UNH-IOL
FIBRE CHANNEL CONSORTIUM

FCoE Interoperability Test Suite
Version 1.0

Technical Document

Last Updated: July 26, 2010

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MODIFICATION RECORD

July 26, 2010   (Version 1.0)   Jacob Donigian

ACKNOWLEDGMENTS

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 vendors evaluate the functioning of their Fibre Channel over Ethernet based products. Rather, they provide one method to isolate problems within a Fibre Channel over Ethernet device. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with all other Fibre Channel over Ethernet devices. However, combined with satisfactory operation in the IOL's semi-production environment, these tests provide a reasonable level of confidence that the Device Under Test (DUT) will function well in most multi-vendor Fibre Channel over Ethernet environments.

Test Number and Title: The test number is given based on the order of the test within the test group. Groups are arranged according to similar test setups or similar observable results. The title is a basic description of the test.

Purpose: The purpose is a short statement describing what the test attempts to achieve. The test is written at the functional level.

References: This section specifies all reference material 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.

TEST SETUPS

Test Setup 1: The Target and the Initiator are connected to the analyzer. The Target is then connected to the Initiator through the Switch.

Target CNA

FCoE Traffic Analyzer

FCoE Switch
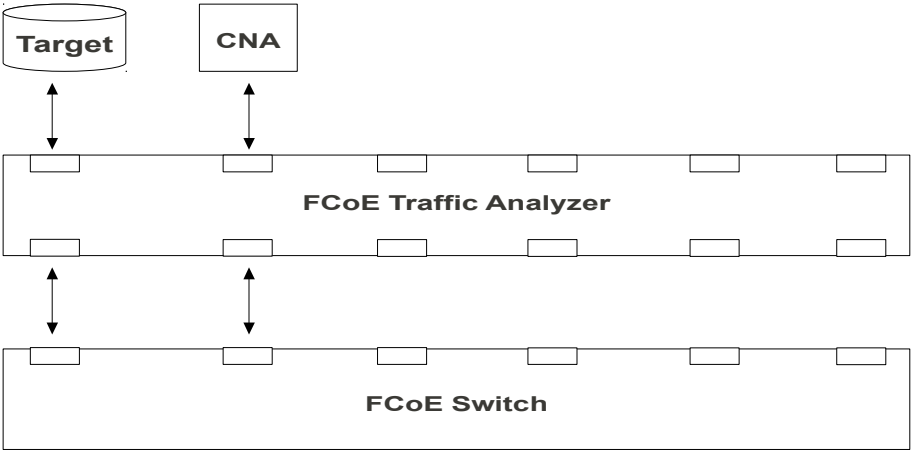
Test Setup 2: The Target and the Initiators are connected to the analyzer. The Target is then connected to the Initiators through the Switch.

Target CNA CNA CNA CNA CNA

FCoE Traffic Analyzer

FCoE Switch
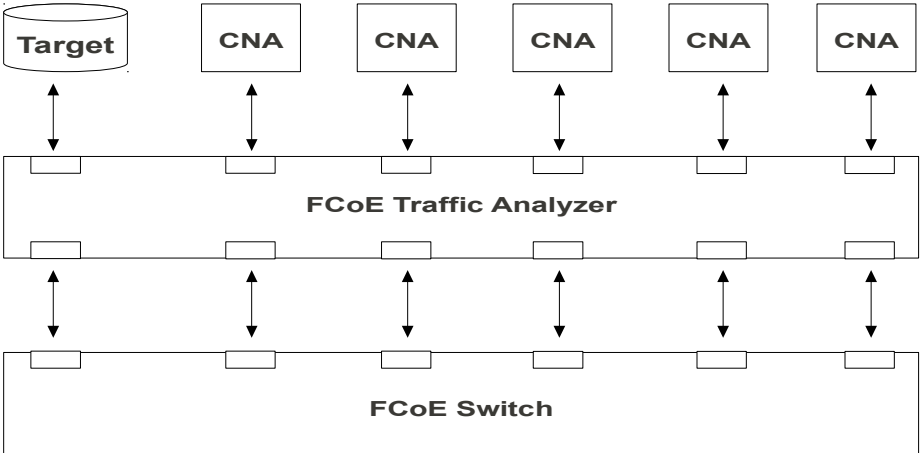
Test Setup 3: The Targets and the Initiator are connected to the analyzer. The Targets are then connected in a fabric with the Initiator through the Switch.
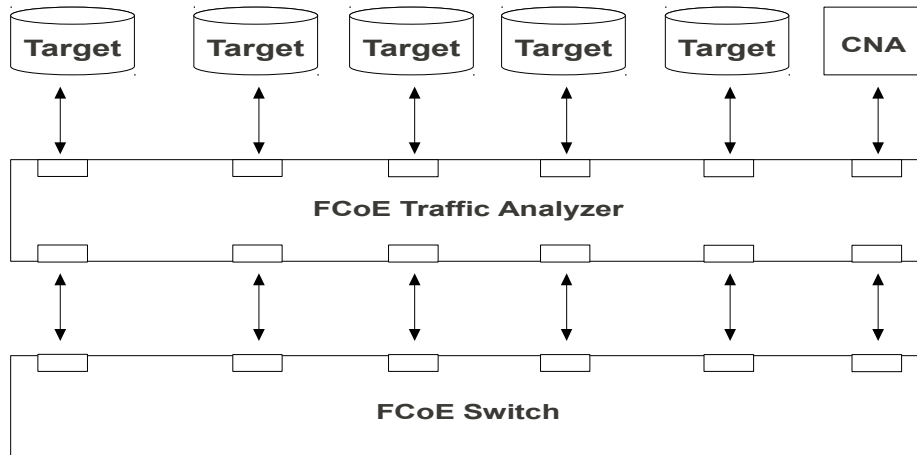
Test Setup 4: Multiple Targets and multiple Initiators are connected to the fabric through the Switch.
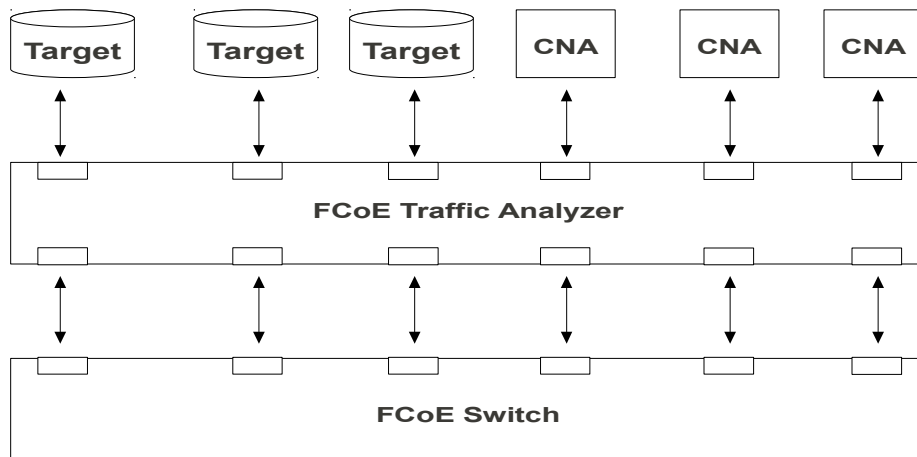
Group 1: Initiator Testing - Screening

Overview: These tests are designed to verify basic interoperability of different Targets with the Initiator. The following tests examine the behavior of a FCoE Initiator device that is operating on a fabric with a single Target.

The interaction between a FCoE Initiator and a Target is complex. This interoperability procedure is designed to verify that two or more devices that act as FCoE Targets will operate properly with a particular FCoE Initiator device that is under test. The procedure requires the ability to observe the behavior of the devices, and to understand the proper behavior of the traffic between the devices.

The primary observable used to determine the "pass/fail" result of test cases is the successful operation of the FCoE-based traffic. During each step, a trace is made and then examined. If the trace shows improper or unexpected behavior the tester may label the test as failing.

During screening, different Targets are checked for basic interoperability with the Initiator. FCoE Targets are identified by the following notation: F_t (n). Each FCoE Target is tested in a pair configuration with the Initiator. The Target F_t (n) is connected to the Switch with the Initiator. The monitor is configured so that the input to the Initiator and the output from the Initiator can be observed. This screening process is then performed for each FCoE Target.

This testing document describes an interoperability procedure. Interoperability procedures require a high degree of analysis by the tester to ensure that the behavior is correct. For this reason the observable results section should be used as a guide. The guide may need to be modified to take into account specifics of the equipment being used in the testing.

Test 1.1: Login with a VLAN

Purpose: To verify proper VLAN Discovery behavior of different Targets in a pair configuration with the Initiator.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: FCoE Targets are tested in a pair configuration with the Initiator. The monitor is configured so that the input to the Initiator and the output from the Initiator can be observed. The FCoE Switch is configured to provide a VLAN ID to the end nodes. It is then verified that the Initiator can still see the Target. This screening process is then performed for each FCoE Target.

Test Setup: *Test Setup 1.* The Initiator and Target are connected to the Switch through an analyzer. The Target and the Initiator are powered on.

Procedure:
1. Configure the FCoE Switch to provide a VLAN ID of 101 to the end nodes via VLAN Discovery.

Observable Results:
- The Target and all of its drives appear in the management of the Initiator.

Possible Problems: None.

Test 1.2: Login with a new VLAN

Purpose: To verify proper VLAN Discovery behavior of different Targets in a pair configuration with the Initiator.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: FCoE Targets are tested in a pair configuration with the Initiator. The monitor is configured so that the input to the Initiator and the output from the Initiator can be observed. The FCoE Switch is configured to provide a VLAN ID the end nodes. It is verified that the Initiator can see the Target. The Switch is then configured to provide a different VLAN ID to the end nodes. It is then verified that the Initiator can still see the Target. This screening process is then performed for each FCoE Target.

Test Setup: *Test Setup 1.* The Initiator and Target are connected to the Switch through an analyzer. The Target and the Initiator are powered on. The FCoE Switch is configured to provide a VLAN ID of 101 to the end nodes.

Procedure:
1. Verify that the Target and all of its drives appear in the management of the Initiator.
2. Configure the FCoE Switch to provide a VLAN ID of 102 to the end nodes via VLAN Discovery.

Observable Results:
- The Target and all of its drives appear in the management of the Initiator.

Possible Problems: None.

Test 1.3: Read

Purpose: To verify basic interoperability of different Targets with the Initiator during read operations.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: FCoE Targets are tested in a pair configuration with the Initiator. The monitor is configured so that the input to the Initiator and the output from the Initiator can be observed. The Initiator begins read operations. The data may be any pattern: random, constant or a looped pattern. It is then verified that the procedure has been completed successfully. This screening process is then performed for each FCoE Target.

Test Setup: *Test Setup 1*. The Initiator and Target are connected to the Switch through an analyzer. The Target and the Initiator are powered on.

Procedure:
1. Configure the Initiator to discover all drives.
2. Perform 100% read operations using 512B transfer size for 10 minutes.

Observable Results:
- Verify that the 10 minutes of read operations completes successfully between the Initiator and the Target.

Possible Problems: None.

Test 1.4: Write

Purpose: To verify basic interoperability of different Targets with the Initiator during write operations.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: FCoE Targets are tested in a pair configuration with the Initiator. The monitor is configured so that the input to the Initiator and the output from the Initiator can be observed. The Initiator begins write operations from the Target. The data may be any pattern: random, constant or a looped pattern. It is then verified that the procedure has been completed successfully. This screening process is then performed for each FCoE Target.

Test Setup: *Test Setup 1.* The Initiator and Target are connected to the Switch through an analyzer. The Target and the Initiator are powered on.

Procedure:
1. Configure the Initiator to discover all drives.
2. Perform 100% write operations using 512B transfer size for 10 minutes.

Observable Results:
- Verify that the 10 minutes of write operations completes successfully between the Initiator and the Target.

Possible Problems: None.

Test 1.5: Read/Write

Purpose: To verify basic interoperability of different Targets with the Initiator during read/write operations.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: FCoE Targets are tested in a pair configuration with the Initiator. The monitor is configured so that the input to the Initiator and the output from the Initiator can be observed. The Initiator begins read/write operations from the Target. The data may be any pattern: random, constant or a looped pattern. It is then verified that the procedure has been completed successfully. This screening process is then performed for each FCoE Target.

Test Setup: *Test Setup 1*. The Initiator and Target are connected to the Switch through an analyzer. The Target and the Initiator are powered on.

Procedure:
1. Configure the Initiator to discover all drives.
2. Perform 50% read, 50% write operations using 512B transfer size for 10 minutes.

Observable Results:
- Verify that the 10 minutes of read/write operations completes successfully between the Initiator and the Target.

Possible Problems: None.

Group 2: Initiator Testing - Fabric Build

Overview: The Targets which were deemed passing during Group 1 testing are added to a fabric with the single FCoE Initiator one at a time and FCoE activity is started to each of the Targets.

Test 2.1: Fabric Build - Multi-Target

Purpose: To verify proper operations of the Targets and the Initiator during fabric build.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Configure Target resources.
    - Perform read/write operations to Target resources.

Modification Record: July 22, 2010

Discussion: In the fabric build phase Targets that have operated properly with the Initiator in the screening phase are added to a fabric one at a time. The Initiator is already operational on the fabric. After the addition of each Target the fabric is examined to see if it is still operating properly. FCoE traffic is checked or started to verify proper operation of the fabric. During the fabric build phase of testing it may be necessary to eliminate devices. A device is removed from the build if the device does not perform properly or exhibits some other behavior that causes other devices to malfunction. In the case where two incorrect behaviors are observed (i.e. a device creates an error condition on the fabric and another device does not respond properly to the error condition) the device which generated the error condition will be removed.

Test Setup: *Test Setup 3.* The Initiator and Target are powered off. Connect the Initiator to the Switch and power up the Initiator. Connect the monitor to the fabric in a passive manner both before and after the Initiator.

Procedure:
For each FCoE Target to be added to the fabric repeat the following procedure:
1. Ensure the fabric is in a stable state with FCoE traffic between the Initiator and all Targets currently on the fabric.
2. Verify the proper operation of traffic running on FCoE Targets currently on the fabric.
3. Connect and then power on the next Target and wait until the Target is operational.
4. Start FCoE activity on the Target from Initiator if the fabric appears to be operational.

Observable Results:
- FCoE traffic on previously added Targets continues to operate properly.
- Added Target establishes connections to the Initiator.
- Added Target's FCoE traffic is properly operational.

Possible problems: None.

Group 3: Initiator Testing - Fabric Disruptions

Overview: The functioning fabric consisting of the FCoE Initiator and multiple FCoE Targets is subjected to disruptions including power cycles and cable disconnects both with and without FCoE Traffic being transmitted on the fabric.

Test 3.1: Initiator Power Cycle – No Traffic

Purpose: To verify proper operations of the Initiator and the Targets during a power cycle of the Initiator when there is no traffic on the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Initiator is removed and reinserted into the operational fabric with a power cycle in order to examine the stability of the configuration.

Test Setup: *Test setup 3.* The Initiator is already operational on the fabric. All Targets are seen by the Initiator.

Procedure:
1. Verify that all Targets appear in the management of the Initiator.
2. Remove the Initiator from the fabric by powering it off.
3. Power on the Initiator.
4. Verify that all Targets appear in the management of the Initiator.

Observable Results:
- All Targets appear in the management of the Initiator both before and after the power cycle.

Possible problems: None.

Test 3.2: Initiator Power Cycle – With Traffic

Purpose: To verify proper operations of the Initiator and the Targets during a power cycle of the Initiator when there is traffic on the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Initiator is removed and reinserted into the operational fabric with a power cycle in order to examine the stability of the configuration.

Test Setup: *Test setup 3.* The Initiator is already operational on the fabric. FCoE traffic is checked or started to verify proper operation of the fabric.

Procedure:
1. Perform 50% read, 50% write operations using 512B transfer size from the Initiator to all Targets.
2. Verify traffic is operating properly.
3. Remove the Initiator from the fabric by powering it off.
4. Verify that FCoE traffic aborts or times out on all Targets.
5. Power on the Initiator.
6. Restart FCoE traffic between the Initiator and the Targets.
7. Verify that all FCoE traffic operates properly.

Observable Results:
- The traffic aborts or times out on every Target.
- All traffic operates properly when the Initiator restarts traffic on the fabric.

Possible problems: None.

Test 3.3: Target Power Cycle – No Traffic

Purpose: To verify proper operations of the Initiator and Targets during a power cycle of the Targets.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: The Targets are power cycled in an operational fabric to examine the stability of the configuration. This procedure is repeated for each Target on the fabric.

Test Setup: *Test setup 3.* The Targets are already operational on the fabric. All Targets are seen by the Initiator.

Procedure:
1. Verify that the Target appears in the management of the Initiator.
2. Remove the Target from the fabric by powering it off.
3. Power on the Target.
4. Verify that the Target appears in the management of the Initiator.

Observable Results:
- The Target appears in the management of the Initiator both before and after the power cycle.

Possible Problems: None.

Test 3.4: Target Power Cycle – With Traffic

Purpose: To verify proper operations of the Initiator and the Targets during a power cycle of the Target when there is traffic on the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Target is removed and reinserted into the operational fabric with a power cycle in order to examine the stability of the configuration. This procedure is repeated for each Target on the fabric.

Test Setup: *Test setup 3.* The Target is already operational on the fabric. FCoE traffic is checked or started to verify proper operation of the fabric.

Procedure:
1. Perform 50% read, 50% write operations using 512B transfer size from the Initiator to all Targets.
2. Verify traffic is operating properly.
3. Remove the Target from the fabric by powering it off.
4. Verify that FCoE traffic continues properly on all remaining Targets.
5. Power on the Target.
6. Restart FCoE traffic between the Initiator and the Targets.
7. Verify that all FCoE traffic operates properly.

Observable Results:
- All traffic operates properly on the remaining Targets when the Target is removed from the fabric.
- All traffic operates properly when the Target reappears on the fabric.

Possible problems: None.

Test 3.5: Initiator Cable Pull – No Traffic

Purpose: To verify proper operations of the Initiator and the Targets during a cable pull of the Initiator when there is no traffic on the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Initiator is removed and reinserted into the operational fabric with a cable pull in order to examine the stability of the configuration.

Test Setup: *Test setup 3.* The Initiator is already operational on the fabric. All Targets are seen by the Initiator.

Procedure:
1. Verify that all Targets appear in the management of the Initiator.
2. Remove the Initiator from the fabric by disconnecting the cable (and module, if possible).
3. Reconnect the cable (and module, if possible).
4. Verify that all Targets appear in the management of the Initiator.

Observable Results:
- All Targets appear in the management of the Initiator both before and after the cable.

Possible problems: None.

Test 3.6: Initiator Cable Pull – With Traffic

Purpose: To verify proper operations of the Initiator and the Targets during a cable pull of the Initiator when there is traffic on the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Initiator is removed and reinserted into the operational fabric with a cable pull in order to examine the stability of the configuration.

Test Setup: *Test setup 3.* The Initiator is already operational on the fabric. FCoE traffic is checked or started to verify proper operation of the fabric.

Procedure:
1. Perform 50% read, 50% write operations using 512B transfer size from the Initiator to all Targets.
2. Verify traffic is operating properly.
3. Remove the Initiator from the fabric by disconnecting the cable (and module, if possible).
4. Verify that FCoE traffic aborts or times out on all Targets.
5. Reconnect the cable (and module, if possible).
6. Restart FCoE traffic between the Initiator and the Targets.
7. Verify that all FCoE traffic operates properly.

Observable Results:
- The traffic aborts or times out on every Target.
- All traffic operates properly when the Initiator restarts traffic on the fabric.

Possible problems: None.

Test 3.7: Target Cable Pull – No Traffic

Purpose: To verify proper operations of the Initiator and Targets during a cable pull of the Targets.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: The Targets are removed from the fabric with a cable pull to examine the stability of the configuration. This procedure is repeated for each Target on the fabric.

Test Setup: *Test setup 3.* The Targets are already operational on the fabric. All Targets are seen by the Initiator.

Procedure:
1. Verify that the Target appears in the management of the Initiator.
2. Remove the Target from the fabric by disconnecting the cable (and module, if possible).
3. Reconnect the cable (and module, if possible).
4. Verify that the Target appears in the management of the Initiator.

Observable Results:
- The Target appears in the management of the Initiator both before and after the power cycle.

Test 3.8: Target Cable Pull – With Traffic

Purpose: To verify proper operations of the Initiator and the Targets during a cable pull of the Target when there is traffic on the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Target is removed and reinserted into the operational fabric with a cable pull in order to examine the stability of the configuration. This procedure is repeated for each Target on the fabric.

Test Setup: *Test setup 3.* The Target is already operational on the fabric. FCoE traffic is checked or started to verify proper operation of the fabric.

Procedure:
1. Perform 50% read, 50% write operations using 512B transfer size from the Initiator to all Targets.
2. Verify traffic is operating properly.
3. Remove the Target from the fabric by disconnecting the cable (and module, if possible).
4. Verify that FCoE traffic continues properly on all remaining Targets.
5. Reconnect the cable (and module, if possible).
6. Restart FCoE traffic between the Initiator and the Targets.
7. Verify that all FCoE traffic operates properly.

Observable Results:
- All traffic operates properly on the remaining Targets when the Target is removed from the fabric.
- All traffic operates properly when the Target reappears on the fabric.

Possible problems: None.

Group 4: Initiator Testing - Stability Test

Overview: During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test 4.1: Stability Testing – Small Blocks

Purpose: I/O operations are performed with small block sizes between the Initiator and all Targets in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Target FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 3*. The Targets and the Initiator are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations from Initiator to the Targets with a block size of 4 bytes. (or the smallest that software can provide).
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from Initiator to the Targets with a block size of 4 bytes. (or the smallest that software can provide).
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from Initiator to the Targets with a block size of 4 bytes. (or the smallest that software can provide).
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between the Initiator and all Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 4.2: Stability Testing – Medium Blocks

Purpose: I/O operations are performed with medium block sizes between the Initiator and all Targets in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Target FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 3*. The Targets and the Initiator are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations from Initiator to the Targets with a block size of 512 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from Initiator to the Targets with a block size of 512 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from Initiator to the Targets with a block size of 512 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between the Initiator and all Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 4.3: Stability Testing – Large Blocks

Purpose: I/O operations are performed with large block sizes between the Initiator and all Targets in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Target FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 3.* The Targets and the Initiator are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations from Initiator to the Targets with a block size of 1 megabyte.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from Initiator to the Targets with a block size of 1 megabyte.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from Initiator to the Targets with a block size of 1 megabyte.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between the Initiator and the Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 4.4: Stability Testing – 1 Outstanding IO

Purpose: I/O operations are performed with outstanding IO's between the Initiator and all Targets in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Target FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 3.* The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations with 1 outstanding IO from Initiator to the Targets with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations with 1 outstanding IO from Initiator to the Targets with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations with 1 outstanding IO from Initiator to the Targets with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between the Initiator and the Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 4.5: Stability Testing – 5 Outstanding IOs

Purpose: I/O operations are performed with outstanding IO's between the Initiator and all Targets in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Target FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 3*. The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations with 5 outstanding IOs from Initiator to the Targets with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations with 5 outstanding IOs from Initiator to the Targets with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations with 5 outstanding IOs from Initiator to the Targets with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between the Initiator and the Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 4.6: Stability Testing – 10 Outstanding IOs

Purpose: I/O operations are performed with outstanding IO's between the Initiator and all Targets in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Target FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 3*. The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations with 10 outstanding IOs from Initiator to the Targets with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations with 10 outstanding IOs from Initiator to the Targets with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations with 10 outstanding IOs from Initiator to the Targets with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between the Initiator and the Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed all the devices begin transmitting again.

Possible Problems: None.

Test 4.7: Stability Testing – ETS Testing

Purpose: I/O operations are performed along-side non-FCoE traffic between the Initiators and the Target in order to stress the fabric and test proper ETS.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Traffic Generator to source non-FCoE traffic.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Target FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 3.* The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing. Configure ETS on the network to provide 50% bandwidth to FCoE traffic and 50% bandwidth to non-FCoE traffic. Begin constantly sourcing non-FCoE traffic on the network with the generator.

Procedure:
1. Perform 100% read operations from Initiator to the Targets with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from Initiator to the Targets with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from Initiator to the Targets with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between the Initiator and the Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.
- Verify that any priority group's traffic does not utilize more than the configured amount of bandwidth on the network.

Possible Problems: None.

Group 1: Target Testing - Screening

Overview: These tests are designed to verify basic interoperability of different Initiators with the Target. The following tests examine the behavior of a FCoE Target device that is operating on a fabric with a single Initiator.

The interaction between a FCoE Initiator and a Target is complex. This interoperability procedure is designed to verify that two or more devices that act as FCoE Targets will operate properly with a particular FCoE Initiator device that is under test. The procedure requires the ability to observe the behavior of the devices, and to understand the proper behavior of the traffic between the devices.

The primary observable used to determine the "pass/fail" result of test cases is the successful operation of the FCoE-based traffic. During each step, a trace is made and then examined. If the trace shows improper or unexpected behavior the tester may label the test as failing.

During screening, different Initiators are checked for basic interoperability with the Target. FCoE Initiators are identified by the following notation: F_i (n). Each FCoE Initiator is tested in a pair configuration with the Target. The Initiator F_i (n) is connected to the Switch with the Target. The monitor is configured so that the input to the Target and the output from the Target can be observed. This screening process is then performed for each FCoE Initiator.

This testing document describes an interoperability procedure. Interoperability procedures require a high degree of analysis by the tester to ensure that the behavior is correct. For this reason the observable results section should be used as a guide. The guide may need to be modified to take into account specifics of the equipment being used in the testing.

Test 1.1: Login with a VLAN

Purpose: To verify proper VLAN Discovery behavior of different Initiators in a pair configuration with the Target.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: FCoE Initiators are tested in a pair configuration with the Target. The monitor is configured so that the input to the Target and the output from the Target can be observed. The FCoE Switch is configured to provide a VLAN ID to the end nodes. It is then verified that the Initiator can still see the Target. This screening process is then performed for each FCoE Initiator.

Test Setup: *Test Setup 1.* The Initiator and Target are connected to the Switch through an analyzer. The Target and the Initiator are powered on.

Procedure:
1. Configure the FCoE Switch to provide a VLAN ID of 101 to the end nodes via VLAN Discovery.

Observable Results:
- The Target and all of its drives appear in the management of the Initiator.

Possible Problems: None.

Test 1.2: Login with a new VLAN

Purpose: To verify proper VLAN Discovery behavior of different Initiators in a pair configuration with the Target.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: FCoE Initiators are tested in a pair configuration with the Target. The monitor is configured so that the input to the Target and the output from the Target can be observed. The FCoE Switch is configured to provide a VLAN ID the end nodes. It is verified that the Initiator can see the Target. The Switch is then configured to provide a different VLAN ID to the end nodes. It is then verified that the Initiator can still see the Target. This screening process is then performed for each FCoE Initiator.

Test Setup: *Test Setup 1*. The Initiator and Target are connected to the Switch through an analyzer. The Target and the Initiator are powered on. The FCoE Switch is configured to provide a VLAN ID of 101 to the end nodes.

Procedure:
1. Verify that the Target and all of its drives appear in the management of the Initiator.
2. Configure the FCoE Switch to provide a VLAN ID of 102 to the end nodes via VLAN Discovery.

Observable Results:
- The Target and all of its drives appear in the management of the Initiator.

Possible Problems: None.

Test 1.3: Read

Purpose: To verify basic interoperability of different Initiators with the Target during read operations.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: FCoE Initiators are tested in a pair configuration with the Target. The monitor is configured so that the input to the Target and the output from the Target can be observed. The Initiator begins read operations. The data may be any pattern: random, constant or a looped pattern. It is then verified that the procedure has been completed successfully. This screening process is then performed for each FCoE Initiator.

Test Setup: *Test Setup 1.* The Initiator and Target are connected to the Switch through an analyzer. The Target and the Initiator are powered on.

Procedure:
1. Configure the Initiator to discover all drives.
2. Perform 100% read operations using 512B transfer size for 10 minutes.

Observable Results:
- Verify that the 10 minutes of read operations completes successfully between the Initiator and the Target.

Possible Problems: None.

Test 1.4: Write

Purpose: To verify basic interoperability of different Initiators with the Target during write operations.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: FCoE Initiators are tested in a pair configuration with the Target. The monitor is configured so that the input to the Target and the output from the Target can be observed. The Initiator begins write operations from the Target. The data may be any pattern: random, constant or a looped pattern. It is then verified that the procedure has been completed successfully. This screening process is then performed for each FCoE Initiator.

Test Setup: *Test Setup 1*. The Initiator and Target are connected to the Switch through an analyzer. The Target and the Initiator are powered on.

Procedure:
1. Configure the Initiator to discover all drives.
2. Perform 100% write operations using 512B transfer size for 10 minutes.

Observable Results:
- Verify that the 10 minutes of write operations completes successfully between the Initiator and the Target.

Possible Problems: None.

Test 1.5: Read/Write

Purpose: To verify basic interoperability of different Targets with the Initiator during read/write operations.

Resource Requirements:
- Two or more FCoE Targets.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: FCoE Initiators are tested in a pair configuration with the Target. The monitor is configured so that the input to the Target and the output from the Target can be observed. The Initiator begins read/write operations from the Target. The data may be any pattern: random, constant or a looped pattern. It is then verified that the procedure has been completed successfully. This screening process is then performed for each FCoE Initiator.

Test Setup: *Test Setup 1.* The Initiator and Target are connected to the Switch through an analyzer. The Target and the Initiator are powered on.

Procedure:
1. Configure the Initiator to discover all drives.
2. Perform 50% read, 50% write operations using 512B transfer size for 10 minutes.

Observable Results:
- Verify that the 10 minutes of read/write operations completes successfully between the Initiator and the Target.

Possible Problems: None.

Group 2: Target Testing - Fabric Build

Overview: The Initiators which were deemed passing during Group 1 testing are added to a fabric with the single FCoE Target one at a time and FCoE activity is started from each of the Initiators.

Test 2.1: Fabric Build - Multi-Initiator

Purpose: To verify proper operations of the Initiators and the Target during fabric build.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Configure Target resources.
    - Perform read/write operations to Target resources.

Modification Record: July 22, 2010

Discussion: In the fabric build phase Initiators that have operated properly with the Target in the screening phase are added to a fabric one at a time. The Target is already operational on the fabric. After the addition of each Initiator the fabric is examined to see if it is still operating properly. FCoE traffic is checked or started to verify proper operation of the fabric. During the fabric build phase of testing it may be necessary to eliminate devices. A device is removed from the build if the device does not perform properly or exhibits some other behavior that causes other devices to malfunction. In the case where two incorrect behaviors are observed (i.e. a device creates an error condition on the fabric and another device does not respond properly to the error condition) the device which generated the error condition will be removed.

Test Setup: *Test Setup 2*. The Initiator and Target are powered off. Connect the Target to the Switch and power up the Target. Connect the monitor to the fabric in a passive manner both before and after the Target.

Procedure:
For each FCoE Initiator to be added to the fabric repeat the following procedure:
1. Ensure the fabric is in a stable state with FCoE traffic between the Target and all Initiators currently on the fabric.
2. Verify the proper operation of traffic running on FCoE Initiators currently on the fabric.
3. Connect and then power on the next Initiator and wait until the Initiator is operational.
4. Start FCoE activity from Initiator to the Target if the fabric appears to be operational.

Observable Results:
- FCoE traffic on previously added Initiators continues to operate properly.
- Added Initiator establishes connections to the Target.
- Added Initiator's FCoE traffic is properly operational.

Possible problems: None.

Group 3: Target Testing - Fabric Disruptions

Overview: The functioning fabric consisting of the FCoE Target and multiple FCoE Initiators is subjected to disruptions including power cycles and cable disconnects both with and without FCoE Traffic being transmitted on the fabric.

Test 3.1: Initiator Power Cycle – No Traffic

Purpose: To verify proper operations of the Initiators and the Target during a power cycle of the Initiator when there is no traffic on the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Initiator is removed and reinserted into the operational fabric with a power cycle in order to examine the stability of the configuration. This procedure is repeated for each of the Initiators on the fabric.

Test Setup: *Test setup 2.* The Initiator is already operational on the fabric. The Target is seen by the Initiator.

Procedure:
1. Verify that the Target appears in the management of the Initiator.
2. Remove the Initiator from the fabric by powering it off.
3. Power on the Initiator.
4. Verify that the Target appears in the management of the Initiator.

Observable Results:
- The Target appears in the management of the Initiator both before and after the power cycle.

Possible problems: None.

Test 3.2: Initiator Power Cycle – With Traffic

Purpose: To verify proper operations of the Initiators and the Target during a power cycle of the Initiator when there is traffic on the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Initiator is removed and reinserted into the operational fabric with a power cycle in order to examine the stability of the configuration. This procedure is repeated for each of the Initiators on the fabric.

Test Setup: *Test setup 2.* The Initiator is already operational on the fabric. FCoE traffic is checked or started to verify proper operation of the fabric.

Procedure:
1. Perform 50% read, 50% write operations using 512B transfer size from all Initiators to the Target.
2. Verify traffic is operating properly.
3. Remove the Initiator from the fabric by powering it off.
4. Verify that FCoE traffic continues properly on all remaining Initiators.
5. Power on the Initiator.
6. Restart FCoE traffic between the Initiator and the Target.
7. Verify that all FCoE traffic operates properly.

Observable Results:
- All traffic operates properly on the remaining Initiators when the Initiator is removed from the fabric.
- All traffic operates properly when the Initiator restarts traffic to the Target.

Possible problems: None.

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Test 3.3: Target Power Cycle – No Traffic

Purpose: To verify proper operations of the Initiators and Target during a power cycle of the Target.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: The Target is power cycled in an operational fabric to examine the stability of the configuration.

Test Setup: *Test setup 2.* The Target is already operational on the fabric. All Initiators are able to see the Target.

Procedure:
1. Verify that the Target appears in the management of the Initiators.
2. Remove the Target from the fabric by powering it off.
3. Power on the Target.
4. Verify that the Target appears in the management of the Initiators.

Observable Results:
- The Target appears in the management of the Initiators both before and after the power cycle.

Possible Problems: None.

Test 3.4: Target Power Cycle – With Traffic

Purpose: To verify proper operations of the Initiators and the Target during a power cycle of the Target when there is traffic on the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Target is removed and reinserted into the operational fabric with a power cycle in order to examine the stability of the configuration.

Test Setup: *Test setup 2.* The Target is already operational on the fabric. FCoE traffic is checked or started to verify proper operation of the fabric.

Procedure:
1. Perform 50% read, 50% write operations using 512B transfer size from all Initiators to the Target.
2. Verify traffic is operating properly.
3. Remove the Target from the fabric by powering it off.
4. Verify that FCoE traffic aborts or times out on each of the Initiators.
5. Power on the Target.
6. Restart FCoE traffic between the Initiators and the Target.
7. Verify that all FCoE traffic operates properly.

Observable Results:
- Traffic aborts or times out on each Initiator when the Target is removed from the fabric.
- All traffic operates properly when the Target reappears on the fabric.

Possible problems: None.

Test 3.5: Initiator Cable Pull – No Traffic

Purpose: To verify proper operations of the Initiators and the Target during a cable pull of the Initiator when there is no traffic on the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Initiator is removed and reinserted into the operational fabric with a cable pull in order to examine the stability of the configuration. This procedure is repeated for each of the Initiators on the fabric.

Test Setup: *Test setup 2.* The Initiator is already operational on the fabric. The Target is seen by the Initiator.

Procedure:
1. Verify that the Target appears in the management of the Initiator.
2. Remove the Initiator from the fabric by disconnecting the cable (and module, if possible).
3. Reconnect the cable (and module, if possible).
4. Verify that the Target appears in the management of the Initiator.

Observable Results:
- The Target appears in the management of the Initiator both before and after the cable.

Possible problems: None.

Test 3.6: Initiator Cable Pull – With Traffic

Purpose: To verify proper operations of the Initiators and the Target during a cable pull of the Initiator when there is traffic on the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Initiator is removed and reinserted into the operational fabric with a cable pull in order to examine the stability of the configuration. This procedure is repeated for each of the Initiators on the fabric.

Test Setup: *Test setup 2*. The Initiator is already operational on the fabric. FCoE traffic is checked or started to verify proper operation of the fabric.

Procedure:
1. Perform 50% read, 50% write operations using 512B transfer size from all Initiators to the Target.
2. Verify traffic is operating properly.
3. Remove the Initiator from the fabric by disconnecting the cable (and module, if possible).
4. Verify that FCoE traffic continues properly on all remaining Initiators.
5. Reconnect the cable (and module, if possible).
6. Restart FCoE traffic between the Initiator and the Target.
7. Verify that all FCoE traffic operates properly.

Observable Results:
- All traffic operates properly on the remaining Initiators when the Initiator is removed from the fabric.
- All traffic operates properly when the Initiator restarts traffic on the fabric.

Possible problems: None.

Test 3.7: Target Cable Pull – No Traffic

Purpose: To verify proper operations of the Initiators and Target during a cable pull of the Target.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to configure Target resources.

Modification Record: July 22, 2010

Discussion: The Target is removed from the fabric with a cable pull to examine the stability of the configuration.

Test Setup: *Test setup 3.* The Target is already operational on the fabric. The Target is seen by all Initiators.

Procedure:
1. Verify that the Target appears in the management of the Initiators.
2. Remove the Target from the fabric by disconnecting the cable (and module, if possible).
3. Reconnect the cable (and module, if possible).
4. Verify that the Target appears in the management of the Initiators.

Observable Results:
- The Target appears in the management of the Initiators both before and after the power cycle.

Test 3.8: Target Cable Pull – With Traffic

Purpose: To verify proper operations of the Initiators and the Target during a cable pull of the Target when there is traffic on the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: During this phase of testing, the Target is removed and reinserted into the operational fabric with a cable pull in order to examine the stability of the configuration.

Test Setup: *Test setup 3.* The Target is already operational on the fabric. FCoE traffic is checked or started to verify proper operation of the fabric.

Procedure:
1. Perform 50% read, 50% write operations using 512B transfer size from all Initiators to the Target.
2. Verify traffic is operating properly.
3. Remove the Target from the fabric by disconnecting the cable (and module, if possible).
4. Verify that FCoE traffic aborts or times out on each of the Initiators.
5. Reconnect the cable (and module, if possible).
6. Restart FCoE traffic between the Initiator and the Targets.
7. Verify that all FCoE traffic operates properly.

Observable Results:
- Traffic aborts or times out on each Initiator when the Target is removed from the fabric.
- All traffic operates properly when the Target reappears on the fabric.

Possible problems: None.

Group 4: Target Testing - Stability Test

Overview: During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test 4.1: Stability Testing – Small Blocks

Purpose: I/O operations are performed with small block sizes between the Initiators and the Target in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Initiator FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 2.* The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations from Initiators to the Target with a block size of 4 bytes. (or the smallest that software can provide).
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from Initiators to the Target with a block size of 4 bytes. (or the smallest that software can provide).
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from Initiators to the Target with a block size of 4 bytes. (or the smallest that software can provide).
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and the Target.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 4.2: Stability Testing – Medium Blocks

Purpose: I/O operations are performed with medium block sizes between the Initiators and the Target in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Initiator FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 2.* The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations from Initiators to the Target with a block size of 512 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from Initiators to the Target with a block size of 512 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from Initiators to the Target with a block size of 512 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and the Target.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 4.3: Stability Testing – Large Blocks

Purpose: I/O operations are performed with large block sizes between the Initiators and the Target in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Initiator FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 2.* The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations from Initiators to the Target with a block size of 1 megabyte.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from Initiators to the Target with a block size of 1 megabyte.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from Initiators to the Target with a block size of 1 megabyte.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and the Target.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 4.4: Stability Testing – 1 Outstanding IO

Purpose: I/O operations are performed with outstanding IO's between the Initiators and the Target in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Initiator FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 2*. The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations with 1 outstanding IO from Initiators to the Target with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations with 1 outstanding IO from Initiators to the Target with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations with 1 outstanding IO from Initiators to the Target with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and the Target.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 4.5: Stability Testing – 5 Outstanding IOs

Purpose: I/O operations are performed with outstanding IO's between the Initiators and the Target in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Initiator FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 2.* The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations with 5 outstanding IOs from Initiators to the Target with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations with 5 outstanding IOs from Initiators to the Target with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations with 5 outstanding IOs from Initiators to the Target with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and the Target.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 4.6: Stability Testing – 10 Outstanding IOs

Purpose: I/O operations are performed with outstanding IO's between the Initiators and the Target in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Initiator FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 2.* The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing.

Procedure:
1. Perform 100% read operations with 10 outstanding IOs from Initiators to the Target with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations with 10 outstanding IOs from Initiators to the Target with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations with 10 outstanding IOs from Initiators to the Target with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and the Target.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed all the devices begin transmitting again.

Possible Problems: None.

Test 4.7: Stability Testing – ETS Testing

Purpose: I/O operations are performed along-side non-FCoE traffic between the Initiators and the Target in order to stress the fabric and test proper ETS.

Resource Requirements:
- Two or more FCoE Initiators.
- An FCoE Switch.
- Traffic Generator to source non-FCoE traffic.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 22, 2010

Discussion: The final phases of testing in the multi-Initiator FCoE environment involves only the set of devices that have operated properly through the previous phases of testing. During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test Setup: *Test Setup 2.* The Target and the Initiators are powered on. Operational fabric resulting from Group 2.1 testing. Configure ETS on the network to provide 50% bandwidth to FCoE traffic and 50% bandwidth to non-FCoE traffic. Begin constantly sourcing non-FCoE traffic on the network with the generator.

Procedure:
1. Perform 100% read operations from Initiators to the Target with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100% write operations from Initiators to the Target with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from Initiators to the Target with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and the Target.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.
- Verify that any priority group's traffic does not utilize more than the configured amount of bandwidth on the network.

Possible Problems: None.

Group 1: Switch Testing - Fabric Build

Overview: Initiators and Targets are added to a fabric with the single FCoE Switch one at a time and FCoE activity is started from each of the Initiators to every Target.

Test 1.1: Fabric Build – Multi-Initiator, Multi-Target

Purpose: To verify proper operations of the Switch during fabric build.

Resource Requirements:
- Two or more FCoE Initiators.
- Two or more FCoE Targets.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Configure Target resources.
  - Perform read/write operations to Target resources.

Modification Record: July 22, 2010

Discussion: In the fabric build phase the Initiators and Targets that behaved properly during screening are added one at a time to a fabric through the Switch. The Targets are added to the fabric first. Then each Initiator is added to the fabric one at a time. After the addition of each Initiator the fabric is examined to see if it is still operating properly. FCoE traffic is checked or started to verify proper operation of the fabric. During the fabric build phase of testing it may be necessary to eliminate devices. A device is removed from the build if the device does not perform properly or exhibits some other behavior that causes other devices to malfunction. In the case where two incorrect behaviors are observed (i.e. a device creates an error condition on the fabric and another device does not respond properly to the error condition) the device which generated the error condition will be removed.

Test Setup: *Test Setup 4*. The Initiators and Targets are powered off. Connect the Targets to the Switch and power up each Target.

Procedure:
For each FCoE Initiator to be added to the fabric repeat the following procedure:
1. Ensure the fabric is in a stable state with FCoE traffic between the Targets and all Initiators currently on the fabric.
2. Verify the proper operation of traffic running on FCoE Initiators currently on the fabric.
3. Connect and then power on the next Initiator and wait until the Initiator is operational.
4. Start FCoE activity from Initiator to all Targets if the fabric appears to be operational.

Observable Results:
- FCoE traffic on previously added Initiators continues to operate properly.
- Added Initiator establishes connections to the Targets.
- Added Initiator's FCoE traffic is properly operational.

Possible problems: None.

Group 2: Switch Testing - Stability Test

Overview: During this phase of testing the traffic load is increased and the fabric is monitored for errors.

Test 2.1: Stability Testing – Small Blocks

Purpose: I/O operations are performed with small block sizes between the Initiators and the Targets in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- Two or more FCoE Targets.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
  - Perform read/write operations to Target resources
  - Configure Target resources

Modification Record: July 26, 2010

Discussion: The fabric created by Test 1.1 is stressed by having all Initiators perform IO operations to all Targets using small block sizes.

Test Setup: *Test Setup 4.* The Targets and the Initiators are powered on. Operational fabric resulting from Test 1.1.

Procedure:
1. Perform 100% read operations from all Initiators to all Targets with a block size of 4 bytes. (or the smallest that software can provide).
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from all Initiators to all Targets with a block size of 4 bytes. (or the smallest that software can provide).
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from all Initiators to all Targets with a block size of 4 bytes. (or the smallest that software can provide).
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write and Read/Write operations complete successfully between all Initiators and all Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 2.2: Stability Testing – Medium Blocks

Purpose: I/O operations are performed with medium block sizes between the Initiators and the Targets in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- Two or more FCoE Targets.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 26, 2010

Discussion: The fabric created by Test 1.1 is stressed by having all Initiators perform IO operations to all Targets using medium block sizes.

Test Setup: *Test Setup 4.* The Targets and the Initiators are powered on. Operational fabric resulting from Test 1.1.

Procedure:
1. Perform 100% read operations from all Initiators to all Targets with a block size of 512 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from all Initiators to all Targets with a block size of 512 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from all Initiators to all Targets with a block size of 512 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and all Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 2.3: Stability Testing – Large Blocks

Purpose: I/O operations are performed with large block sizes between the Initiators and the Targets in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- Two or more FCoE Targets.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 26, 2010

Discussion: The fabric created by Test 1.1 is stressed by having all Initiators perform IO operations to all Targets using large block sizes.

Test Setup: *Test Setup 4.* The Targets and the Initiators are powered on. Operational fabric resulting from Test 1.1.

Procedure:
1. Perform 100% read operations from all Initiators to all Targets with a block size of 1 megabyte.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from all Initiators to all Targets with a block size of 1 megabyte.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from all Initiators to all Targets with a block size of 1 megabyte.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and all Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 2.4: Stability Testing – 1 Outstanding IO

Purpose: I/O operations are performed with outstanding IO's between the Initiators and the Targets in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- Two or more FCoE Targets.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 26, 2010

Discussion: The fabric created by Test 1.1 is stressed by having all Initiators perform IO operations to all Targets with a single outstanding IO.

Test Setup: *Test Setup 4.* The Targets and the Initiators are powered on. Operational fabric resulting from Test 1.1.

Procedure:
1. Perform 100% read operations with 1 outstanding IO from all Initiators to all Targets with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations with 1 outstanding IO from all Initiators to all Targets with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations with 1 outstanding IO from all Initiators to all Targets with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and all Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 2.5: Stability Testing – 5 Outstanding IOs

Purpose: I/O operations are performed with outstanding IO's between the Initiators and the Target in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- Two or more FCoE Targets.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 26, 2010

Discussion: The fabric created by Test 1.1 is stressed by having all Initiators perform IO operations to all Targets with five outstanding IO's.

Test Setup: *Test Setup 4.* The Targets and the Initiators are powered on. Operational fabric resulting from Group 1.1 testing.

Procedure:
1. Perform 100% read operations with 5 outstanding IOs from all Initiators to all Targets with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations with 5 outstanding IOs from all Initiators to all Targets with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations with 5 outstanding IOs from all Initiators to all Targets with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and all Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.

Possible Problems: None.

Test 2.6: Stability Testing – 10 Outstanding IOs

Purpose: I/O operations are performed with outstanding IO's between the Initiators and the Target in order to stress the fabric.

Resource Requirements:
- Two or more FCoE Initiators.
- Two or more FCoE Targets.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 26, 2010

Discussion: The fabric created by Test 1.1 is stressed by having all Initiators perform IO operations to all Targets with ten outstanding IO's.

Test Setup: *Test Setup 4.* The Targets and the Initiators are powered on. Operational fabric resulting from Group 1.1 testing.

Procedure:
1. Perform 100% read operations with 10 outstanding IOs from all Initiators to all Targets with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations with 10 outstanding IOs from all Initiators to all Targets with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations with 10 outstanding IOs from all Initiators to all Targets with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and all Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed all the devices begin transmitting again.

Possible Problems: None.

Test 2.7: Stability Testing – ETS Testing

Purpose: I/O operations are performed along-side non-FCoE traffic between the Initiators and the Target in order to stress the fabric and test proper ETS.

Resource Requirements:
- Two or more FCoE Initiators.
- Two or more FCoE Targets.
- Traffic Generator to source non-FCoE traffic.
- Monitor to capture traffic.
- Applications or system software that allows the administrator to:
    - Perform read/write operations to Target resources
    - Configure Target resources

Modification Record: July 26, 2010

Discussion: The fabric created by Test 1.1 is stressed by having all Initiators perform IO operations to all Targets with non-FCoE traffic also on the line.

Test Setup: *Test Setup 4.* The Targets and the Initiators are powered on. Operational fabric resulting from Group 1.1 testing.

Procedure:
1. Perform 100% read operations from all Initiators to all Targets with a block size of 4 kilobytes.
2. Allow traffic to run for 10 minutes.
3. Perform 100%write operations from all Initiators to all Targets with a block size of 4 kilobytes.
4. Allow traffic to run for 10 minutes.
5. Perform 50% read, 50% write operations from all Initiators to all Targets with a block size of 4 kilobytes.
6. Allow traffic to run for 10 minutes.

Observable Results:
- Verify that the Read and Write operations complete successfully between all Initiators and all Targets.
- Verify that when there is a PAUSE all devices properly halt transmission and when it is removed the devices begin transmitting again.
- Verify that any priority group's traffic does not utilize more than the configured amount of bandwidth on the network.

Possible Problems: None.