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07-058r0 SAS-2 OOB and SSC

To: T10 Technical Committee  
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Subject: 07-058r0 SAS-2 OOB and SSC

### **Revision history**

Revision 0 (25 January 2007) First revision

### **Related documents**

sas2r08 - Serial Attached SCSI - 2 (SAS-2) revision 8

### **Overview**

The SAS OOB signaling defined in SAS-1 did not allow for Spread Spectrum Clocking (SSC).

SSC has been added to the SAS-2 draft (clause 5.3.8).

Some SAS-2 devices that have more than one phy want to utilize a common transmit clock in order to reduce implementation costs. If one of the phys has successfully completed speed negotiation with SSC enabled, then the common clock will be modulated per the SSC requirements.

Any additional phy may then enter an OOB sequence. The current requirements for OOB signaling utilize an OOBI timing parameter based upon the non-SSC clock tolerances. If the additional phy transmits its OOB signals using the transmit clock it would be in violation of the current definition.

This proposal changes the definition of OOBI to allow SSC to be enabled or disabled when transmitting OOB signals (COMWAKE, COMINIT and COMSAS).

### **Discussion**

Detection of OOB signals is based upon carrier detection during bursts and the lack of a carrier during spaces. The content of the bursts are not important. In fact, SAS-2 indicates the bursts may/should consist of D24.3 characters and this would not allow dword synchronization to be accomplished, thus the content could not be received.

The transmitter is required to send bursts and spaces of defined sizes based upon the transmitter clock. The transmitter clock with SSC off is defined as  $\pm 100$ ppm. With SAS SSC on the range becomes +2300 ppm to -2300 ppm. (NOTE: I did not include SATA SSC timings.)

The receiver detects the bursts and spaces based upon time, and not any clock. The detection process defines a range of times that determine what a valid burst or space can be. These are relatively loose in comparison to the transmission requirements.

This proposal does not change the requirements of the receiver, only the transmitter.

The following table provides the actual timings of all bursts and spaces given the various clock tolerances:

		COMWAKE Space; All Bursts	COMWAKE Negation	COMINIT Space	COMINIT Negation	COMSAS Space	COMSAS Negation
OOB's	1	160	280	480	800	1440	2400
Nominal (ns)	0.6666667	106.667	186.667	320.000	533.333	960.000	1600.000
-100ppm (ns)	0.6666000	106.656	186.648	319.968	533.280	959.904	1599.840
+100ppm (ns)	0.6667334	106.677	186.685	320.032	533.387	960.096	1600.160
-2300ppm (ns)	0.6651334	106.421	186.237	319.264	532.107	957.792	1596.320
+2300ppm (ns)	0.6682000	106.912	187.096	320.736	534.560	962.208	1603.680

For reference, here are the receiver requirements:

Burst: (For COMWAKE, COMINIT or COMSAS)

May detect  $T_{burst} \leq 100 \text{ ns}$   
 Shall detect  $T_{burst} > 100 \text{ ns}$

Space Detection:

**Table 76 — OOB signal receiver device idle time detection requirements**

Signal	may detect	shall detect	shall not detect
COMWAKE	$35 \text{ ns} \leq T_{idle} < 175 \text{ ns}$	$101,3 \text{ ns} \leq T_{idle} \leq 112 \text{ ns}$	$T_{idle} < 35 \text{ ns}$ or $T_{idle} \geq 175 \text{ ns}$
COMINIT/ COMRESET	$175 \text{ ns} \leq T_{idle} < 525 \text{ ns}$	$304 \text{ ns} \leq T_{idle} \leq 336 \text{ ns}$	$T_{idle} < 175 \text{ ns}$ or $T_{idle} \geq 525 \text{ ns}$
COMSAS	$525 \text{ ns} \leq T_{idle} < 1\,575 \text{ ns}$	$911,7 \text{ ns} \leq T_{idle} \leq 1\,008 \text{ ns}$	$T_{idle} < 525 \text{ ns}$ or $T_{idle} \geq 1\,575 \text{ ns}$

Negation Detection:

**Table 77 — OOB signal receiver device negation time detection requirements**

Signal	shall detect
COMWAKE	$T_{idle} > 175 \text{ ns}$
COMINIT/COMRESET	$T_{idle} > 525 \text{ ns}$
COMSAS	$T_{idle} > 1\,575 \text{ ns}$

The proposal modifies the following table:

Table 73 — OOB signal timing specifications

Parameter	Minimum	Nominal	Maximum	Comments
OOB Interval (OOBI) <sup>a</sup>	666,600 ps	666,6 ps	666,733 ps	The time basis for burst times and idle times used to create OOB signals. Based on 1,5 Gbps clock tolerance (see table 52 in 5.3.3).
COMSAS detect timeout	13,65 $\mu$ s			The minimum time a receiver device shall allow to detect COMSAS after transmitting COMSAS. Derived from: OOB I x 512 x 40
<sup>a</sup> OOBI is different than UI(OOB) defined in SATA (e.g., SAS has tighter clock tolerance). This is a fixed value equal to the UI for 1,5 Gbps, regardless of the actual transfer rate being used to create the burst time.				

### **Proposal**

Modify the Minimum and Maximum values of OOB Interval (OOBI) in Table 73.

The Minimum value to be changed from 666,600 ps to 665,133 ps.

The Maximum value to be changed from 666,733 ps to 668,200 ps.