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Subject: Synchronization Status and Errors

ABSTRACT:

In a disk array application, the array controller needs a mechanism to determine the status of spindle synchronization and to allow accurate problem reporting when a loss of synchronization occurs. When a master drive is logically downed and hot swapped or when a redundant initiator fails and must be hot swapped, the status of the synchronization is currently difficult if not impossible to attain. Also, currently there is no mechanism for a drive to report the cause of the problem when a loss of synchronization occurs. Addition of new additional sense code qualifiers as well as some changes to the current additional sense code/qualifier descriptions and the definition of synchronization status bits in Mode Page 4 would alleviate these problems.

ISSUES:

The following concerns/questions have arisen that do not seem to be adequately addressed in the SCSI-2 standard Rev. 10h. In reviewing these issues please keep in mind that this information can be obtained from each drive manufacturer, but there is currently not enough formal standardization in the implementations across all vendors to allow a complete array controller/host driver design that will accurately report sync spindle changes/problems for all SCSI drives.

A) Currently, the initiator must maintain a "current state" for each drive to know which drives are/are not synchronized. If power to the initiator is lost, there is no way to determine the synchronization status since the drives will not re-report the sync spindle unit attentions.

B) When loss of synchronization occurs, there is no indication of the cause. (Is no sync pulse being received or does a drive/controller malfunction prevent the drive from being able to synchronize to the reference signal ?)

C) There is no specification for what is reported if 2 masters are selected. This can be caused by an initiator problem or improper cabling.

PROPOSED CHANGES FOR SCSI-3

Management of sync spindle changes by an initiator would be simpler and more complete if changes were made in the SCSI-3 standard to address the concerns listed above. Changes requested can be broken down into 2 major categories:

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1) addition of a synchronization status that reflects the drives current synchronization state (issue A)

2) addition of new additional sense codes and qualifiers or specification of existing codes that allow better synchronization problem diagnosis (issues B and C)

Proposed additions/changes to SCSI-2 Rev. 10h are shown below.

Table 71:

ASC	ASCQ	DESCRIPTION
SCSI-2:		–
5C	00	RPL STATUS CHANGE
5C	01	SPINDLES SYNCHRONIZED
5C	02	SPINDLES NOT SYNCHRONIZED
PROPOSED:		
5C	00	RPL STATUS CHANGE OR ERROR
5C	01	SPINDLE HAS SYNCHRONIZED
5C	02	SPINDLE HAS LOST SYNCHRONIZATION DUE TO A LOSS OF THE SYNCHRONIZATION SIGNAL
5C	03	SPINDLE IS NOT SYNCHRONIZED BECAUSE OF AN INTERNAL PROBLEM (THE REFERENCE SIGNAL IS BEING RECEIVED)
5D	00	SELECTION OF A MASTER/MASTER CONTROL ATTEMPTED WHEN A REFERENCE SIGNAL IS ALREADY BEING RECEIVED

Section 8.3.3.7 Rigid Disk Drive Geometry Page

(additions are underlined)

Page Code 04h:

SCSI-2:

Bit Byte	7	6	5	4	3	2	1	0
17	Reserved						RPL	

Proposed:

Bit Byte	7	6	5	4	3	2	1	0
17	Reserved				Synchronization Status		RPL	

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The Synchronization Status field is used to report whether or not the spindle has synchronized with the reference signal or to report that the synchronization is in progress. The definitions of values in this field are shown in Table 172.

Table 172: Synchronization Status

Synchronization Status	Description
00b	Synchronization status reporting is not supported or the status cannot be determined
01b	Spindle is synchronized with the reference signal
10b	Spindle cannot synchronize with the reference signal or no reference signal is present
11b	Spindle is in process of synchronizing with the reference signal

If the drive has not been selected as a master, master control, or slave or if the reporting of synchronous status is not supported, the synchronous status shall be set to 00b.

If no reference signal is being received but the drive is currently set up as a master, slave, or master control, the synchronization status will be set to 10b.

Once the reference signal is received, the drive controller will begin its internal synchronization, attempting to match the drive's spindle speed to the reference signal. During this time, the synchronization status shall be set to 11b. The amount of time required for the synchronization will likely vary with drive type.

If the drive is unable to synchronize to the reference signal, the drive shall change the synchronization status to 10b. The sense key shall be set to UNIT ATTENTION, the additional sense code will be set to RPL STATUS CHANGE OR ERROR and the additional sense code qualifier will be set to SPINDLE IS NOT SYNCHRONIZED BECAUSE OF AN INTERNAL PROBLEM (THE REFERENCE SIGNAL IS BEING RECEIVED).

Once the target successfully synchronizes to the reference signal, if the drive loses synchronization due to a loss of the reference signal or a controller/drive malfunction, unit attentions will be generated for all initiators and the synchronization status will be set to 10b. The sense key shall be set to UNIT ATTENTION. If the target has successfully achieved synchronization and then loses synchronization while executing an I/O process and no other error occurs, then the target shall return CHECK CONDITION status. The sense key shall be set to RECOVERED ERROR if the target is able to complete the I/O process or HARDWARE ERROR if the target is unable to complete the I/O process. The additional sense code is set to RPL STATUS CHANGE OR ERROR for these cases. The additional sense code qualifier will be set to SPINDLE IS NOT SYNCHRONIZED BECAUSE OF AN INTERNAL PROBLEM (THE REFERENCE SIGNAL IS BEING RECEIVED) or SPINDLE HAS LOST SYNCHRONIZATION DUE TO A LOSS OF THE SYNCHRONIZATION SIGNAL.

The rotational position locking (RPL) field is used for spindle synchronization as defined in Table 173. See Appendix K of the Enhanced Small Device Interface (ANSI X3.170A-1991) for further information on synchronized spindles.

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Table 173: Rotational Position Locking

RPL	Description
00b	Indicates that spindle synchronization is disabled or not supported
01b	The target operates as a synchronized-spindle slave
10b	The target operates as a synchronized-spindle master
11b	The target operates as a synchronized-spindle master control

IMPLEMENTORS NOTE: The signals and connectors used for rotational position locking are external to the SCSI bus and are not part of this standard.

If a drive is selected as a master or master control and a reference signal is already being received (another drive has already been selected as a master/master control), the target will terminate the MODE SELECT command with CHECK CONDITION status, set the sense key to ILLEGAL REQUEST, and set the additional sense code to SELECTION OF A MASTER/MASTER CONTROL ATTEMPTED WHEN A REFERENCE SIGNAL IS ALREADY BEING RECEIVED.

The rotational offset indicates the amount of rotational skew that the target shall use when synchronized. The rotational skew is applied in the retarded direction (lagging the synchronized spindle master control). The value in the field is the numerator of a fractional multiplier that has 256 as its denominator (e.g., a value of 128 indicates a one-half revolution skew). A value of zero indicates that rotational offset shall not be used. This value may be rounded as defined in 6.5.4. The rotational offset is not used when a target is configured as synchronized-spindle master.

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STATE DIAGRAM:

IN PROCESS OF
SYNCHRONIZING

STATE = 11b

reference signal
received

internal sync
problem

5C/03

5C/01

spindle sync'd to
reference signal

NOT
IN SYNC

STATE = 10b

no reference signal

internal sync
problem

5C/02

IN SYNC

STATE = 01b

loss of sync pulse

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