UNH-IOL
FIBRE CHANNEL Test Service

FC Interoperability Test Suite
Version 1.0

Technical Document

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Fibre Channel Test Service
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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 particular suite of tests has been developed to help implementers evaluate the functionality of their Fibre Channel (FC) products.

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.

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 sub clauses references for the test in question, and any other references that might be helpful in understanding the test methodology and/or test results.

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.

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 as well.

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.

Group 1: Discovery, Connection and Verification

Overview: The following tests cover the transitions made by an initiator, target and switch on power-on and on fiber removal/re-insertion. The goal of this group of tests is to verify the basic interoperability of the switch with the initiator and target using the various storage protocols (eg. FCP(SCSI) or NVMe/FC).

This version of the test plan will cover FCP(SCSI) and NVMe/FC. Both FCP(SCSI) and NVMe/FC should be tested separately for each test. If the device under testing has dual ports then after testing FCP(SCSI) and NVMe/FC separately, it should be tested using both ports at the same time. For example, if the initiator that is being tested has two ports, have one port sending FCP(SCSI) traffic and the other port sending NVMe/FC traffic.

If the device under testing does not have dual ports then you will have to perform the testing for FCP(SCSI) and NVMe/FC on the same port, not at the same time, if supported.

Test 1.1: Initial Discovery and Connection

Purpose: Verify the initiator discovers a target

Discussion: A FCP(SCSI) and/or NVMe/FC initiator(s) should be able to discover a FCP(SCSI) and/or NVMe/FC target(s) over a fabric.

Test Setup: See Appendix A.

Test Procedure:

1. Perform steps 2-3 for all storage protocols being tested
2. Connect the FCP(SCSI) initiator and target to the fabric
3. Allow the FCP(SCSI) Initiator to discover and connect to the fabric attached target
4. If the DUT is a dual port HBA, initiate and discover unique storage protocols on each port, if possible

Observable Results:

1. Verify the initiator and target(s) show up in the fabric name server and that they register appropriately as FCP(SCSI) and NVMe/FC devices
2. Verify the target(s) are visible from the initiator

Test 1.2: Initiator to Target traffic testing

Purpose: Verify the initiator can perform I/O verification to the target without error

Discussion: An initiator should be able to read and write data to a target over a fabric without data being corrupted.

Test Setup: See Appendix A

Test Procedure:

1. Perform Read/Write IO verification from the initiator to thetTarget for each storage protocol that is supported for 15 minutes
2. If the DUT is a dual port HBA perform IO verification using unique storage protocol on each HBA port for 15 minutes, if supported

Observable Results:

1. Ensure no data integrity errors were detected during IO operations

Test 1.3: Verify Initiator to Target traffic after link event

Purpose: Verify the initiator can transfer data to the target without errors after link event (down/up) in the test setup topology

Discussion: An initiator should be able to send data to a target over a fabric after a link has been disconnected and then reconnected

Test Setup: See Appendix A

Test Procedure:

1. Remove the link between the Initiator and fabric
2. Leave the cable disconnected until the Initiator is removed from the fabric name server and the Initiator host system can no longer see the Target
3. Re-establish link between the Initiator and fabric
4. When the Target is visible at the Initiator host, send IO traffic for a minute
5. Perform steps 1-4 while re-establishing the link between the fabric switches(ISL) and between the Target and fabric
6. Perform steps 1-5 using each storage protocol that is supported

Observable Results:

1. After each link pull, verify that the host system can no longer see the target and that the fabric name servers are correctly reflecting attached end devices
2. After each time a link is re-established verify that the target is rediscovered and the fabric name server is correct
3. After each instance of sending IO traffic, ensure that no data integrity errors occurred during the IO traffic

Test 1.4: Initiator to Target traffic after reboot

Purpose: Verify the initiator can transfer data to the target without errors after a reboot of any device in the test setup topology

Discussion: An initiator should be able to send data to a target over a fabric after a reboot of any device in the test topology.

Test Setup: See Appendix A

Test Procedure:

1. Establish the initial state of the test setup where the initiator can discover and perform IO verification to the target
2. Power down the initiator. Leave the initiator powered off until it is no longer in the fabric name server. Power on the initiator
3. When the target is visible from the initiator, send read/write IO verification traffic from the initiator to the target for one minute
4. Power off the target.
5. Leave the target powered off until the target is no longer visible in the initiator or the switch's name servers. Power on the target
6. When the target is visible from the initiator, send read/write IO verification traffic from the initiator to the target
7. Power off switch 1
8. Leave the switch powered off until the target is no longer visible from the initiator. Power on switch 1
9. When the target is visible from the initiator, send read/write IO verification traffic from the initiator to the target
10. Power off switch 2.
11. Leave the switch powered off until the target is no longer visible from the initiator. Power on switch 2
12. When the target is visible from the initiator, send read/write IO verification traffic from the initiator to the target

Observable Results:

1. After each time you power off a device verify that the initiator can no longer see the target. Verify that end ports are no longer in the fabric name server. This may take a few minutes once the device is powered off
2. When power cycling switch elements make sure test partner switch recognizes the link event and that the powered off switch leaves the fabric
3. After each time the device is brought online verify the connection is re-established and the fabric name server is correct

4. After each instance of sending IO traffic, ensure that no data integrity errors occurred during the IO traffic

Test 1.5: Longevity Test

Purpose: Verify the initiator can transfer data to the target without errors for a period greater than 24 hours

Discussion: An initiator should be able to send data to a target over a fabric for a long period of time

Test Setup: See Appendix A

Test Procedure:

1. Perform read/write IO verification from the Initiator to the Target for a time greater than 24 hours

Observable Results:

1. Ensure no data integrity errors were detected during IO operations
2. Record the I/Os per seconds and the MBs per second.

Group 2: Performance

Overview: Record the results when traffic is sent in the same test setup using the same equipment but using different storage protocols.

Test 2.1: Performance Testing

Purpose: Run performance testing on supported storage protocols (eg. NVMe/FC, FCP (SCSI))

Discussion: When I/O traffic is performed in the same test bed on the same products using different storage protocols there may be a performance difference. Document the performance of any storage protocol used.

Test Setup: See Appendix A.

Test Procedure:

1. Connect the devices as shown in the test setup.
2. Verify that each initiator(NVMe/FC & FCP(SCSI) can see it's respective target
3. Perform 5 minutes of write IO with a 8Kbyte transfer size. Record the IO completion time(ms), IO completed per seconds(IOPS) and the bandwidth(MB/s)
4. Perform 5 minutes of write IO with a 256Kbyte transfer size. Record the IO completion time(ms), IO completed per seconds(IOPS) and the bandwidth(MB/s)
5. Perform 5 minutes of read IO with a 8Kbyte transfer size. Record the IO completion time(ms), IO completed per seconds(IOPS) and the bandwidth(MB/s)
6. Perform 5 minutes of read IO with a 256Kbyte transfer size. Record the IO completion time(ms), IO completed per seconds(IOPS) and the bandwidth(MB/s)
7. Perform 5 minutes of read/write IO (50%/50%) with a 8Kbyte transfer size. Record the IO completion time(ms), IO completed per seconds(IOPS) and the bandwidth(MB/s)
8. Perform 5 minutes of read/write IO (50%/50%) with a 256Kbyte transfer size. Record the IO completion time(ms), IO completed per seconds(IOPS) and the bandwidth(MB/s)

Observable Results:

1. Trace and record latency measurements
2. Verify the initiator, switch, and target ports do not have CRC, LRs, ABTS, or other errors

Group 3: Fabric Disruptions

Overview: The goal of this group of tests is to verify the interoperability of the switch with the initiator and target when there is different types of activity happening in a fabric (ISL removal, addition of devices to the fabric, etc.)

Test 3.1: Fiber Removal/Reinsertion

Purpose: Observe fabric behavior when switches are added or removed from the fabric

Discussion: When end devices are unplugged from a fabric, notifications will be sent to each switch name server in a fabric and all end devices that have registered will receive these the notifications. The same will happen when a device is reintroduced into a fabric.

Test Setup: See Appendix A

Procedure:

1. Remove the connection from the target to the switch
2. Once the initiator can no longer see the target, reattach the target to the fabric
3. Remove the connection from the initiator to the switch
4. Once the initiator can no longer see the target, reattach the target to the fabric

Observable Results:

1. Verify that the switch's name servers are update correctly and that a SCN is sent out to all devices in the fabric with appropriate content
2. Confirm that the fabric and all end devices are updated when a device is removed from the fabric

Test 3.2: FDMI-2 Registered Data

Purpose: To ensure that the FDMI-2 registered data is correct

Discussion: The FDMI-2 registered data should display information about the attached HBAs and host operating systems

Test Setup: See Appendix A

Procedure:

1. Connect the end devices to the fabric
2. Use the switch specific command to view the FDMI-2 registered data

Observable Results:

1. Confirm that the FMDI-2 registered data is correct

Test 3.3: End Device Switch Port Change

Purpose: Determine the behavior of the initiator or target when there is a fabric port change.

Discussion: When target devices are unplugged from a fabric, notifications will be sent to each switch in a fabric and all end devices that have registered will receive these notifications. The same will happen when a target is reintroduced into a fabric.

Test Setup: See Appendix A

Procedure:

1. Connect, discover and start sending IO traffic with the end device pair that is being tested
2. Remove the connection of the initiator for a few seconds and then reattach it to the fabric in a different port on the switch. Check Observable Results
3. Remove the connection of the target for a few seconds and then reattach it to the fabric in a different port on the switch. Check Observable Results

Observable Results:

1. Confirm that the IO traffic continues to run after the end device is reattached to the fabric
2. Continue to perform IO traffic for 5 minutes and verify that there are no errors
3. Verify that all end devices appear in the nameserver of all the switches in the fabric

Appendix A - Test Topologies

1. Basic Fabric with a two switches. If the DUT does not have multiple ports that can run different storage protocol traffic at the same time you will need to use the same port and switch between the different storage protocols. If it can run both storage protocols at the same time on unique ports then you will need to zone each end pair of ports separately so there is a single target and initiator port in each zone.