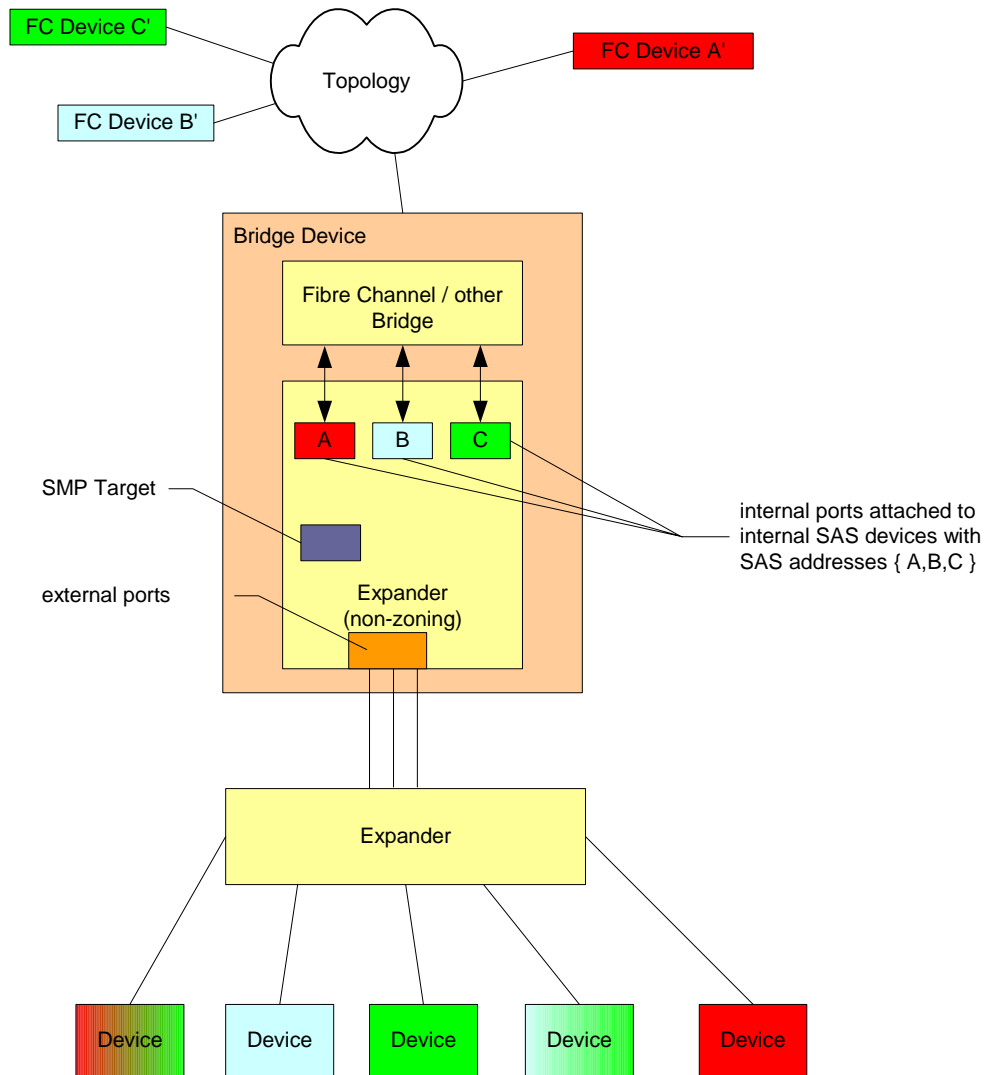
Figure 5: Bridged devices

This usage model cannot be realized with the phy-resolved source zone group mapping.

Address-resolved source zone group mapping example

Figure 6 shows how Address resolved source zone group mapping satisfies the requirements of Usage model 4 Non-zoned JBODs.
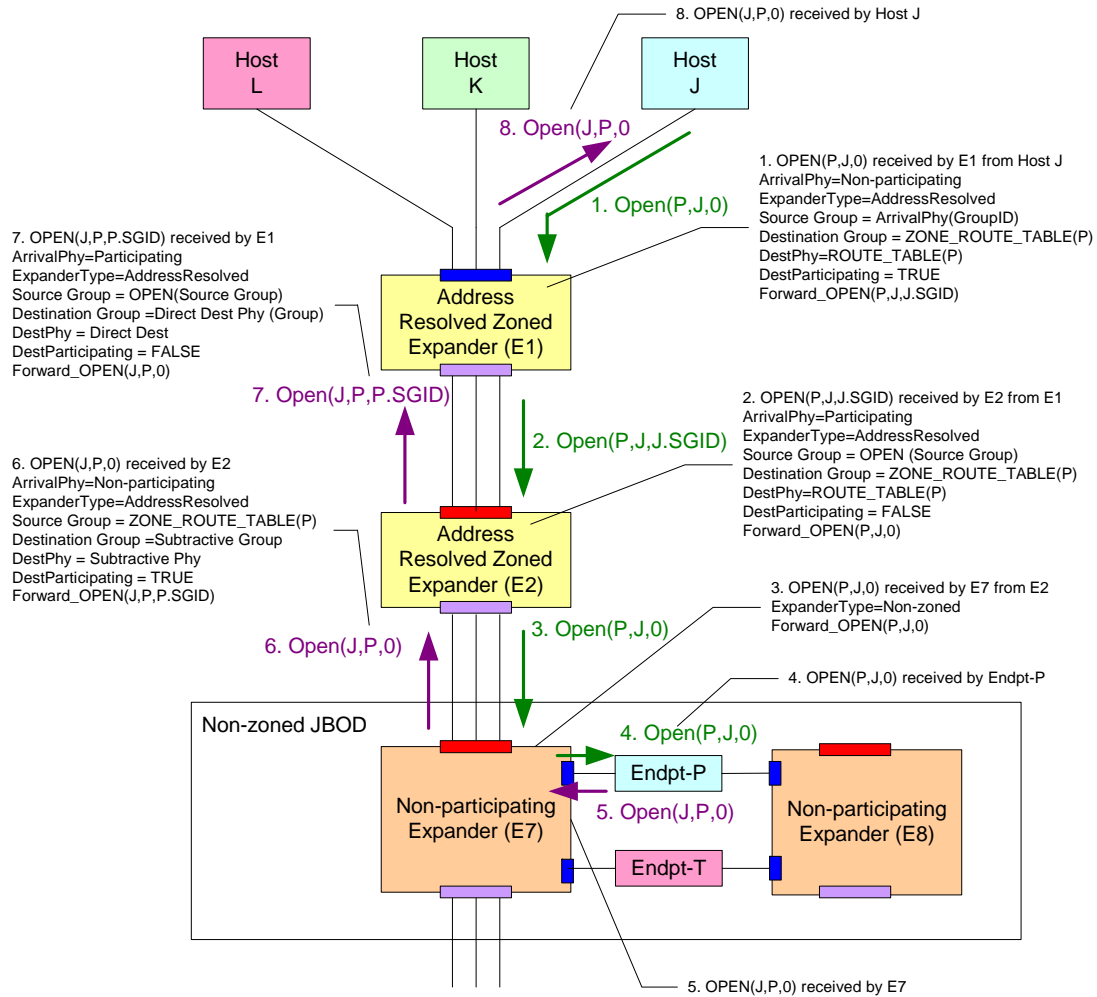

8. OPEN(J,P,0) received by Host J

8. Open(J,P,0

1. Open(P,J,0)

1. OPEN(P,J,0) received by E1 from Host J
ArrivalPhy=Non-participating
ExpanderType=AddressResolved
Source Group = ArrivalPhy(GroupID)
Destination Group = ZONE_ROUTE_TABLE(P)
DestPhy=ROUTE_TABLE(P)
DestParticipating = TRUE
Forward_OPEN(P,J,J.SGID)

7. OPEN(J,P,P.SGID) received by E1
ArrivalPhy=Participating
ExpanderType=AddressResolved
Source Group = OPEN(Source Group)
Destination Group =Direct Dest Phy (Group)
DestPhy = Direct Dest
DestParticipating = FALSE
Forward_OPEN(J,P,0)

7. Open(J,P,P.SGID)

2. Open(P,J,J.SGID)

2. OPEN(P,J,J.SGID) received by E2 from E1
ArrivalPhy=Participating
ExpanderType=AddressResolved
Source Group = OPEN (Source Group)
Destination Group = ZONE_ROUTE_TABLE(P)
DestPhy=ROUTE_TABLE(P)
DestParticipating = FALSE
Forward_OPEN(P,J,0)

6. OPEN(J,P,0) received by E2
ArrivalPhy=Non-participating
ExpanderType=AddressResolved
Source Group = ZONE_ROUTE_TABLE(P)
Destination Group =Subtractive Group
DestPhy = Subtractive Phy
DestParticipating = TRUE
Forward_OPEN(J,P,P.SGID)

6. Open(J,P,0)

3. Open(P,J,0)

3. OPEN(P,J,0) received by E7 from E2
ExpanderType=Non-zoned
Forward_OPEN(J,P,0)

4. OPEN(P,J,0) received by Endpt-P

4. Open(P,J,0)

5. Open(J,P,0)

5. OPEN(J,P,0) received by E7

Figure 6: Address-resolved source zone group mapping example

[start proposal text]

4.6.2 Expander ports

[add the following text to SAS2r02 section 4.6.2]

Each phy in an expander port shall have the same ZONE ADDRESS RESOLVED bit value and ZONE GROUP field value. ~~The DISCOVER function (see 10.4.3.5) shall return the same value in the ZONE ADDRESS RESOLVED and ZONE GROUP fields for each phy in an expander port.~~

[changes proposed to ~~T10/06-019~~T10/06-107]

4.9.3.1 Zone phy information

[add ZONE ADDRESS RESOLVED bit to set of information supported by each phy]

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

    a)   ZONE PARTICIPATING bit;
    b)   ZONE ADDRESS RESOLVED bit; and
    ~~b)~~c) 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. 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 ADDRESS RESOLVED bit specifies the method used to determine the source zone group for an OPEN request received by a phy at the boundary of the ZPSDS as specified in Table k1.

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 0 to 127 that indicates the zone group to which the phy belongs.

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 are identified as defined in tables k1 and n3. If 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 k1 to determine the zone group of the source port.

Table k1 – Source zone group determination

	ZONE ADDRESS RESOLVED bit = 0	ZONE ADDRESS RESOLVED bit = 1		
		Direct routing	**Subtractive Routing**	**Table routing**
ZONE PARTICIPATING bit = 1	Source zone group in OPEN address frame	N/A	N/A	N/A
ZONE PARTICIPATING bit = 0	Zone group of the receiving phy	Zone group of the receiving phy	Zone group of the receiving phy	Zone group stored in the zone route table for the source SAS address. If the source SAS address is not found in the zone route table then zone group of the receiving phy

[end of proposal text]

[greyed out sections below are related to zoning management and shall not be considered as changes to SAS-2 proposed by this document. They are included below as a placeholder to identify minimal management requirements to identify Address-resolved zoning capability and to configure and report the ZONE ADDRESS RESOLVED bit at each phy of a zoning expander device that supports Address-resolved source group mapping.]

10 Application Layer…
10.4.3 SMP functions

10.4.3.1 REPORT GENERAL function

Add an ADDRESS RESOLVED ZONE DEVICE bit to indicate that the device is capable of Address-resolved source group mapping.

Table NN defines the response format.

Table NN - REPORT GENERAL response

Byte\Bit	7	6	5	4	3	2	1	0
	…							
10	ZONE DEVICE	ADDRESS RESOLVED ZONE DEVICE	Reserved				CONFIGUR ING	CONFIGUR ABLE ROUTE TABLE

…

The ADDRESS RESOLVED ZONE DEVICE bit shall be set to one if the device supports Address-resolved source zone group mapping (see 4.9.3.6). The ADDRESS RESOLVED ZONE DEVICE bit shall be ignored if the ZONE DEVICE bit is set to zero.

…

10.4.3.5 DISCOVER function

Add ZONE ADDRESS RESOLVED bit to indicate that a phy within a zoned device is configured for Address-Resolved Source Group Mapping.

Table MM defines the response format.

Table MM - DISCOVER response

Byte\Bit	7	6	5	4	3	2	1	0
	…							
48	ZONE ADDRESS RESOLVED	ZONE SUPERVISOR	ZONE VIOLATION	ZONE PARTICIPATING	ZONE SUPERVISING PRIORITY			
49	Reserved	ZONE GROUP						
	…							

…

A ZONE ADDRESS RESOLVED bit set to one indicates that the phy within a zoning expander device is configured to use an Address-resolved method as specified in Table k1 to determine the source group for received OPEN address frames.

A ZONE ADDRESS RESOLVED bit set to zero indicates that the phy within a zoning expander device is configured to use a Phy-resolved method as specified in Table 2 to determine the source group for received OPEN address frames.

…

10.4.3.13 CONFIGURE PHY ZONE function

Add a ZONE ADDRESS RESOLVED bit to configure a phy within a zoned device for Address-Resolved Source Group Mapping.

Table 18 - Phy zone configuration entry descriptor

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

…

A ZONE ADDRESS RESOLVED bit set to one indicates that the phy within a zoning expander device shall use an Address-resolved method as specified in Table k1 to determine the source group for received OPEN address frames.

A ZONE ADDRESS RESOLVED bit set to zero indicates that the phy within a zoning expander device shall use a Phy-resolved method as specified in Table k1 to determine the source group for received OPEN address frames.

…