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To: **T10 SAS Protocol Working Group**
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Subject: SAS-1.1, SAS phy test functions diagnostic page

Introduction

There has been much discussion about providing a standard method for invoking specific phy diagnostic test functions for SAS phys, particularly how to enable a SAS phy to send CJTPAT continuously. The following is an attempt to provide a method using a new diagnostic page for the SEND DIAGNOSTICS command. Though other patterns may be defined in the future, this proposal is strictly limited to defining how a SAS initiator port may send a command to a SAS target device in order to enable (and disable) a specified SAS phy in the SAS target device to send CJTPAT continuously.

This proposal is based on SBC-2r12 and SAS1r04.

Changes for SBC-2:

6.1.1 Diagnostic parameters overview
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Table 80 — Diagnostic page codes

Code	Description	Reference
00h	Supported diagnostic pages	SPC-3
01h - 1Fh	SCSI enclosure services diagnostic pages	SES-2
20h - 3Fh	Diagnostic pages assigned by SPC-3	SPC-3
40h	Translate Address Output diagnostic page	6.1.2
40h	Translate Address Input diagnostic page	6.1.3
41h	Device Status Output diagnostic page	6.1.4
41h	Device Status Input diagnostic page	6.1.5
42h - 76Fh	Reserved for this standard	
70h - 7Fh	Reserved for SAS-1.1	SAS-1.1
80h - FFh	Vendor-specific diagnostic pages	

Changes for SAS 1.1:

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4.7 Phy diagnostic testing model

The optional SAS Phy Test Functions diagnostic page (see 10.2.10.2) provides a method for an application client to enable and disable transmission of CJTPAT (see Annex A) by a selected phy in a SAS target device.

The application client sends a SEND DIAGNOSTIC command followed by a SAS Phy Test Functions diagnostic page to a SAS target device containing a SAS phy that is to start or stop transmitting CJTPAT. The SAS Phy Test Functions diagnostic page specifies the SAS phy in the SAS target device that is to start or stop transmitting CJTPAT and the rate at which the SAS phy is to transmit CJTPAT. The SEND DIAGNOSTIC command may be sent to any SSP target port in a SAS target device that contains the SAS phy that is to start or stop transmitting CJTPAT.

The SAS target device receives the COMMAND frame containing the SEND DIAGNOSTIC command and the DATA frame containing the SAS Phy Test Functions diagnostic page. The SAS target device sends a RESPONSE frame for the COMMAND frame. If there were no errors in the COMMAND or DATA frames, and the SAS target device receives an ACK for the RESPONSE frame, then the SAS phy specified in the SAS Phy Test Functions diagnostic page starts or stops transmitting CJTPAT.

If the SAS phy is not transmitting CJTPAT and the SAS Phy Test Functions diagnostic page specifies that the SAS phy is to begin transmitting CJTPAT, then the SAS phy specified in the SAS Phy Test Functions diagnostic page transitions to transmitting CJTPAT. If the SAS phy is transmitting CJTPAT and the SAS Phy Test Functions diagnostic page specifies that the SAS phy is to stop transmitting CJTPAT, then the SAS phy specified in the SAS Phy Test Functions diagnostic page transitions from transmitting CJTPAT to initiating a phy reset sequence.

Once a SAS phy has begun to transmit CJTPAT, it ignores its receiver. To stop the SAS phy from transmitting CJTPAT, an application client sends a SEND DIAGNOSTIC command to a SAS phy in the SAS target device that is not transmitting CJTPAT, or the application client causes a power on reset to occur.

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10.2.10 SCSI diagnostic parameters

10.2.10.1 SCSI diagnostic parameters overview

This subclause defines the descriptors and pages for diagnostic parameters used with SSP devices. Table w defines the diagnostic page codes for SSP devices.

Table w — SAS diagnostic page codes

Code	Description	Reference
00h	Supported diagnostic pages	SPC-3
01h - 1Fh	SCSI enclosure services diagnostic pages	SES-2
20h - 3Fh	Diagnostic pages assigned by SPC-3	SPC-3
40h - 6Fh	Diagnostic pages assigned by SBC-2	SBC-2
70h	SAS Phy Test Functions diagnostic page	10.2.10.2
71h - 7Fh	Reserved for this standard	
80h - FFh	Vendor-specific diagnostic pages	

10.2.10.2 SAS Phy Test Functions diagnostic page

Table x defines the SAS Phy Test Functions diagnostic page.

Table x — SAS Phy Test Functions diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (70h)							
1	Reserved							
2	(MSB)			PAGE LENGTH (000Ch)				
3								(LSB)
4	PHY IDENTIFIER							
5	Reserved							
6	Reserved							TX TEST PATTERN
7	TEST PATTERN				TEST PATTERN RATE			
8	Reserved							
15								

The PHY IDENTIFIER field specifies the phy identifier (see 4.2.7) of the phy in the SAS phy that is to perform or to stop performing a diagnostic test function (i.e., the selected phy). If the PHY IDENTIFIER field specifies a SAS phy that does not exist in the SAS target device, then the device server shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the TX TEST PATTERN bit is set to one and the selected phy is not performing a diagnostic test function, then the selected phy shall be set to transmit the test pattern specified by the TEST PATTERN field at the physical link rate specified by the TEST PATTERN RATE field and set to ignore its receiver. If the TX TEST PATTERN bit is set to one and the selected phy is transmitting the specified test pattern, then the device server shall terminate the SEND DIAGNOSTIC command.

If the TX TEST PATTERN bit is set to zero and the selected phy is performing a diagnostic test function, then the selected phy shall be set to stop performing the test function and originate a link reset sequence. If the TX TEST PATTERN bit is set to zero and the selected phy is not performing a diagnostic test function, then the device server shall terminate the SEND DIAGNOSTIC command.

> NOTE x - If there is no SSP target port available to receive a SEND DIAGNOSTIC command to stop a selected phy from performing a diagnostic test function, then a power on reset may be required to cause the selected phy to stop performing the function and originate a phy reset sequence.

Table y defines the TEST PATTERN field.

Table y — TEST PATTERN field

Code	Description
0h	Reserved
1h	The selected phy shall transmit CJTPAT (see Annex A). The SAS target port containing the selected phy may include other valid dwords in the CJTPAT transmission (e.g., ALIGN primitives may be transmitted in order to maintain internal synchronization). If the selected phy receives data while transmitting CJTPAT, then the selected phy shall ignore the received data.
2h - Fh	Reserved

The TEST PATTERN RATE field specifies the physical link rate at which the test pattern shall be transmitted. If the physical link rate specified by the TEST PATTERN RATE field is less than the hardware minimum physical link rate or greater than the hardware maximum physical link rate, then the device server shall terminate the SEND DIAGNOSTIC command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

Table z defines the TEST PATTERN RATE field.

Table z — TEST PATTERN RATE field

Code	Description
0h - 7h	Reserved
8h	1,5 Gbps
9h	3,0 Gbps
Ah - Fh	Reserved

The selected phy shall begin to perform or stop performing the diagnostic test function after:

1) the SAS target device received a COMMAND frame containing the SEND DIAGNOSTIC command and the DATA frame containing the SAS Phy Test Functions diagnostic page with no errors,
2) the SAS target port has sent a RESPONSE frame for the SEND DIAGNOSTIC command; and
3) the SAS target port has received acknowledgement that the SAS initiator port has received the RESPONSE frame for the SEND DIAGNOSTIC command (i.e., the SAS target port received an ACK for the RESPONSE frame from the SAS initiator port).