To:     T10 Technical Committee
From:  Tim Symons, PMC-Sierra (Tim_Symons@pmc-sierra.com)
Date:   30 Aug 2006
Subject: 06-358r4 SAS-2 Zone Configuration model

**Revision Information**

- Revision 0: Initial proposal
- Revision 1: Use of the term "zone manager" extended throughout this document.
- Revision 2: Text improvements identified during conference call. Added Broadcast (Activate)
- Revision 3: Additional text and changes per Seattle working group meeting
- Revision 4: Improve readability by changing configuration steps format.

**Referenced Documents**

sas2r05b Serial Attached SCSI – 2 (SAS-2) revision 5b
06-202r7 SAS-2 SMP Configure zone permission (Tim Symons, PMC-Sierra)
06-326r1 SAS-2 SMP Zone Locked Timer (Tim Symons, PMC-Sierra)
06-373r0 SAS-2 Enable and disable zoning by management identifier key (Rob Elliott, HP)

**Overview**

For a ZPSDS to function correctly all zoning expander devices must have identical values in their zone permission tables. The zone configuration model identifies the scenarios encountered when configuring zoning expander devices and defines procedures to minimize the risk of corruption of the ZPSDS.

Examples of causes of inconsistent zone permission tables are:
a) Two or more zone management application clients attempt to update the ZPSDS at the same time;
b) A device failure causes the process to be aborted part way through an update; and
c) A zoning expander device is configured by an out-of-band mechanism.

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Start of Suggested additions to SAS-2. Additions to existing text are shown in blue. Changes between revisions shown in red
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**3.1 Definitions**

**3.1.267 zone manager:** The entity responsible for configuring a ZPSDS (see 3.1.269). See 4.9.1.

**3.1.x active zone manager:** The zone manager that successfully locked a zoning expander device (see 4.7.5.x).
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Editors Note: Zone configuration model reference
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**3.1.x locked zoning expander device:** A zoning expander device that has been locked by a zone manager (see 10.4.3.18).

**3.1.x SMP zone configuration function:** An SMP function that is only accepted by a zoning expander device when it is locked (see 4.7.5.x).
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Editors Note: Zone configuration model reference

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**3.1.x zoning expander active values:** the active zone permission table and the active zone phy information for each phy of a zoning expander device (see 4.7.5.x).
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Editors Note: Zone configuration model reference
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**3.1.x zoning expander shadow values:** A copy of the active zone permission tables and zone phy information for each phy of a zoning expander device that is changed by SMP zone configuration function requests until the activate step has been successfully completed (see 4.7.5.x)
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Editors Note: Zone configuration model reference
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## 4.8.2 Zoning expander device requirements

In addition to the requirements for expander devices described in 4.6, a zoning expander device shall:
…
- h)     store active zone permission table values;
- i)     store shadow zone permission table values;
- j)     store active zone phy information values for each phy;
- k)     store shadow zone phy information values for each phy;
- l)     support PHYSICAL PRESENCE ASSERTED bit;
- m)    store active ZONE ENABLED bit;
- n)     store shadow ZONE ENABLED bit; and
- o)     support the zone locked timer.

## 4.9.4 Power on

A zoning expander device may configure the zone permission table, and zone phy information at power on and become part of a ZPSDS without a zone manager configuring the zoning expander device.
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Editors note: Suggestion from working group. Put the sentence above into the "power-on" section of SAS-2.  Move section 4.9.4 to 4.9.5.
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## 10.4.3.16 ENABLE DISABLE ZONING function

The ENABLE DISABLE ZONING function enables or disables zoning. This SMP function shall be supported by SMP target ports in zoning expander devices (see 4.9). Other SMP target ports shall not support this SMP function. This SMP function shall only be processed if the zoning expander device is locked.
~~This SMP function shall only be processed if:~~
   a) ~~the request is received from an SMP initiator port that has access to zone group 2 (see 4.9.3.2); or~~
   b) ~~the request is received from any SMP initiator port while physical presence is asserted.~~

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## 4.7.5.x Zone configuration model

### 4.7.5.x.1 Zone configuration process

A zoning expander device only accepts SMP zone configuration function requests when it is locked, and only accepts SMP zone configuration function requests from the zone manager that locked the zoning expander device (i.e. the active zone manager). SMP zone configuration functions change the zoning expander shadow values. When changes are complete, the zone manager activates the changes and the zoning expander device sets the zoning expander active values equal to the zoning expander shadow values and then unlocks the zoning expander devices.

For a ZPSDS to function correctly, all zoning expander devices are required to have identical values in their zone permission tables. A zone manager device locks all zoning expander devices in a ZPSDS to make changes to the zone permission table values.

To change zone phy information a zone manager locks only the zoning expander devices containing the phys to be changed.

When two or more ZPSDSes are to be merged, or a zoning expander device is to be added to a ZPSDS, then the zone manager locks all of the zoning expander devices that are to be included in the final ZPSDS. The active zone manager configures all of the zone permission tables to be identical and the zone phy information for the ZPSDS. The zone manager configures the REQUESTED INSIDE ZPSDS bit for each phy in each zoning expander device that will be included in the merged ZPSDS to enable the zoning expander devices to be merged into the ZPSDS.

If the zone locked timer expires then the zoning expander device processes the unlock step. The zoning expander device is unlocked and the zoning expander shadow values are not activated.

There are four steps in the zone configuration process; lock, load, activate and unlock.

### 4.7.5.x.2 Lock step

The lock step ensures that the same zone manager locks each zoning expander device. A zone manager sends the SMP ZONE LOCK request (see 10.4.3.18) to lock a zoning expander device. A zoning expander device is locked when the ZONE LOCKED bit is set to one in any REPORT GENERAL response and after the SAS address of the zone management server device has been stored. A locked zoning expander device processes SMP zone configuration functions.

If more than one zone manager attempts to lock a group of zoning expander devices, the following rules ensure that any concurrent requests are resolved:

1) If the first SMP ZONE LOCK response received by a zone manager has the FUNCTION RESULT field set to ZONE LOCK VIOLATION (see 10.4.3.2), then the group of zoning expander devices is locked by another zone manager and no further requests should be originated until a Broadcast (change) event is received;

2) If at least one SMP ZONE LOCK request is successful and at least one other response has:
   a) the FUNCTION RESULT field set to ZONE LOCK VIOLATION (see 10.4.3.2); and
   b) the CONFIGURING bit is set to one (see 4.7.5.x.3 load step),

   then a zoning expander device is locked and being configured by another zone manager. The zone manager that failed to lock the zoning expander devices should unlock all zoning expander devices that it has locked. When a Broadcast (change) event is received, then the zone manager should retry the lock step; or

3) If at least one SMP ZONE LOCK request is successful and at least one other response has:

    a) the FUNCTION RESULT field set to ZONE LOCK VIOLATION  (see 10.4.3.2); and

    b) the CONFIGURING bit is set to zero,

then another zone manager has locked at least one zoning expander device in the group of zoning expander devices and the zone manager evaluates the ZONE LOCKED SAS ADDRESS field from the SMP ZONE LOCK response:

    a) if the returned SAS address has a lower numeric value than the SMP port SAS address of the zone manager, then the zone manager with the higher numeric value SAS address repeats the SMP ZONE LOCK request to all zoning expander devices that it has not already locked until all required zoning expander devices are locked, or a Broadcast (Change) is received; or

    b) if the returned ZONE LOCKED SAS ADDRESS field has a higher numeric value than the SMP port SAS address of the zone manager, then the zone manager with the lower numeric value SAS address originates an SMP ZONE UNLOCK request to unlock all zoning expander devices that it locked.

After a zone manager receives a successful ZONE LOCK response from all required zoning expander devices the lock step is complete.

### 4.7.5.x.3 Load step

The load step stores SMP zone configuration information in the zoning expander shadow values. When a zoning expander device is successfully locked then SMP zone configuration function requests originated by the active zone manager may be processed. The SMP zone configuration functions include:

    a) SMP CONFIGURE ZONE PHY INFORMATION (see 10.4.3.21);
    b) SMP CONFIGURE ZONE PERMISSION TABLE (see 10.4.3.22);
    c) SMP ZONE ACTIVATE (see 10.4.3.19);
    d) SMP ZONE UNLOCK (see 10.4.3.20); and
    e) SMP ENABLE DISABLE ZONING (see 10.4.2.16).

After a locked zoning expander device processes any SMP zone configuration function request, the CONFIGURING bit is set to one in any SMP REPORT GENERAL response (see 10.4.3.3). SMP zone configuration functions change the zoning expander shadow values and do not become zoning expander active values until the activate step.

The load and activate steps may be skipped when a locked zoning expander device is unlocked:

    a) by a zone manager of higher SAS address during a lock step (see 4.7.5.x.2); or
    b) when the zone locked timer expires.

After all outstanding SMP zone configuration functions have completed the load step is complete.

### 4.7.5.x.4 Activate step

The activate step copies the zoning expander shadow register values to the zoning expander active values. The active zone manager issues one of the following:

    a) a Broadcast (Activate) (see 4.1.12); or
    b) an SMP ZONE ACTIVATE request (see 10.4.3.19) to all locked zoning expander devices;

When a locked zoning expander device receives a Broadcast (Activate) or an SMP ZONE ACTIVATE request, then the zoning expander device sets the zoning expander active values equal to the zoning expander shadow values.

The activate step may be skipped when a locked zoning expander device is unlocked:

    a)   by a zone manager of higher SAS address during a lock step (see 4.7.5.x.2); or

    b)   when the zone locked timer expires.

### 4.7.5.x.5 Unlock step

The unlock step ensures that the active zone manager unlocks the locked zoning expander devices, or if the zone manager fails then the zone locked timer expires and the zoning expander devices unlock.

If the active zone manager originated a Broadcast (Activate) then active zone manager sends an SMP ZONE UNLOCK request (see 10.4.3.20) with the ACTIVATE REQUIRED bit set to one, to the locked zoning expander devices.

If the active zone manager originated an SMP ZONE ACTIVATE request, then after all outstanding SMP ZONE ACTIVATE functions have successfully completed the active zone manager sends an SMP ZONE UNLOCK request with the ACTIVATE REQUIRED bit set to zero, to the locked zoning expander devices.

When the SMP ZONE UNLOCK request is successful or the zone locked timer expires, then the zoning expander device is unlocked and the zoning expander device sets the ZONE LOCKED bit to zero and sets the CONFIGURING bit to zero in the REPORT GENERAL response (see 10.4.3.3) and;

    1)   for ports with the INSIDE ZPSDS bit set to one and access to zone group 3 the zoning expander device originates an SMP ZONED BROADCAST function with type Broadcast (change) to:

        a.   all zones that changed (see 4.9.5); or

        b.   if the zone locked timer expires, then all zones

    2)   for ports with the INSIDE ZPSDS bit set to one but no access to zone group 3 the zoning expander device originates an SMP ZONED BROADCAST function with type Broadcast (change) for all zones (see 4.9.5); and

    3)   for ports with the INSIDE ZPSDS bit set to zero the zoning expander device originates Broadcast (Change) (see 4.9.5).

If the SMP ZONE UNLOCK response is BUSY (see 10.4.3.2), then the zone manager originates a new SMP ZONE UNLOCK request.

If the SMP ZONE UNLOCK response is NOT ACTIVATED (see 10.4.3.2), then the zone manager repeats the SMP ZONE UNLOCK request to the locked zoning expander devices until all required zoning expander devices are unlocked, or a Broadcast (Change) is received.

When all SMP ZONE UNLOCK requests are successful the configuration process is complete.

### 4.7.5.x.6 Enable a zoning expander device

If a zoning expander device has the ZONING SUPPORTED bit set to one and the ZONING ENABLED bit set to zero in the REPORT GENERAL response (see 10.4.3.3) then a zone manager configures the zoning expander device using the zone configuration process to ensure that the zone permission table is concurrent with the ZPSDS. The SMP ENABLE DISABLE ZONING function is sent by the active zone manager and changes to the the ZONING ENABLED bit become active when the activate step is processed.