

## SAS Simplified Support for Multiple STP Initiators

To: T10 Technical Committee  
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Subject: T10/02-430r3, SAS Simplified Handling of Multiple STP Initiators

**Revision History**

Revision 0 (October 24, 2002) first revision

Revision 1 (October 25, 2002) Modified so as not to preclude the complex Multiple STP initiator port model supported by extensive SATA Target Port capabilities in the expander. Added an SMP command extensions to query current initiator affiliations. Added an SMP command to clear the affiliation for specified initiators. Added an option for the expander to broadcast an AFFILIATION\_CLEARED primitive to all STP initiator ports whenever an affiliation is cleared.

Revision 2 (November 4, 2002) Modified to specify removal of task file register shadowing in expander devices, specifies that HARD\_RESET clears affiliation and causes broadcast of CHANGE, specifies that link reset sequence does not clear affiliation but still causes broadcast of CHANGE, does not specify an AFFILIATION\_CLEARED primitive, specifies an SMP PHY CONTROL function for an STP initiator to clear it's own affiliation, defines an extension to the REPORT\_PHY\_SATA SMP command to list the STP Initiator SAS address for a single active affiliation and corresponding valid bit to handle the case where there is no affiliation, defines an optional CLOSE variant (CLOSE(CLEAR AFFILIATION)) that specifies to clear the affiliation when processing of the CLOSE.

Revision 3 (November 5, 2002): Incorporated feedback from SAS WG to submit accepted proposal "as revised". Modified CHANGE AND CLEAR AFFILIATION to read CHANGE(CLEAR AFFILIATION) everywhere it appears. Specified removal of section 10.3.1.3 REPORT SATA CAPABILITIES function, (in deleting shadowed task file registers everything left in the response is redundant with the DISCOVER response). In Table 114 – Report SATA PHY response, moved the AFF VALID flag back to byte-11. Cleaned up the description of HARD\_RESET and CLEAR AFFILIATION in Table 128.

**Related Documents**

SAS-r02c – Serial Attached SCSI revision 02c.

**Overview**

This proposal offers a means to greatly simplify the way expander devices handle multiple STP initiator port access to SATA targets in a SAS domain without imposing any additional requirements on SATA targets. This proposal offers a way to shift the greater burden of arbitrating access to shared SATA targets from the expander device to the STP initiator port, and to limit the role of

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the expander device to detecting and reporting collisions accessing shared SATA ports.

The SAS working draft defines support of SATA targets attached to expander devices in a SAS domain with text in several places indicating multiple STP initiator ports can access any given SATA target. Because SATA targets have no intrinsic capability to support access by multiple initiators, the requirement to arbitrate access to a SATA disk among multiple STP initiator ports falls upon the expander device supporting attachment of SATA targets.

SAS supports control of SATA targets in a SAS domain in order to address cost-sensitive markets where SSP targets may prove too expensive. To that end, the incremental cost required to implement an expander device supporting attachment of SATA targets should be negligible as compared to the cost of an expander that supports SSP and SMP only.

As currently written, the SAS draft standard specifies a number of capabilities an expander device must provide to enable access to SATA targets from multiple STP initiator ports:

- For each SATA port, the expander device must replicate a shadow ATA task file register set for each STP initiator port that may access the attached SATA device.
- The expander device must translate Queue Tags between any STP initiator port and a SATA target to avoid collision of identical Queue Tags issued by different STP initiator ports.
- The expander device must detect when all available target queue-tags are in use and queue subsequent commands until outstanding commands complete, freeing up target queue tags.

The required capabilities for each expander port supporting a SATA target roughly correspond to the capability of a complete SATA host bus adapter, replicated for each STP initiator port that might communicate with the SATA target. Clearly this is at odds with the objective to provide a cost-effective interconnect for SATA devices and is far beyond the intended usage of SAS or SATA.

A decided simplification of the protocol to support SATA devices is essential before SAS can effectively support SATA target devices in a multi-initiator SAS domain. This proposal defines a simplified alternative to the complex model that provides limited multiple STP initiator port access to shared SATA disks without imposing severe requirements on the expander device.

The proposed changes are summarized as follows:

- A successful connection between an STP initiator and a SATA port establishes an explicit affiliation.
- Delete task-file register shadowing in expanders

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- Any SMP PHY CONTROL HARD RESET operation clears affiliation & causes change primitive,
- SMP PHY CONTROL LINK RESET does not clear affiliation but causes change primitive,
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- Define a new SMP PHY CONTROL request phy operation to clear an STP Initiator port's own affiliation. If the sender doesn't have an affiliation, the expander device responds with PHY OPERATION FAILED status.
- SMP REPORT\_PHY\_SATA reports the current affiliation with a single valid bit.
- A new CLOSE primitive is defined to allow an STP initiator to clear its affiliation upon close. If this appears anywhere other than in an STP connection, it is interpreted as a normal CLOSE. This is optional for STP initiators (can choose to use SMP method). It is required for expander devices that support SATA targets to use CLOSE (CLEAR AFFILIATION) to clear an affiliation.

**Suggested Changes**

**Modify Table 42 – Primitives not specific to the type of connection to add the “CLOSE(CLEAR AFFILIATION)” primitive sequence:**

Primitive	Use <sup>a</sup>	From <sup>b</sup>			To <sup>b</sup>			Primitive sequence type <sup>c</sup>
		I	E	T	I	E	T	
CLOSE(CLEAR AFFILIATION)	STP	I					T	Triple

**Modify Table 45 – Primitive encoding for primitives not specific to type of connection as follows:**

Primitive	Character			
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
CLOSE(CLEAR AFFILIATION)	K28.5	D02.0	D07.3	D04.7

**Add section 7.1.4.6 CLOSE(CLEAR AFFILIATION):**

CLOSE(CLEAR AFFILIATION) shall be processed in the same manner as CLOSE except that an STP initiator port may issue CLOSE(CLEAR AFFILIATION) in place of a normal CLOSE to cause the expander device on the far end of the STP connection to clear the affiliation between the STP initiator and the SATA phy at the other end of the STP connection, leaving the phy available for another STP initiator to establish a connection.

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This behavior is in addition to the normal effect of closing the connection. If an expander that supports attachment of a SATA target receives CLOSE(CLEAR AFFILIATION), the expander shall clear the affiliation between the STP initiator that sent the CLOSE(CLEAR AFFILIATION) and the phy at the other end of the connection being closed.

**Replace the text under the heading 9.3.2 tunneling for multiple initiator ports with the following text:**

After power-on reset or a HARD RESET issued through the PHY CONTROL request, and subsequent initialization affecting an expander phy with a SATA target device attached, the expander device may accept a connection request to the SATA target port from any STP initiator port. Once the expander device has accepted a connection request for that SATA target port from an STP initiator port, the expander device shall reject all subsequent connection requests for that SATA target port from other STP initiator ports with OPEN REJECT (STP RESOURCES BUSY). The expander device shall continue to reject connection requests from other STP initiator ports to that SATA target port even if the connection with the original STP initiator port is closed. In this state, the expander device is said to maintain an affiliation between the STP initiator port and the SATA target port. This affiliation shall persist until any of the following occurs:

- Another power-on condition occurs,
- A PHY CONTROL request specifying a PHY OPERATION of HARD RESET from any initiator specifying the phy with an affiliation is received,
- An STP initiator port issues an SMP PHY CONTROL request specifying a PHY OPERATION of CLEAR AFFILIATION specifying the phy which has an affiliation with that STP initiator,
- An STP initiator closes a connection to the affected phy with CLOSE(CLEAR AFFILIATION).

Any condition causing a link reset sequence other than power-on or PHY CONTROL request specifying a PHY OPERATION of HARD RESET shall not clear an affiliation held between an expander phy connected to a SATA target port and an STP initiator port.

**Modify the description of OPEN\_REJECT (STP RESOURCES BUSY) in Table 50 – OPEN\_REJECT primitives as follows:**

Destination device exists but the corresponding phy has an active affiliation with another STP initiator port.

**Remove the row in Table 101 – Management Functions listing REPORT SATA CAPABILITIES (Code 01h).**

**Remove clause 10.3.1.3 REPORT SATA CAPABILITIES function and all text and tables (Tables 104 and 105) related to the REPORT SATA CAPABILITIES function.**

**Modify Table 119 – REPORT PHY SATA response as follows:**

Table 114 – REPORT PHY SATA response

Bit Byte	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (12h)							
2	FUNCTION RESULT							

Bit Byte	7	6	5	4	3	2	1	0
3	Reserved							
4	Ignored							
7	Reserved							
8	PHY IDENTIFIER							
9	Ignored							
10	Reserved							
11	Reserved							AFF VALID
12	Reserved							
15	Reserved							
16	(MSB)	STP SAS ADDRESS						(LSB)
23	REGISTER DEVICE TO HOST FIS							
24	(MSB)	REGISTER DEVICE TO HOST FIS						(LSB)
43	Reserved							
44	Reserved							
47	Reserved							
48	(MSB)	AFFILIATED STP INITIATOR SAS ADDRESS						(LSB)
55	AFFILIATED STP INITIATOR SAS ADDRESS							
56	(MSB)	CRC						(LSB)
59	CRC							

**Add the following descriptive text for the AFFILIATED STP INITIATOR SAS ADDRESS:**

The AFFILIATED STP INITIATOR SAS ADDRESS in bytes 48 through 55 is the SAS address of the STP Initiator port that currently has an affiliation with the SATA target port indicated by PHY IDENTIFIER. The AFF VALID bit shall be set to a one when the AFFILIATED STP INITIATOR SAS ADDRESS is valid indicating the expander maintains an active affiliation between the indicated phy and the reported STP initiator SAS address. The AFF VALID bit shall be cleared to a value of zero when no STP initiator has an affiliation with the specified phy to indicate the AFFILIATED STP INITIATOR SAS ADDRESS field is not valid.

**Modify the description of the LINK RESET operation and HARD\_RESET operations in Table 128 – Phy operations as follows:**

Code	Operation	Description
01h	LINK RESET	Perform a link reset sequence (see 4.4) on the specified phy. Any affiliation active at the time the LINK RESET operation is issued shall continue to be active following the LINK RESET sequence executed as a result of receiving this request. Execution of this request shall cause the expander to broadcast CHANGE.

Code	Operation	Description
02h	HARD RESET	Perform a link reset sequence (see 4.4) on the specified phy. If the attached phy is a SAS phy, the link reset sequence shall indicate an identification sequence. If the specified phy is attached to a SATA phy a link reset sequence is processed on the link. Processing of this request shall clear any active affiliation maintained by the expander between the specified phy and an STP initiator and shall result in broadcast of BROADCAST(CHANGE).

**Add the following Phy Operation to table 128 – Phy operation:**

Table 128 – Phy operation

Code	Operation	Description
07h	CLEAR AFFILIATION	This request clears the affiliation held by the STP initiator port issuing the request. If the STP initiator issuing this request does not currently have an affiliation with the specified phy, the expander shall issue a response of PHY OPERATION FAILED. If clear affiliation is received by an expander for a phy that does not have a SATA device attached the expander shall fail the command with UNKNOWN PHY OPERATION.