SERIAL ATTACHED SCSI (SAS) CONSORTIUM

Clause 8
SAS SPL Transport Layer Test Suite
Version 1.14

Technical Document

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MODIFICATION RECORD

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David Woolf: Initial draft release

[2]April 14, 2005 (Version 0.12) DRAFT RELEASE
David Woolf: added STP Operations tests

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Leon Cyril: added discussion for all tests.

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David Woolf: fixed 'Purpose' sections of Tests 9.1.9 – 9.1.12

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Leon Cyril	UNH InterOperability Laboratory (UNH-IOL)
Michael Davidson	UNH InterOperability Laboratory (UNH-IOL)
Kurtis Kofler	UNH InterOperability Laboratory (UNH-IOL)
David Woolf	UNH InterOperability Laboratory (UNH-IOL)

INTRODUCTION

The University of New Hampshire's InterOperability Laboratory (IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. This particular suite of tests has been developed in junction with CATC to help implementers evaluate the functionality of their Serial Attached SCSI (SAS) products. Specifically this Test Suite is directed at verifying the Transport layer of SAS Targets and Initiators.

These tests are designed to determine if a SAS product conforms to specifications defined in **ISO/IEC 14776-150, *Serial Attached SCSI (SAS) standard* T10/1562-D, Revision 5** (hereafter referred to as the "SAS SPL"). Successful completion of all tests contained in this suite does not guarantee that the tested device will successfully operate with other SAS products. However, when combined with satisfactory operation in the IOL's interoperability test bed, these tests provide a reasonable level of confidence that the Device Under Test (DUT) will function properly in many SAS environments.

The tests contained in this document are organized in order to simplify the identification of information related to a test, and to facilitate in the actual testing process. Tests are separated into groups, primarily in order to reduce setup time in the lab environment, however the different groups typically also tend to focus on specific aspects of device functionality. A three-number, dot-notated naming system is used to catalog the tests, where the first number always indicates the specific clause of the reference standard on which the test suite is based. The second and third numbers indicate the test's group number and test number within that group, respectively. This format allows for the addition of future tests in the appropriate groups without requiring the renumbering of the subsequent tests.

The test definitions themselves are intended to provide a high-level description of the motivation, resources, procedures, and methodologies specific to each test. Formally, each test description contains the following sections:

Purpose

The purpose is a brief statement outlining what the test attempts to achieve. The test is written at the functional level.

References

This section specifies all reference material *external* to the test suite, including the specific subclauses references for the test in question, and any other references that might be helpful in understanding the test methodology and/or test results. External sources are always referenced by a bracketed number (e.g., [1]) when mentioned in the test description. Any other references in the test description that are not indicated in this manner refer to elements within the test suite document itself (e.g., "Appendix 5.A", or "Table 5.1.1-1")

Resource Requirements

The requirements section specifies the test hardware and/or software needed to perform the test. This is generally expressed in terms of minimum requirements, however in some cases specific equipment manufacturer/model information may be provided.

Last Modification

This specifies the date of the last modification to this test.

Test Setup

The setup section describes the initial configuration of the test environment. Small changes in the configuration should not be included here, and are generally covered in the test procedure section (next).

Procedure

The procedure section of the test description contains the systematic instructions for carrying out the test. It provides a cookbook approach to testing, and may be interspersed with observable results.

Observable Results

This section lists the specific observables that can be examined by the tester in order to verify that the DUT is operating properly. When multiple values for an observable are possible, this section provides a short discussion on how to interpret them. The determination of a pass or fail outcome for a particular test is generally based on the successful (or unsuccessful) detection of a specific observable.

Possible Problems

This section contains a description of known issues with the test procedure, which may affect test results in certain situations. It may also refer the reader to test suite appendices and/or other external sources that may provide more detail regarding these issues.

REFERENCES

The following document is referenced in this text:

[1] T10/Project 2124-D/Rev 7 – Information Technology SAS Protocol Layer – (SAS SPL)

GROUP 1: TRANSPORT LAYER TESTS FOR TARGETS

Overview:

This group of tests verifies the Transport Layer specifications of the SAS protocol defined in Clause 8 of the SAS SPL, for Targets.

Test 8.1.1 - SSP FRAMES STRUCTURE – HASHED ADDRESS

Purpose: To determine that the DUT properly calculated a hashed destination SAS address based on the sas address provided in a received Identify Frame.

References:
[1] 4.2.5 SAS SPL
[2] Annex C SAS SPL
[3] Annex D SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. SAS Target.

Last Modification: August 8, 2011

Discussion: SSP frames include a hashed version of the SAS address to provide an additional level of verification of proper frame routing. The code used for the hashing algorithm is a cyclic binary Bose, Chaudhuri, and Hocquenghem (BCH) (63, 39, 9) code.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is an initiator. The SAS address provided in the Identify Frame should be 7FFFFFFFFFFFFFFFh.
2. The Testing Station is instructed to open an SSP connection to the DUT.
3. Wait for the DUT to transmit OPEN_ACCEPT and RRDY. The Testing Station is instructed to transmit a SCSI INQUIRY command to the DUT, then close the connection.
4. Wait for the DUT to open an SSP connection to the Testing Station. Allow the DUT to transmit a SCSI Response to the Testing Station.

Observable Results: In each case verify that the DUT transmitted an SSP frame (command or response) with a hashed destination SAS address of 000000h.

Possible Problems: None

Test 8.1.2 - SSP FRAMES STRUCTURE – INFORMATION UNIT

Purpose: To determine that the DUT does not transmit an SSP frame with an Information Unit exceeding 1024 bytes.

References:
[1] 8.2.1 SAS SPL
[2] Table 117 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. SAS Target.

Last Modification: August 8, 2011

Discussion: [2] defines the SSP frame format. The INFORMATION UNIT field contains the information unit, the format of which is defined by the FRAME TYPE field. The maximum size of the INFORMATION UNIT field is 1 024 bytes, making the maximum size of the frame 1052 bytes (1024 bytes of data + 24 bytes of header + 4 bytes of CRC).

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is an initiator.
2. The Testing Station is instructed to open an SSP connection to the DUT. The Testing Station is instructed to transmit a Test Unit Ready command to the DUT, then close the connection.
3. Wait for the DUT to open an SSP connection to the Testing Station. Allow the DUT to transmit a SCSI Response to the Testing Station. The Testing Station is instructed to repeat this 100 times.

Observable Results: If the DUT is an initiator, verify that the Information Unit in the SSP Command frame is between 28 and 284 bytes long. If the DUT is a target, verify that the Information Unit in the SSP Response frame is between 24 and 1024 bytes long.

Possible Problems: None

Test 8.1.3 - SSP FRAMES STRUCTURE – NUMBER OF FILL BYTES

Purpose: To determine that the DUT properly sets the NUMBER OF FILL BYTES field.

References:
[1] 8.2.1 SAS SPL
[2] 8.2.2.4 SAS SPL
[3] 8.2.2.5 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: Table 117 defines the SSP frame format. The NUMBER OF FILL BYTES field specifies the number of fill bytes between the INFORMATION UNIT field and the CRC field. The NUMBER OF FILL BYTES field shall be set to zero for all frame types except DATA frames as specified in [2] and RESPONSE frames as specified in [3].

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is an initiator.
2. The Testing Station is instructed to open an SSP connection to the DUT. The Testing Station is instructed to transmit a READ command to the DUT.
3. Wait for the DUT to open an SSP connection to the Testing Station. Allow the DUT to transmit DATA and SCSI Response to the Testing Station.

Observable Results: If the DUT is a target, verify that the NUMBER OF FILL BYTES field in the SSP Response frame is set to 0.

Possible Problems: None

Test 8.1.4 - SSP COMMAND IU – TAG

Purpose: To determine that the DUT properly sets the TAG field.

References:
[1] 8.2.1 SAS SPL
[2] 6.13 SAS SPL
[3] 9.2.1 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. SAS Target with 2 LUNs within the same SSP Target Port. If the DUT is an initiator, it will need to have software capable of generating SCSI traffic.

Last Modification: August 8, 2011

Discussion: Table 117 defines the SSP frame format. The TAG field contains a value that allows the SSP initiator port to establish a context for commands and task management functions. For COMMAND frames and TASK frames, the SSP initiator port shall set the TAG field to a value that is unique for the I_T nexus established by the connection (see 6.13). An SSP initiator port shall not reuse the same tag when transmitting COMMAND frames or TASK frames to different LUNs in the same SSP target port. An SSP initiator port may reuse a tag when transmitting frames to different SSP target ports. The TAG field in a COMMAND frame contains the task tag defined in SAM-3. The TAG field in a TASK frame does not correspond to a SAM-3 task tag, but corresponds to an SAM-3 association (see 9.2.1). The tag space used in the TAG fields is shared across COMMAND frames and TASK frames (e.g., if a tag is used for a COMMAND frame, it is not also used for a concurrent TASK frame).

Test Setup: The DUT and the Testing Station are physically connected. The DUT is not powered on.

Test Procedure:
1. Power on the DUT.
2. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is an initiator.
3. The Testing Station is instructed to open an SSP connection to the DUT. The Testing Station is instructed to transmit a READ command to the DUT.
4. Wait for the DUT to open an SSP connection to the Testing Station. Allow the DUT to transmit DATA and SCSI Response to the Testing Station.
5. The Testing Station is instructed to open an SSP connection to the DUT. The Testing Station is instructed to transmit a WRITE command to the DUT.
6. Wait for the DUT to open an SSP connection to the Testing Station. Allow the DUT to transmit XFER_RDY, then The Testing Station is instructed to transmit a SSP DATA frame. Allow the DUT to transmit a SCSI Response to the Testing Station.

Observable Results: If the DUT is a target, verify that the TAG in the XFER_RDY, DATA and RESPONSE frames matched the TAG of the COMMAND frames which they corresponded to.

Possible Problems: None

Test 8.1.5 - SSP COMMAND IU – TARGET PORT TRANSFER TAG

Purpose: To determine that the DUT properly sets the TARGET PORT TRANSFER TAG field.

References:
[1] 8.2.1 SAS SPL
[2] Table 117 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. SAS Target with 2 LUNs within the same SSP Target Port. If the DUT is an initiator, it will need to have software capable of generating SCSI traffic.

Last Modification: August 8, 2011

Discussion: [2] defines the SSP frame format. The TARGET PORT TRANSFER TAG field provides an optional method for an SSP target port to establish the write data context when receiving a write DATA frame (i.e., determine the command to which the write data corresponds). Unlike the TAG field, which was assigned by the SSP initiator port, the TARGET PORT TRANSFER TAG field in a write DATA frame contains a value assigned by the SSP target port that was delivered to the SSP initiator port in the XFER_RDY frame requesting the write data.

Test Setup: The DUT and the Testing Station are physically connected. The DUT is not powered on.

Test Procedure:
1. Power on the DUT.
2. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is an initiator.
3. The Testing Station is instructed to open an SSP connection to the DUT. The Testing Station is instructed to transmit a WRITE BUFFER command to the DUT.
4. Wait for the DUT to open an SSP connection to the Testing Station. Allow the DUT to transmit XFER_RDY, then The Testing Station is instructed to transmit a SSP DATA frame. Allow the DUT to transmit a SCSI Response to the Testing Station.
5. The Testing Station is instructed to open a second SSP connection to the DUT. The Testing Station is instructed to transmit a WRITE BUFFER command to the DUT do a different LUN than the first WRITE_BUFFER command .
6. Wait for the DUT to open an SSP connection to the Testing Station. Allow the DUT to transmit XFER_RDY, then The Testing Station is instructed to transmit a SSP DATA frame. Allow the DUT to transmit a SCSI Response to the Testing Station.

Observable Results: SSP Targets have the option of setting the TARGET PORT TRANSFER TAG field to any value when transmitting a frame. In an XFER_RDY frame the Target Port Transfer Tag should be unique for the L_Q portion of the I_T_L_Q nexus.

Possible Problems: None

Test 8.1.6 - SSP DATA IU – NUMBER OF FILL BYTES NON-ZERO

Purpose: To determine that the DUT, an SSP Target port, properly sets the NUMBER OF FILL BYTES field when transmitting DATA frames.

References:
[1] 8.2.2.4 SAS SPL
[2] 8.2.1 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: An SSP target port shall set the NUMBER OF FILL BYTES field to zero in the frame header [2] in all read DATA frames for a command except the last read DATA frame for that command. The SSP target port may set the NUMBER OF FILL BYTES field to a non-zero value in the last read DATA frame for a command (i.e., only the last read DATA frame for a command may contain data with a length that is not a multiple of four).

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
2. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI READ or READ_BUFFER command for 1539 bytes. Close the connection
3. Allow the DUT to open an SSP connection to the Testing Station and transmit DATA frames and a SCSI response frame to the received command.

Observable Results: Verify that if the DUT sets the NUMBER OF FILL BYTES field to a non-zero value in a DATA frame, the DUT does not transmit any further DATA frames for that command.

Possible Problems: None

Test 8.1.7 - SSP DATA IU – NUMBER OF FILL BYTES ZERO

Purpose: To determine that the DUT, an SSP Target port, properly sets the NUMBER OF FILL BYTES field when transmitting DATA frames.

References:
[1] 8.2.2.4 SAS SPL
[2] 8.2.1 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: An SSP target port shall set the NUMBER OF FILL BYTES field to zero in the frame header [2] in all read DATA frames for a command except the last read DATA frame for that command. The SSP target port may set the NUMBER OF FILL BYTES field to a non-zero value in the last read DATA frame for a command (i.e., only the last read DATA frame for a command may contain data with a length that is not a multiple of four).

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
2. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI READ or READ_BUFFER command for 1539 bytes. Close the connection
3. Allow the DUT to open an SSP connection to the Testing Station and transmit DATA frames and a SCSI response frame to the received command.

Observable Results: Verify that if the DUT sets the NUMBER OF FILL BYTES field to zero in a DATA frame, the DUT continues to transmit DATA frames for that command.

Possible Problems: None

Test 8.1.8 - SSP DATA IU – DATA OFFSET

Purpose: To determine that the DUT, an SSP Target port, properly sets the DATA OFFSET field when transmitting DATA frames.

References:
[1] 8.2.2.4 SAS SPL
[2] 8.2.1 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: The DATA OFFSET field in the frame header [2] contains the application client buffer offset as described by SAM-3. The data offset shall be a multiple of four (i.e., each DATA frame shall transfer data beginning on a dword boundary). The initial read DATA frame for a given command shall set the DATA OFFSET field to zero. If any additional read DATA frames are required, the DATA OFFSET field shall be set to the value of the previous read DATA frame's data offset plus the previous read DATA frame's data length. The initial write DATA frame for a given command shall set the DATA OFFSET field to zero. If any additional write DATA frames are required, the DATA OFFSET field shall be set to the value of the previous write DATA frame's data offset plus the previous write DATA frame's data length.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
2. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI READ_BUFFER command for 3836 bytes. Close the connection
3. Allow the DUT to open an SSP connection to the Testing Station and transmit DATA frames and a SCSI response frame to the received command.

Observable Results: Verify that if the DUT sets the DATA OFFSET field to zero in the first DATA frame, then sets the DATA OFFSET field in subsequent DATA frames to the value of the previous frames DATA OFFSET field plus the data length of the previous frame.

Possible Problems: None

Test 8.1.9 - SSP XFER_RDY IU – REQUESTED OFFSET

Purpose: To determine that the DUT, an SSP Target port, properly sets the REQUESTED OFFSET field when transmitting XFER_RDY frames.

References:
[1] 8.2.2.3 SAS SPL
[2] 9.2.7.2.1 SAS SPL
[3] 8.2.2.1 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: The REQUESTED OFFSET field contains the application client buffer offset of the segment of write data the SSP initiator port may transmit to the logical unit (using DATA frames). The requested offset shall be a multiple of four (i.e., each DATA frame shall begin transferring data on a dword boundary). The REQUESTED OFFSET field shall be zero for the first XFER_RDY frame of a command unless:

- the ENABLE FIRST BURST field in the COMMAND frame [3] was set to one; and
- the FIRST BURST SIZE field in the Disconnect-Reconnect mode page [2] is not set to zero.
- If the ENABLE FIRST BURST field in the COMMAND frame [3] was set to one, then in the initial XFER_RDY frame for the command, the SSP target port shall set the REQUESTED OFFSET field to the value indicated by the FIRST BURST SIZE field in the Disconnect-Reconnect mode page [2]. If any additional XFER_RDY frames are required, the REQUESTED OFFSET field shall be set to the value of the previous XFER_RDY frame's REQUESTED OFFSET field plus the value of the previous XFER_RDY frame's WRITE DATA LENGTH field.

Test Setup: The DUT and the Testing Station are physically connected. The DUT is not powered on.

Test Procedure:

1. Power on the DUT.
2. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
3. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI MODE SENSE command for the Disconnect-Reconnect Mode Page. Close the connection
4. Allow the DUT to open an SSP connection to the Testing Station and transmit DATA frame with the Mode Page Block Descriptor and a SCSI response frame to the received MODE SENSE command.
5. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI WRITE command for 2048 bytes. Close the connection
6. Allow the DUT to open an SSP connection to the Testing Station and transmit XFER_RDY, DATA, SCSI response frame to the received command.

Observable Results: Verify that the DUT sets the REQUESTED OFFSET field to zero in the first XFER_RDY frame unless the First Burst Size field in the Disconnect Reconnect Mode Page is not zero. If the First Burst Size field in the Disconnect Reconnect Mode Page is not zero then the REQUESTED OFFSET field should be set to 512 times the value in the First Burst Size field.

Possible Problems: None

Test 8.1.10 - SSP XFER_RDY IU – REQUESTED OFFSET LARGE TRANSFER

Purpose: To determine that the DUT, an SSP Target port, properly sets the REQUESTED OFFSET field when transmitting multiple XFER_RDY frames.

References:
[1] 8.2.2.3 SAS SPL
[2] 9.2.7.2.1 SAS SPL
[3] 8.2.2.1 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: The REQUESTED OFFSET field contains the application client buffer offset of the segment of write data the SSP initiator port may transmit to the logical unit (using DATA frames). The requested offset shall be a multiple of four (i.e., each DATA frame shall begin transferring data on a dword boundary). The REQUESTED OFFSET field shall be zero for the first XFER_RDY frame of a command unless:
a) the ENABLE FIRST BURST field in the COMMAND frame [3] was set to one; and
b) the FIRST BURST SIZE field in the Disconnect-Reconnect mode page [2] is not set to zero.
If the ENABLE FIRST BURST field in the COMMAND frame [3] was set to one, then in the initial XFER_RDY frame for the command, the SSP target port shall set the REQUESTED OFFSET field to the value indicated by the FIRST BURST SIZE field in the Disconnect-Reconnect mode page [2]. If any additional XFER_RDY frames are required, the REQUESTED OFFSET field shall be set to the value of the previous XFER_RDY frame's REQUESTED OFFSET field plus the value of the previous XFER_RDY frame's WRITE DATA LENGTH field.

Test Setup: The DUT and the Testing Station are physically connected. The DUT is not powered on.

Test Procedure:
1. Power on the DUT.
2. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
3. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI WRITE command for 65536 bytes. Close the connection
4. Allow the DUT to open an SSP connection to the Testing Station and transmit XFER_RDY, SCSI response frame to the received command.

Observable Results: Verify that for each XFER_RDY frame, the DUT sets the REQUESTED OFFSET field to the REQUESTED OFFSET value of the previous XFER_RDY frame plus the WRITE DATA LENGTH field of the previous XFER_RDY frame.

Possible Problems: None

Test 8.1.11 - SSP XFER_RDY IU – MAXIMUM BURST SIZE

Purpose: To determine that the DUT, an SSP Target port, properly sets the WRITE DATA LENGTH field when transmitting XFER_RDY frames.

References:
[1] 8.2.2.3 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: The WRITE DATA LENGTH field contains the number of bytes of write data the SSP initiator port may transmit to the logical unit (using DATA frames) from the application client buffer starting at the requested offset. The SSP target port shall set the WRITE DATA LENGTH field to a value greater than or equal to 00000001h. If the value in the MAXIMUM BURST SIZE field in the Disconnect-Reconnect mode page is not zero, the SSP target port shall set the WRITE DATA LENGTH field to a value less than or equal to the value in the MAXIMUM BURST SIZE field

Test Setup: The DUT and the Testing Station are physically connected. The DUT is not powered on.

Test Procedure:
1. Power on the DUT.
2. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
3. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI MODE SENSE command for the Disconnect-Reconnect Mode Page. Close the connection
4. Allow the DUT to open an SSP connection to the Testing Station and transmit DATA frame with the Mode Page Block Descriptor and a SCSI response frame to the received MODE SENSE command.
5. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI WRITE command for 2048 bytes. Close the connection
6. Allow the DUT to open an SSP connection to the Testing Station and transmit XFER_RDY, DATA, and SCSI response frame to the received command.

Observable Results: Verify that the DUT sets the WRITE DATA LENGTH field to a value less than or equal to the value in the MAXIMUM BURST SIZE field in the Disconnect Reconnect Mode Page. If the DUT sets MAXIMUM BURST SIZE to Zero, this would indicate that it can accept any WRITE DATA LENGTH, and this item is not testable.

Possible Problems: None

Test 8.1.12 - SSP XFER_RDY IU – WRITE DATA LENGTH

Purpose: To determine that the DUT, an SSP Target port, properly sets the WRITE DATA LENGTH field when transmitting XFER_RDY frames.

References:
[1] 8.2.2.3 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: If an SSP target port transmits a XFER_RDY frame containing a WRITE DATA LENGTH field that is not divisible by four, the SSP target port shall not transmit any subsequent XFER_RDY frames for that command (i.e., only the last XFER_RDY for a command may request a non-dword multiple write data length).

Test Setup: The DUT and the Testing Station are physically connected. The DUT is not powered on.

Test Procedure:
1. Power on the DUT.
2. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
3. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI MODE SENSE command for the Disconnect-Reconnect Mode Page. Close the connection
4. Allow the DUT to open an SSP connection to the Testing Station and transmit DATA frame with the Mode Page Block Descriptor and a SCSI response frame to the received MODE SENSE command.
5. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI WRITE_BUFFER command for 2051 bytes. Close the connection
6. Allow the DUT to open an SSP connection to the Testing Station and transmit XFER_RDY, DATA, SCSI response frame to the received command.

Observable Results: Verify that if the DUT sets the WRITE DATA LENGTH field not a value that is not divisible by four, that this is the last XFER_RDY frame for a command.

Possible Problems: None

Test 8.1.13 - SSP RESPONSE IU – NO DATA PRESENT

Purpose: To determine that the DUT, an SSP Target port, properly sets the DATAPRES field to NO_DATA if a command completes without sense data to return.

References:

[1] 8.2.2.5.1 SAS SPL
[2] Table 126SAS SPL
[3] 8.2.1 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: [2] defines the response IU. The RESPONSE frame is sent by an SSP target port to deliver SCSI status (e.g., GOOD or CHECK CONDITION) and sense data, or to deliver SSP-specific status (e.g., illegal frame format). The maximum size of the RESPONSE frame is the maximum size of any IU in an SSP frame [3]. The SSP target port shall return a RESPONSE frame with the DATAPRES field set to NO_DATA if a command completes without response data or sense data to return.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
2. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI Test Unit Ready command to the DUT. This should not be the first command received by the DUT since power on. Close the connection
3. Allow the DUT to open an SSP connection to the Testing Station and transmit a SCSI response frame to the received command.

Observable Results: Verify that if the DUT sets the DATAPRES field to NO_DATA if the command completes without sense data to return when the command finishes with status GOOD.

Possible Problems: None

Test 8.1.14 - SSP RESPONSE IU – SENSE DATA PRESENT

Purpose: To determine that the DUT, an SSP Target port, properly sets the DATAPRES field to SENSE_DATA if a command completes with sense data to return.

References:

[1] 8.2.2.5.1 SAS SPL
[2] Table 126SAS SPL
[3] 8.2.1 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: [2] defines the response IU. The RESPONSE frame is sent by an SSP target port to deliver SCSI status (e.g., GOOD or CHECK CONDITION) and sense data, or to deliver SSP-specific status (e.g., illegal frame format). The maximum size of the RESPONSE frame is the maximum size of any IU in an SSP frame [3]. The SSP target port shall return a RESPONSE frame with the DATAPRES field set to SENSE_DATA if a command completes with sense data to return (e.g., CHECK CONDITION status).

Test Setup: The DUT and the Testing Station are physically connected. The DUT is not powered on.

Test Procedure:

1. Power on the DUT.
2. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
3. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI Test Unit Ready command to the DUT. This should be the first command received by the DUT since power on. Close the connection
4. Allow the DUT to open an SSP connection to the Testing Station and transmit a SCSI response frame to the received command.

Observable Results: Verify that the DUT sets the DATAPRES field to SENSE_DATA and the command completes with sense data to return when the command finishes with status CHECK CONDITION.

Possible Problems: None

Test 8.1.15 - SSP RESPONSE IU – SENSE/RESPONSE DATA NOT PRESENT

Purpose: To determine that the DUT, an SSP Target port, properly sets the SENSE DATA LENGTH, SENSE DATA, RESPONSE DATA LENGTH, and RESPONSE DATA fields if a command completes without sense data to return.

References:
[1] 8.2.2.5.2 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: If the DATAPRES field is set to NO_DATA, then:
- the SSP target port shall set the STATUS field to the status code for a command that has ended (see SAM-3 for a list of status codes);
- the SSP target port shall set the SENSE DATA LENGTH field to zero and the RESPONSE DATA LENGTH field to zero;
- the SSP target port shall not include the SENSE DATA field and the RESPONSE DATA field.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
2. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI Test Unit Ready command to the DUT. This should not be the first command received by the DUT since power on. Close the connection
3. Allow the DUT to open an SSP connection to the Testing Station and transmit a SCSI response frame to the received command.

Observable Results: Verify that if the DUT sets the DATAPRES field to NO_DATA if the command completes without sense data to return when the command finishes with status GOOD. The SENSE DATA LENGTH and RESPONSE DATA LENGTH fields shall be set to 0. The SENSE DATA and RESPONSE DATA fields should not be present.

Possible Problems: None

Test 8.1.16 - SSP RESPONSE IU –RESPONSE DATA PRESENT

Purpose: To determine that the DUT, an SSP Target port, properly sets the RESPONSE DATA fields if a command completes with response data to return.

References:
[1] 8.2.2.5.3 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: If the DATAPRES field is set to RESPONSE_DATA, then:
- the SSP target port shall set the STATUS field to zero and the SENSE DATA LENGTH field to zero;
- the SSP target port shall not include the SENSE DATA field;
- the SSP target port shall set the RESPONSE DATA LENGTH field to 00000004h. Other lengths are reserved for future standardization; and
- the SSP target port shall include the RESPONSE DATA field.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
2. The Testing Station is instructed to open an SSP connection to the DUT and transmit a TASK MANAGEMENT command with an Invalid LUN.
3. Allow the DUT to open an SSP connection and transmit a SCSI response frame to the received command and data.

Observable Results: Verify that if the DUT sets the DATAPRES field to RESPONSE_DATA. The SENSE DATA LENGTH should be set to zero. The RESPONSE DATA LENGTH field shall be set to 4 and the RESPONSE DATA field should be present.

Possible Problems: None

Test 8.1.17 - SSP ERROR HANDLING – INVALID LENGTH

Purpose: To determine that the DUT, an SSP Target port properly handles a command received which is too short to contain a valid CDB.

References:

[1] 8.2.5.1 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: If an SSP target port receives a COMMAND frame and:

- the frame is too short to contain a LUN field;
- the frame is too short to contain a CDB; or
- the ADDITIONAL CDB LENGTH field specifies that the frame should be a different length,

the ST_TTS state machine returns a RESPONSE frame with the DATAPRES field set to RESPONSE_DATA and the RESPONSE CODE field set to INVALID FRAME. This test verifies that an appropriate RESPONSE frame is sent when a frame is too short to contain a valid CDB.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
2. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI INQUIRY command with a too short CDB. Close the connection
3. Allow the DUT to open an SSP connection and transmit a SCSI response frame to the received command and data.

Observable Results: Verify if the DUT sets the DATAPRES field to RESPONSE_DATA and the RESPONSE CODE field to INVALD FRAME.

Possible Problems: None

Test 8.1.18 - SSP ERROR HANDLING – INVALID LUN

Purpose: To determine that the DUT, an SSP Target port, properly handles a TASK frame received with an invalid LUN.

References:
[1] 8.2.2.2 SAS SPL
[2] 8.2.6.3.2 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: If an SSP target port receives a TASK frame with an unknown logical unit number, the ST_TFR state machine returns a RESPONSE frame with the DATAPRES field set to RESPONSE_DATA and the RESPONSE CODE field set to INVALID LOGICAL UNIT NUMBER [2].

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
2. The Testing Station is instructed to open an SSP connection to the DUT and transmit a TASK frame of function LOGICAL UNIT RESET with an invalid LUN. Close the connection
3. Allow the DUT to open an SSP connection and transmit a SCSI response frame to the received TASK frame.

Observable Results: Verify that the DUT sets the DATAPRES field to RESPONSE_DATA and the RESPONSE CODE field to INVALD LOGICAL UNIT.

Possible Problems: None

Test 8.1.19 - SSP ERROR HANDLING – NO ACK/NAK RECEIVED

Purpose: To determine that the DUT, an SSP Target port, responds properly when no acknowledgement is received for a transmitted RESPONSE frame.

References:

[1] 8.2.4.7 SAS SPL
[2] 6.17.8.6.5 SAS SPL
[3] 8.2.6.3.3 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: If an SSP target port transmits a RESPONSE frame and does not receive an ACK or NAK for that frame (e.g., times out, or the connection is broken):

1. the SSP_TF state machine closes the connection with DONE (ACK/NAK TIMEOUT) [2];and
2. the ST_TTS state machine retransmits, in a new connection, the RESPONSE frame with the RETRANSMIT bit set to one [3].

Test Setup: The DUT and the Testing Station are physically connected. The DUT is not powered on.

Test Procedure:

1. Power on the DUT.
2. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
3. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI WRITE command for 1024 bytes. Close the connection
4. Allow the DUT to open an SSP connection to the Testing Station and transmit XFER_RDY.
5. The Testing Station is instructed to open a connection to the DUT and transmit 2 512 byte data frames. Close the connection.
6. Allow the DUT to open an SSP connection and transmit a SCSI RESPONSE frame to the received command and data. The Testing Station is instructed to not transmit ACK or NAK to the RESPONSE frame.

Observable Results: Verify that if the DUT retransmits the RESPONSE frame with the RETRANSMIT bit set to 1.

Possible Problems: None

Test 8.1.20 - SSP ERROR HANDLING – UNKNOWN TAG

Purpose: To determine that the DUT, an SSP Target port, responds properly when a DATA frame is received with an unknown tag.

References:
[1] 8.2.5.1 SAS SPL
[2] 8.2.6.3.2 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: If the frame type is DATA, and the tag does not match a tag for an outstanding command performing write operations, then this state machine shall discard the frame. If the frame type is DATA, and the tag matches a tag for an outstanding command performing write operations without first burst data enabled or for which no Transmission Complete (Xfer_Rdy Delivered) message has been received from an ST_TTS state machine, then this state machine shall discard the frame. If the frame type is DATA and a target port transfer tag was assigned in an XFER_RDY frame for the request, then this state machine shall check the target port transfer tag. If the target port transfer tag does not specify a valid state machine, then this state machine shall discard the frame.

Test Setup: The DUT and the Testing Station are physically connected. The DUT is not powered on.

Test Procedure:
1. Power on the DUT.
2. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is a target The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Initiator.
3. The Testing Station is instructed to open an SSP connection to the DUT and transmit a SCSI WRITE command for 1024 bytes. Close the connection
4. Allow the DUT to open an SSP connection to the Testing Station and transmit XFER_RDY.
5. The Testing Station is instructed to open a connection to the DUT and transmit 3 512 byte DATA frames. One of the DATA frames should have a TAG different than the TAG of the WRITE command. Close the connection.
6. Allow the DUT to open an SSP connection and transmit a SCSI RESPONSE frame to the received command and data.

Observable Results: Verify that the DUT transmits RESPONSE frame indicating that the command completed with GOOD status and that the DUT discarded the DATA frame with an unknown TAG.

Possible Problems: None

GROUP 2: TRANSPORT LAYER TESTS FOR INITIATIORS

Overview:

This group of tests verifies the Transport Layer specifications of the SAS protocol defined in Clause 8 of the SAS SPL, for Initiators.

Test 8.2.1 - SSP FRAMES STRUCTURE – HASHED ADDRESS

Purpose: To determine that the DUT properly calculated a hashed destination SAS address based on the sas address provided in a received Identify Frame.

References:
[1] 4.2.5 SAS SPL
[2] Annex C SAS SPL
[3] Annex D SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. SAS Target.

Last Modification: August 8, 2011

Discussion: SSP frames include a hashed version of the SAS address to provide an additional level of verification of proper frame routing. The code used for the hashing algorithm is a cyclic binary Bose, Chaudhuri, and Hocquenghem (BCH) (63, 39, 9) code.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:
1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is an initiator The Testing Station is instructed to transmit an Identify Address frame indicating that it is a target. The SAS address provided in the Identify Frame should be 7FFFFFFFFFFFFFFFh.
2. Wait for the DUT to open an SSP connection to the Testing Station. Allow the DUT to transmit a SCSI Command to the Testing Station.

Observable Results: In each case verify that the DUT transmitted an SSP frame (command or response) with a hashed destination SAS address of 000000h.

Possible Problems: None

Test 8.2.2 - SSP FRAMES STRUCTURE – INFORMATION UNIT

Purpose: To determine that the DUT does not transmit an SSP frame with an Information Unit exceeding 1024 bytes.

References:
[1] 8.2.1 SAS SPL
[2] Table 117 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. SAS Target. If the DUT is a SAS Intiator, software capable of generating SCSI commands.

Last Modification: August 8, 2011

Discussion: Table 117 defines the SSP frame format. The INFORMATION UNIT field contains the information unit, the format of which is defined by the FRAME TYPE field. The maximum size of the INFORMATION UNIT field is 1 024 bytes, making the maximum size of the frame 1052 bytes (1024 bytes of data + 24 bytes of header + 4 bytes of CRC).

Test Setup: The DUT and the Testing Station are physically connected. The SAS Initiator DUT is attached to the SAS Target through a SAS Protocol analyzer.

Test Procedure:
1. Wait for the DUT to open an SSP connection to the attached SAS Target. Allow the DUT to transmit a SCSI commands to the target. The DUT should transmit at least 50 commands.
2. The target should respond to each received command with SCSI Response with status GOOD.

Observable Results: Verify that the Information Unit in the SSP Command frame is between 28 and 284 bytes long.

Possible Problems: None

Test 8.2.3 - SSP FRAMES STRUCTURE – NUMBER OF FILL BYTES

Purpose: To determine that the DUT properly sets the NUMBER OF FILL BYTES field.

References:

[1] 8.2.1 SAS SPL
[2] Table 117 SAS SPL
[3] 8.2.2.4 SAS SPL
[4] 8.2.2.5 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. SAS Target. If the DUT is a SAS Initiator, software capable of generating SCSI commands.

Last Modification: August 8, 2011

Discussion: [2] defines the SSP frame format. The NUMBER OF FILL BYTES field specifies the number of fill bytes between the INFORMATION UNIT field and the CRC field. The NUMBER OF FILL BYTES field shall be set to zero for all frame types except DATA frames as specified in [3] and RESPONSE frames as specified in [4].

Test Setup: The DUT and the Testing Station are physically connected. The SAS Initiator DUT is attached to the SAS Target through a SAS Protocol analyzer.

Test Procedure:

1. Wait for the DUT to open an SSP connection to the attached SAS target. Allow the DUT to transmit a SCSI WRITE command to the Testing Station. The target should respond with XFER_RDY and wait for the DUT to transmit DATA frames.

Observable Results: Verify that the NUMBER OF FILL BYTES field in the SSP Command frame is set to 0.

Possible Problems: None

Test 8.2.4 - SSP COMMAND IU – TAG

Purpose: To determine that the DUT properly sets the TAG field.

References:
[1] 8.2.1 SAS SPL
[2] Table 117 SAS SPL
[3] 6.13 SAS SPL
[4] 9.2.1 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. SAS Target with 2 LUNs within the same SSP Target Port. If the DUT is an initiator, it will need to have software capable of generating SCSI traffic.

Last Modification: August 8, 2011

Discussion: [2] defines the SSP frame format. The TAG field contains a value that allows the SSP initiator port to establish a context for commands and task management functions. For COMMAND frames and TASK frames, the SSP initiator port shall set the TAG field to a value that is unique for the I_T nexus established by the connection [3]. An SSP initiator port shall not reuse the same tag when transmitting COMMAND frames or TASK frames to different LUNs in the same SSP target port. An SSP initiator port may reuse a tag when transmitting frames to different SSP target ports. The TAG field in a COMMAND frame contains the task tag defined in SAM-3. The TAG field in a TASK frame does not correspond to a SAM-3 task tag, but corresponds to an SAM-3 association [4]. The tag space used in the TAG fields is shared across COMMAND frames and TASK frames (e.g., if a tag is used for a COMMAND frame, it is not also used for a concurrent TASK frame).

Test Setup: The DUT and the Testing Station are physically connected. The SAS Initiator DUT is attached to the SAS Target through a SAS Protocol analyzer.

Test Procedure:
1. Allow the DUT to open a connection to the attached SAS Target. Observe commands from the DUT to each LUN on the target.

Observable Results: If the DUT is an initiator, verify that the TAG field is unique for commands to different LUNs on the SSP target port.

Possible Problems: None

Test 8.2.5 - SSP COMMAND IU – TARGET PORT TRANSFER TAG

Purpose: To determine that the DUT properly sets the TARGET PORT TRANSFER TAG field.

References:
[1] 8.2.1 SAS SPL
[2] 8.2.2.4 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. SAS Target with 2 LUNs within the same SSP Target Port. If the DUT is an initiator, it will need to have software capable of generating SCSI traffic.

Last Modification: August 8, 2011

Discussion: SSP initiator ports shall set the TARGET PORT TRANSFER TAG field as follows:

- For each write DATA frame that is sent in response to an XFER_RDY frame, the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to the value that was in the corresponding XFER_RDY frame;
- For each write DATA frame that is sent containing first burst data [2], the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to FFFFh; and
- For frames other than write DATA frames, the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to FFFFh.

Test Setup: The DUT and the Testing Station are physically connected. The SAS Initiator DUT is attached to the SAS Target through a SAS Protocol analyzer.

Test Procedure:

1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is an initiator, the Testing Station is instructed to transmit an Identify Address frame indicating that it is a target.
2. Allow the DUT to open a connection to the Testing Station and transmit a WRITE command. The Testing Station is instructed to transmit XFER_RDY in response, with a Target Port Transfer Tag of 5555h.

Observable Results: If the DUT is an initiator, verify that the TARGET PORT TRANSFER TAG field is the same in all DATA frames as the TARGET PORT TRANSFER TAG offered by the Testing Station in the XFER_RDY frame.

Possible Problems: None

Test 8.2.6 - SSP DATA IU – TPT TAG FIRST BURST DATA

Purpose: To determine that the DUT, a SAS Initiator, properly sets the TARGET PORT TRANSFER TAG field when sending First Burst Data.

References:

[1] 8.2.1 SAS SPL
[2] 8.2.2.4 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. The DUT will need to have software capable of generating SCSI traffic.

Last Modification: August 8, 2011

Discussion: SSP initiator ports shall set the TARGET PORT TRANSFER TAG field as follows:

- For each write DATA frame that is sent in response to an XFER_RDY frame, the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to the value that was in the corresponding XFER_RDY frame;
- For each write DATA frame that is sent containing first burst data (see 8.2.2.4), the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to FFFFh; and
- For frames other than write DATA frames, the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to FFFFh

Test Setup: The DUT and the Testing Station are physically connected. The SAS Initiator DUT is attached to the SAS Target through a SAS Protocol analyzer.

Test Procedure:

1. Allow the DUT to open a connection to the attached SAS target and transmit a WRITE command with First Burst data. The Testing Station is instructed to transmit XFER_RDY in response.

Observable Results: Verify that the TARGET PORT TRANSFER TAG field is set to FFFFh in all First Burst DATA frames sent by the DUT.

Possible Problems: None

Test 8.2.7 - SSP DATA IU – TPT TAG NON-DATA

Purpose: To determine that the DUT, a SAS Initiator, properly sets the TARGET PORT TRANSFER TAG field when sending frames other than DATA frames.

References:
[1] 8.2.1 SAS SPL
[2] 8.2.2.4 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator. The DUT will need to have software capable of generating SCSI traffic.

Last Modification: August 8, 2011

Discussion: SSP initiator ports shall set the TARGET PORT TRANSFER TAG field as follows:

- For each write DATA frame that is sent in response to an XFER_RDY frame, the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to the value that was in the corresponding XFER_RDY frame;
- For each write DATA frame that is sent containing first burst data [2], the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to FFFFh; and
- For frames other than write DATA frames, the SSP initiator port shall set the TARGET PORT TRANSFER TAG field to FFFFh

Test Setup: The DUT and the Testing Station are physically connected. The SAS Initiator DUT is attached to the SAS Target through a SAS Protocol analyzer.

Test Procedure:

1. Allow the DUT to open a connection to the attached SAS Target and transmit a READ command.

Observable Results: Verify that the TARGET PORT TRANSFER TAG field is set to FFFFh in all non-DATA frames sent by the DUT.

Possible Problems: None

Test 8.2.8 - SSP RESPONSE IU – DATAPRES RESERVED

Purpose: To determine that the DUT, an SSP Initiator, properly handles a response frame received with a reserved value in the DATA PRES field.

References:

[1] 6.17.8.7 SAS SPL
[2] 8.2.2.5.1 SAS SPL
[3] Table 126 SAS SPL
[4] 8.2.1 SAS SPL
[5] 8.2.4.2 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: [3] defines the response IU. The RESPONSE frame is sent by an SSP target port to deliver SCSI status (e.g., GOOD or CHECK CONDITION) and sense data, or to deliver SSP-specific status (e.g., illegal frame format). The maximum size of the RESPONSE frame is the maximum size of any IU in an SSP frame [4]. If the DATAPRES field is set to a reserved value, then the SSP initiator port shall discard the RESPONSE frame.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is an initiator The Testing Station is instructed to transmit an Identify Address frame indicating that it is a target.
2. Allow the DUT to open a connection to the Testing Station and transmit an INQUIRY command. Close the connection.
3. The Testing Station is instructed to transmit DATA and RESPONSE to the command from the DUT. The Testing Station is instructed to set the DATAPRES field in the Response frame to 11b, a reserved value.

Observable Results: Verify that the DUT discards the response frame that is received with a reserved value in the DATAPRES field. The DUT should ACK this frame. The DUT should retry the INQUIRY command.

Possible Problems: To determine whether the DUT has discarded the received RESPONSE frame, it is first necessary to perform the test with a valid INQUIRY RESPONSE with a valid DATAPRES field. This way the DUTs 'normal' behavior can be observed. It is important to note the number of times the DUT transmits each command, to what LUNs the command is transmitted to, and what type of INQUIRY data is requested. After this information is know the test can be performed with the incorrect value in the DATAPRES field and it can be determined properly whether the DUT retried the command or not.

Test 8.2.9 - SSP ERROR HANDLING – EXTRA RESPONSE FRAME RECEIVED

Purpose: To determine that the DUT, an SSP Initiator port, responds properly when a RESPONSE frame is improperly retransmitted.

References:

[1] 8.2.4.5 SAS SPL
[2] 8.2.6.3.2 SAS SPL
[3] 8.2.4.7 SAS SPL

Resource Requirements: SAS Protocol Analyzer and Generator.

Last Modification: August 8, 2011

Discussion: If an SSP initiator port receives a RESPONSE frame with a RETRANSMIT bit set to one, and it has previously received a RESPONSE frame for the same I_T_L_Q nexus, the ST_TFR state machine discards the extra RESPONSE frame [2]. If the ST_TFR state machine and the ST_TTS state machine have not previously received the RESPONSE frame, they consider the RESPONSE frame to be the valid RESPONSE frame.

Test Setup: The DUT and the Testing Station are physically connected.

Test Procedure:

1. The Testing Station is instructed to start and complete a phy Reset sequence followed by an Identify sequence with the DUT. Since the DUT is an initiator The Testing Station is instructed to transmit an Identify Address frame indicating that it is a SAS Target.
2. Allow the DUT to open an SSP connection to the Testing Station and transmit a SCSI INQUIRY command.
3. The Testing Station is instructed to open a connection to the DUT and transmit DATA and 2 RESPONSE frames to the DUT. The second response frame should have the retransmit bit set to close the connection.

Observable Results: Verify that the DUT discards the response frame that is received with retransmit bit set. The DUT should ACK this frame. When discarding the frame the DUT not retry or transmit a TASK MANAGEMENT function.

Possible Problems: To determine whether the DUT has discarded the received RESPONSE frame, it is first necessary to perform the test with a single valid INQUIRY RESPONSE with the retransmit bit set to 0. This way the DUTs 'normal' behavior can be observed. It is important to note the number of times the DUT transmits each command, to what LUNs the command is transmitted to, and what type of INQUIRY data is requested. After this information is know the test can be performed with 2 RESPONSE frames, one with the Retransmit bit set. It can then be determined whether the DUT performed properly or not.