The University of New Hampshire
InterOperability Laboratory

MODIFICATION RECORD

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The University of New Hampshire
InterOperability Laboratory

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David Woolf University of New Hampshire
INTRODUCTION

Overview
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 suite of tests has been developed to help implementers identify problems that Fibre Channel devices may have in establishing link and exchanging packets with each other. The tests do not determine if a product conforms to T11 standards. Rather, they provide one method to verify that the two devices can link and exchange data when operating over a small switched environment.

Note: Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other compliant devices. However, 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 well in most environments.

Organization of Tests
The tests contained in this document are organized to simplify the identification of information related to a test and to facilitate in the actual testing process. Each test contains an identification section that describes the test and provides cross-reference information. The discussion section covers background information and specifies why the test is to be performed. Tests are grouped in order to reduce setup time in the lab environment. Each test contains the following information:

Test Number
The Test Number associated with each test follows a simple grouping structure. Listed first is the Test Group Number followed by the test's number within the group. This allows for the addition of future tests to the appropriate groups of the test suite without requiring the renumbering of the subsequent tests.

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

References
The references section lists cross-references to the T11 standards and other documentation that might be helpful in understanding and evaluating the test and results.

Resource Requirements
The requirements section specifies the hardware and test equipment that will be needed to perform the test. The items contained in this section are special test devices or other facilities, which may not be available on all devices.

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

Discussion
The discussion covers the assumptions made in the design or implementation of the test as well as known limitations. Other items specific to the test are covered here.

Test Setup
The setup section describes the configuration of the test environment. Small changes in the configuration should be included in the test procedure.

Procedure
The procedure section of the test description contains the step-by-step instructions for carrying out the test. It provides a cookbook approach to testing, and may be interspersed with observable results.
Observable Results
The observable results section lists specific items that can be examined by the tester to verify that the DUT is operating properly. When multiple values are possible for an observable result, this section provides a short discussion on how to interpret them. The determination of a pass or fail for a certain test is often based on the successful (or unsuccessful) detection of a certain observable result.

Possible Problems
This section contains a description of known issues with the test procedure, which may affect test results in certain situations.
# TABLE OF CONTENTS

MODIFICATION RECORD ........................................................................................................... 1  
ACKNOWLEDGEMENTS ............................................................................................................. 2  
INTRODUCTION .......................................................................................................................... 3  
TABLE OF CONTENTS .................................................................................................................... 5  
LIST OF FIGURES .......................................................................................................................... 6  
GROUP 1: FL_PORT AND F_PORT PAIRS ..................................................................................... 7  
  Test #1.1: Loop to N_Port .......................................................................................................... 8  
  Test #1.2: N_Port to Loop .......................................................................................................... 11
LIST OF FIGURES

Figure 1: Test Setup #1.................................................................9
Figure 2: Test Setup #2.................................................................12
GROUP 1: FL_Port and F_Port Pairs

Scope: The following tests cover fabric pair interoperability specific to Fibre Channel devices.

Overview: These tests are designed to identify problems that T11 compliant devices may have in establishing link and exchanging data with each other over a switched environment.
Test #1.1: Loop to N_Port

**Purpose:** To determine if the DUT establishes a link and can exchange data with a reference set of stations when the initiator is connected to an FL_Port and the target to an F_Port.

**References:**

[1] T11 Std. FC-FLA 2.7

**Resource Requirements:**

- A reference set of stations that can be used as switches, SCSI targets, and SCSI initiators.
- Link monitoring facilities that are able to monitor primitives on the link.
- Local management indicators on the DUT and reference set that indicate the state of the link as perceived by the different stations.

**Last Modification:** March 10, 2005

**Discussion:** The ability to establish a link and exchange data is dependent on the three devices that make up the link segment, and providing and detecting the signaling method or connection information being passed. These devices are a SCSI initiator (referred to as L1), SCSI target (referred to as L2), and a switch. The initiator is connected to an FL_Port on the switch, and the target is connected to an F_Port. Both the initiator and target are NL_Ports. This test procedure addresses five conditions in which the three devices should link and exchange traffic. The first procedure covers the case where the initiator is initialized before the target. The second procedure covers the case where the initiator is disconnected and then reconnected from the same port on the switch. The third procedure covers the case where the target is disconnected and reconnected to the same port on the switch. The fourth procedure covers the case where the initiator is disconnected from the FL_Port and reconnected to a different FL_Port. The final fifth procedure is the case where the target is disconnected and reconnected to a different F_Port on the switch. A SCSI read/write operation is performed after each case.

When an End Device is powered on when connected to a Switch, it is expected to transmit FLOGI after completing Loop or Link Initialization. The Switch is expected to respond to the received FLOGI with FLOGI_ACC. The End Device is then expected to transmit PLOGI and RFC-4 to the Switch Directory Server. The Switch is expected to respond to these frames with PLOGI_ACC and FS_ACC respectively.

If the End Device in Arbitrated Loop mode is disconnected then reconnected from a Switch which it had completed FLOGI with, the End Device must perform FLOGI if the L bit is set during Loop Initialization, or if the End Device does not acquire the same AL_PA it had before being disconnected.

If FLOGI is not required by the Switch, the End Device shall wait a minimum of E_D_TOV to receive FAN from the Switch. If FAN is not received the End Device must perform FLOGI. If the End Device does not acquire the AL_PA it had prior to being disconnected it must perform PLOGI with the Directory Server and RFC-4 with the Name Service. The Switch is expected to respond to these frames with PLOGI_ACC and FS_ACC respectively.

If an End Device in Point to Point mode is disconnected then reconnected from a Switch which it had completed FLOGI with, the End Device must perform FLOGI since when the End Device is disconnected and reconnected, it will transmit NOS, causing it to be implicitly logged out from the Fabric. When the End Device is implicitly logged out from the Fabric, FLOGI is required.

The only case where FLOGI is not required, is if the End Device completed FLOGI, then received LR or LRR. In this case, upon completing Link Initialization after receiving LR or LRR, FLOGI would not be required and the End Device could perform FDISC. The End Device may choose to perform FLOGI instead of FDISC, however it must perform either FDISC or FLOGI. This case does not occur when a properly functioning N_Port is physically removed from a Fabric.

If the End Device received an N_Port ID that is different than the N_Port ID it received before being disconnected, the End Device must perform PLOGI with the Directory Server and RFC-4 with the Name Service. The Switch is expected to respond to these frames with PLOGI_ACC and FS_ACC respectively.
This test is an interoperability test. Failure of this test does not mean that the DUT is non-conformant. It does suggest that a problem in the ability of the devices to work properly together exists and further work should be done to isolate the cause of the failure.

**Test Setup:** Connect the SCSI initiator (L<sub>1</sub>) to an FL_Port on the switch, and the SCSI target (L<sub>2</sub>) to an F_Port. The switch is powered on, and L<sub>1</sub> and L<sub>2</sub> are powered off. Refer to Figure 1 below.

![Diagram of test setup](image-url)

**Figure 1: Test Setup #1**

**Procedure:**

**Case 1: L<sub>1</sub> is initialized before L<sub>2</sub>.**
1. Power off L<sub>1</sub> and L<sub>2</sub>.
2. Power on L<sub>1</sub> and ensure that the device is initialized and all needed drivers are loaded.
3. Power on L<sub>2</sub> and ensure that the device is initialized and all needed drivers are loaded.
4. Check local management information to verify that the link is established.
5. Perform SCSI reads and writes between the initiator and target, and observe if the traffic is accepted or not.

**Case 2: L<sub>1</sub> is disconnected and reconnected to the same FL_Port on the switch.**
1. L<sub>1</sub> and L<sub>2</sub> are powered up and properly connected.
2. Disconnect L<sub>1</sub> from the FL_Port for a few seconds, and then reconnect it to the same port.
3. Check local management information to verify that the links came up at the proper speeds and that link auto-negotiation, if supported, negotiated the optimal common values for the devices.
4. Perform SCSI reads and writes between the initiator and target, and observe if the traffic is accepted or not.

**Case 3: L<sub>2</sub> is disconnected and reconnected to the same F_Port on the switch.**
1. L<sub>1</sub> and L<sub>2</sub> are powered up and properly connected.
2. Disconnect L<sub>2</sub> from the F_Port for a few seconds, and then reconnect it to the same port.
3. Check local management information to verify that the links came up at the proper speeds and that link auto-negotiation, if supported, negotiated the optimal common values for the devices.
4. Perform SCSI reads and writes between the initiator and target, and observe if the traffic is accepted or not.

**Case 4: L<sub>1</sub> is disconnected and reconnected to a different FL_Port on the switch.**
1. L<sub>1</sub> and L<sub>2</sub> are powered up and properly connected.
2. Disconnect L<sub>1</sub> from the FL_Port for a few seconds, and then reconnect it to a different FL_Port.
3. Check local management information to verify that the links came up at the proper speeds and that link auto-negotiation, if supported, negotiated the optimal common values for the devices.
4. Perform SCSI reads and writes between the initiator and target, and observe if the traffic is accepted or not.

**Case 5: L<sub>2</sub> is disconnected and reconnected to a different F_Port on the switch.**
1. L<sub>1</sub> and L<sub>2</sub> are powered up and properly connected.
2. Disconnect L<sub>2</sub> from the F_Port for a few seconds, and then reconnect it to a different F_Port.
3. Check local management information to verify that the links came up at the proper speeds and that link auto-negotiation, if supported, negotiated the optimal common values for the devices.
4. Perform SCSI reads and writes between the initiator and target, and observe if the traffic is accepted or not.
Observable Results:

Case 1: Verify that:
- L_1 and L_2 are visible in the Switch Name Server
- SCSI traffic can flow between L_1 and L_2

Case 2: Verify that:
- L_1 and L_2 are visible in the Switch Name Server
- SCSI traffic can flow between L_1 and L_2

Case 3: Verify that:
- L_1 and L_2 are visible in the Switch Name Server
- SCSI traffic can flow between L_1 and L_2

Case 4: Verify that:
- L_1 and L_2 are visible in the Switch Name Server
- SCSI traffic can flow between L_1 and L_2

Case 5: Verify that:
- L_1 and L_2 are visible in the Switch Name Server
- SCSI traffic can flow between L_1 and L_2

Possible Problems: Local management information may not be available, depending on the device.
Test #1.2: N_Port to Loop

Purpose: To determine if the DUT establishes a link and can exchange data with a reference set of stations when the initiator is connected to an F_Port and the target to an FL_Port.

References:
[1] T11 Std. FC-FLA 2.7

Resource Requirements:
- A reference set of stations that can be used as switches, SCSI targets, and SCSI initiators.
- Link monitoring facilities that are able to monitor primitives on the link.
- Local management indicators on the DUT and reference set that indicate the state of the link as perceived by the different stations.

Last Modification: March 10, 2005

Discussion: The ability to establish a link and exchange data is dependent on the three devices that make up the link segment, and providing and detecting the signaling method or connection information being passed. These devices are a SCSI initiator (referred to as L1), SCSI target (referred to as L2), and a switch. The initiator is connected to an FL_Port on the switch, and the target is connected to an F_Port. Both the initiator and target are NL_Ports. This test procedure addresses five conditions in which the three devices should link and exchange traffic. The first procedure covers the case where the initiator is initialized before the target. The second procedure covers the case where the initiator is disconnected and then reconnected from the same port on the switch. The third procedure covers the case where the target is disconnected and reconnected to the same port on the switch. The fourth procedure covers the case where the target is disconnected and reconnected to a different FL_Port. The final fifth procedure is the case where the target is disconnected and reconnected to a different F_Port on the switch. A SCSI read/write operation is performed after each case.

When an End Device is powered on when connected to a Switch, it is expected to transmit FLOGI after completing Loop or Link Initialization. The Switch is expected to respond to the received FLOGI with FLOGI_ACC. The End Device is then expected to transmit PLOGI and RFC-4 to the Switch Directory Server. The Switch is expected to respond to these frames with PLOGI_ACC and FS_ACC respectively.

If an End Device in Arbitrated Loop mode is disconnected then reconnected from a Switch which it had completed FLOGI with, the End Device must perform FLOGI if the L bit is set during Loop Initialization, or if the End Device does not acquire the same AL_PA it had before being disconnected.

If FLOGI is not required by the Switch, the End Device shall wait a minimum of E_D_TOV to receive FAN from the Switch. If FAN is not received the End Device must perform FLOGI. If the End Device does not acquire the AL_PA it had prior to being disconnected it must perform PLOGI with the Directory Server and RFC-4 with the Name Service. The Switch is expected to respond to these frames with PLOGI_ACC and FS_ACC respectively.

If an End Device in Point to Point mode is disconnected then reconnected from a Switch which it had completed FLOGI with, the End Device must perform FLOGI since when the End Device is disconnected and reconnected, it will transmit NOS, causing it to be implicitly logged out from the Fabric. When the End Device is implicitly logged out from the Fabric, FLOGI is required.

The only case where FLOGI is not required, is if the End Device completed FLOGI, then received LR or LRR. In this case, upon completing Link Initialization after receiving LR or LRR, FLOGI would not be required and the End Device could perform FDISC. The End Device may choose to perform FLOGI instead of FDISC, however it must perform either FDISC or FLOGI. This case does not occur when a properly functioning N_Port is physically removed from a Fabric.

If the End Device received an N_Port ID that is different than the N_Port ID it received before being disconnected, the End Device must perform PLOGI with the Directory Server and RFC-4 with the Name Service. The Switch is expected to respond to these frames with PLOGI_ACC and FS_ACC respectively.
This test is an interoperability test. Failure of this test does not mean that the DUT is non-conformant. It does suggest that a problem in the ability of the devices to work properly together exists and further work should be done to isolate the cause of the failure.

**Test Setup:** Connect the SCSI initiator (L\(_1\)) to an F Port on the switch, and the SCSI target (L\(_2\)) to an FL Port. The switch is powered on, and L\(_1\) and L\(_2\) are powered off. Refer to Figure 2 below.

![Figure 2: Test Setup #2](image)

**Procedure:**

**Case 1: L\(_1\) is initialized before L\(_2\).**
1. Power off L\(_1\) and L\(_2\).
2. Power on L\(_1\) and ensure that the device is initialized and all needed drivers are loaded.
3. Power on L\(_2\) and ensure that the device is initialized and all needed drivers are loaded.
4. Check local management information to verify that the link is established.
5. Perform SCSI reads and writes between the initiator and target, and observe if the traffic is accepted or not.

**Case 2: L\(_1\) is disconnected and reconnected to the same F Port on the switch.**
1. L\(_1\) and L\(_2\) are powered up and properly connected.
2. Disconnect L\(_1\) from the F Port for a few seconds, and then reconnect it to the same port.
3. Check local management information to verify that the links came up at the proper speeds and that link auto-negotiation, if supported, negotiated the optimal common values for the devices.
4. Perform SCSI reads and writes between the initiator and target, and observe if the traffic is accepted or not.

**Case 3: L\(_2\) is disconnected and reconnected to the same FL Port on the switch.**
1. L\(_1\) and L\(_2\) are powered up and properly connected.
2. Disconnect L\(_2\) from the FL Port for a few seconds, and then reconnect it to the same port.
3. Check local management information to verify that the links came up at the proper speeds and that link auto-negotiation, if supported, negotiated the optimal common values for the devices.
4. Perform SCSI reads and writes between the initiator and target, and observe if the traffic is accepted or not.

**Case 4: L\(_1\) is disconnected and reconnected to a different F Port on the switch.**
1. L\(_1\) and L\(_2\) are powered up and properly connected.
2. Disconnect L\(_1\) from the F Port for a few seconds, and then reconnect it to a different F Port.
3. Check local management information to verify that the links came up at the proper speeds and that link auto-negotiation, if supported, negotiated the optimal common values for the devices.
4. Perform SCSI reads and writes between the initiator and target, and observe if the traffic is accepted or not.

**Case 5: L\(_2\) is disconnected and reconnected to a different FL Port on the switch.**
1. L\(_1\) and L\(_2\) are powered up and properly connected.
2. Disconnect L\(_2\) from the FL Port for a few seconds, and then reconnect it to a different FL Port.
3. Check local management information to verify that the links came up at the proper speeds and that link auto-negotiation, if supported, negotiated the optimal common values for the devices.
4. Perform SCSI reads and writes between the initiator and target, and observe if the traffic is accepted or not.
Observable Results:

Case 1: Verify that:
- L1 and L2 are visible in the Switch Name Server
- SCSI traffic can flow between L1 and L2

Case 2: Verify that:
- L1 and L2 are visible in the Switch Name Server
- SCSI traffic can flow between L1 and L2

Case 3: Verify that:
- L1 and L2 are visible in the Switch Name Server
- SCSI traffic can flow between L1 and L2

Case 4: Verify that:
- L1 and L2 are visible in the Switch Name Server
- SCSI traffic can flow between L1 and L2

Case 5: Verify that:
- L1 and L2 are visible in the Switch Name Server
- SCSI traffic can flow between L1 and L2

Possible Problems: Local management information may not be available, depending on the device.