Date: **March 10, 03**
To: T10 Technical Committee
From: Jim Coomes (jim.comes@seagate.com)
Subject: SAS proposed scrambling text

The following changes are suggested to the description of the scrambling function in SAS-03d:

7.5 Scrambling
Scrambling is used to reduce the probability of long strings of repeated patterns appearing on the physical link.

~~There are several types of scrambling defined in table 77.~~All data dwords are scrambled. Table 77 provides a list of data dwords types.

Table 77 — ~~Scrambling~~ Data dword types

Data dword t~~T~~ype	Description
Address frame scrambling	After an SOAF, all data dwords shall be scrambled until the EOAF.
SSP frame scrambling	SSP connection after an SOF, all data dwords shall be scrambled.
SMP frame scrambling	SMP connection after an SOF, all data dwords shall be scrambled.
STP frame scrambling	STP connection after a SATA_SOF, all data dwords shall be scrambled intil the SATA_EOF.
Repeated SATA primitives scrambling	After a SATA_CONT, vendor-specific scrambled data dwords shall be sent until a primitive other than ALIGN is sent.
SAS idle dwords	When a connection is not open and the physical link is idle, vendor-specific scrambled data dwords shall be sent.
SSP idle dwords	When an SSP connection is open and the physical link is idle, vendor-specific scrambled data dwords shall be sent.

~~The scrambling polynomial is $x^{16} + x^{15} + x^{13} + x^4 + 1$. The data scrambling value shall be initialized to FFFFh at each SOF, SOAF, and SATA_SOF by both the transmitter and receiver. The data being transmitted shall be XORed with the data scrambling value by the transmitter, and the data being received shall be XORed with the data scrambling value by the receiver.~~

~~The polynomial shall be applied to the lower 16 bits of the 32-bit dword being transmitted or received first; the polynomial shall then be applied to the upper 16 bits. See 7.6 for details on how the scrambler and descrambler fit into the dword flow.~~

Data dwords being transmitted shall be XORed with a defined pattern to produce the scrambled value encoded and transmitted on the physical link. Received data dwords shall be XORed with the same pattern after decoding to produce the original dword value provided there are not transmission errors.

The pattern that is XORed with the data dwords shall be defined by the output of a linear feedback shift register implemented with the following polynomial:

$G(X) = X^{16} + X^{15} + X^{13} + X^4 + 1$

The output of the pattern generator is 16 bits wide. For each Data dword t~~T~~he ~~first~~ output of the generator is applied the lower 16 bits (bits 15-0) of the 32 bit data dword being transmitted or received ~~first~~; the next output of the generator shall then be applied to the upper 16 bits (bits 31-16).

The value of the linear shift register is initialized at each SOF, SOAF., ~~, and~~ The linear shift register shall be initialized to a value of FFFFh.

For scrambling of data dwords following SATA_SOF and SATA_CONT ~~SATA~~ reference ATA/ATAPI-7 V3
~~_SOF by both the transmitter and receiver.~~

Annex E contains information on scrambling implementations.

NOTE 23 - Scrambling is not based on data feedback, so the sequence of values XORed with the data being transmitted is constant.

See 7.6 for details on how the scrambler and descrambler fit into the dword flow.

Other changes:

In E.2, the paragraph:

“For parallelized versions of the scrambler, the initialized value is selected to produce a first dword output of C2D2768Dh for a dword input of all zeros.”

Should be changed to

“For all implementations, the initialized value is selected to produce a first dword output of C2D2768Dh for a dword input of all zeros.”