Fibre Channel Consortium

FC-BB-6
VN_Port to VN_Port Test Suite
Version 1.0

Technical Document

Last Updated: April 8, 2013

Fibre Channel Consortium
InterOperability Laboratory
University of New Hampshire

121 Technology Drive, Suite 2
Durham, NH 03824
Phone: +1-603-862-0701
Fax: +1-603-862-4181
http://www.iol.unh.edu/consortiums/fc

The University of New Hampshire
InterOperability Laboratory

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Modification Record

- April 8, 2013 – Version 1.0 Release – Dan Shea: Original Document based off of FC-BB-6 rev 1.2 Standard

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Mikkel Hagen   University of New Hampshire
Dan Shea   University of New Hampshire

Introduction

Overview
The University of New Hampshire's InterOperability Laboratory (UNH-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. These tests are designed to determine if an FCoE product conforms to specifications defined in ***Fibre Channel Backbone 6 (FC-BB-6) Rev 1.2 Standard T11/Project 2159-D*** (hereafter refered to as "FC-BB-6"). This suite of tests has been developed to help implementers evaluate the functioning of their Fibre Channel over Ethernet-based products. The tests do not determine if a product conforms to the Fibre Channel standard, nor are they purely interoperability tests. Rather, they provide one method to isolate problems within a Fibre Channel device. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other Fibre Channel 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 multivendor Fibre Channel Environments.

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

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

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

References
This section specifies all reference material *external* to the test suite, including the specific subclauses references for the test in question, and any other references that might be helpful in understanding the test methodology and/or test results. External sources are always referenced by a bracketed number (e.g., [1]) when mentioned in the test description. Any other references in the test description that are not indicated in this manner refer to elements within the test suite document itself (e.g., "Appendix 6.A", or "Table 6.1.1-1")

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

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

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

Test Setup
The setup section describes in detail the configuration of the test environment and includes a block diagram for clarification as well as information such as the interconnection of devices, what monitoring equipment should capture, what the generation equipment should send, and any other configuration information vital to carrying out the test. Small changes in the configuration should be included in the test procedure.

Procedure
The procedure section of the test description contains the step-by-step instructions for carrying out the test. It provides a cookbook approach to testing, and will often be interspersed with observable results.

Observable Results
The observable results section list observables that can be examined by the tester to verify that the DUT is operating properly. When multiple values are possible for an observable, this section provides a short discussion on how to interpret them. Note that complete delineation between the observables in the **Procedure** and **Observable** is virtually impossible. As such, a careful note should be made of the requirement in both sections. In certain cases, it may be necessary to modify certain steps in the **Procedure** section while doing the actual tests so as to be able to perform the tests. In such cases, the modifications will be noted in the summary report.

Possible Problems
This section provides some troubleshooting procedures in the event that the test does not yield the expected results.

Legend
For reasons of brevity, the following abbreviations are used within this test suite:

DUT	Device Under Test
FCoE	Fibre Channel over Ethernet
FIP	FCoE Initialization Protocol
TS	Testing Station

In the test suite, state transitions have been described using the notations used in the FC-BB-6 document. Any underlined set of transitions implies that the transition is repeated continuously.

References

The following documents are referenced in this text:

- ANSI X3T11/Project 2159-D/Rev. 1.2 Fibre Channel Backbone 6 FC-BB-6 (hereafter referred to as "FC-BB-6")

Test Setup

The following test setup is used in this test suite:

Test Setup 1:

Testing Station   Monitor   DUT
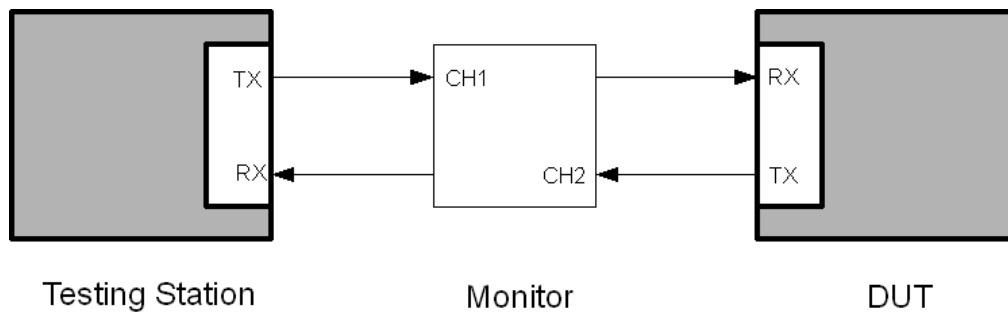
Group 1: VN_Port to VN_Port Virtual Link Instantiation

Overview: The following tests exercise the DUT's ability to instantiate VN_Port to VN_Port virtual links.

Test #7.1.1: VN_Port to VN_Port Virtual Link Instantiation

Purpose: To verify that the DUT establishes a VN_Port to VN_Port Virtual Link after fabric login.

References:
    FC-BB-6 – Clause 7.9.4.3 – Page 113

Resource Requirements:
    • A Testing Station capable of transmitting user-defined FCoE Frames
    • A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
    A VN2VN ENode MAC, operating in either multipoint or point-to-point mode, instantiates VN_Port to VN_Port Virtual Links on successful completion of a FIP FLOGI for a point-to-point topology

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
    1. The Testing Station is instructed to log into the DUT using FIP.
    2. The DUT is expected to then proceed into preforming Fabric login.
    3. Traffic is monitored and captured.

Observable Results:
    Verify that the DUT instantiates a VN_Port to VN_Port Virtual Link upon successful completion of the fabric login process.

Possible Problems: None.

Test #7.1.2: Proper FIP Frame Formatting

Purpose: To verify that the DUT specifies the addressing mode that it intends to use when it transmits a FIP FLOGI or a FIP NPIV FDISC during Fabric login.

References:
    FC-BB-6 – Clause 7.9.4.3 – Page 113

Resource Requirements:
   • A Testing Station capable of transmitting user-defined FCoE Frames
   • A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
    Both FIP FLOGI Request and LS_ACC shall have the Locally Unique N_Port_ID of the originating VN2VN_Port as S_ID, the Locally Unique N_Port_ID of the destination VN2VN_Port as D_ID for the point-to-point FLOGI protocol, and the originating VN_Port FPMA in the MAC Address descriptor. The MAC addresses of the FIP FLOGI Request and LS_ACC shall be the ENode MAC addresses of the involved VN2VN_Ports. As specified in FC-LS-2, the VN2VN_Port with the greater N_Port_Name proceeds to N_Port Login, with the PLOGI ELSs encapsulated in FCoE. Both FCoE PLOGI Request and LS_ACC shall have the Locally Unique N_Port_ID of the originating VN2VN_Port as S_ID and the Locally Unique N_Port_ID of the destination VN2VN_Port as D_ID.

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
    1. The Testing Station is instructed to log into the DUT using FIP.
    2. The DUT is expected to then proceed into preforming Fabric login.
    3. Traffic is monitored and captured.

Observable Results:
    Verify that the FIP FLOGI Request and LS_ACC have the Locally Unique N_Port_ID of the originating VN2VN_Port as S_ID, the Locally Unique N_Port_ID of the destination VN2VN_Port as D_ID for the point-to-point FLOGI protocol, and the originating VN_Port FPMA in the MAC Address descriptor. Verify that the MAC addresses of the FIP FLOGI Request and LS_ACC are the ENode MAC addresses of the involved VN2VN_Ports. Also verify that the VN2VN_Port with the greater N_Port_Name proceeds to N_Port Login, with the PLOGI ELSs encapsulated in FCoE. Further verify that the FCoE PLOGI Request and LS_ACC have the Locally Unique N_Port_ID of the originating VN2VN_Port as S_ID and the Locally Unique N_Port_ID of the destination VN2VN_Port as D_ID.

Possible Problems: None.

Test #7.1.3: Rejection of Invalid FIP FLOGI Request

Purpose: To verify that the DUT rejects FIP FLOGI Requests from an invalid VN2VN_Port.

References:
    FC-BB-6 – Clause 7.9.4.3 – Page 113

Resource Requirements:
- A Testing Station capable of transmitting user-defined FCoE Frames
- A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
    A FIP FLOGI Request in a point-to-point topology coming from a VN2VN_Port not listed in the VN2VN Neighbor Set shall be rejected with reason code 'FIP Error' (i.e., 20h) and reason code explanation 'VN2VN_Port Not in Neighbor Set' (i.e., 62h).

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
1. The Testing Station is instructed to log into the DUT using FIP.
2. The DUT is expected to then proceed into preforming Fabric login.
3. The Testing Station then transmits a FIP FLOGI Request from an invalid VN2VN_Port.
4. Traffic is monitored and captured.

Observable Results:
    Verify that the DUT responds with a LS_RJT frame with the reason Reason Code 20h and Reason Explanation 62h.

Possible Problems: None.

Test #7.1.4: VN_Port to VN_Port Link Deinstantiation

Purpose: To verify that the DUT properly deinstantiates the virtual link upon reception of a properly formatted FIP LOGO frame.

References:
FC-BB-6 – Clause 7.9.4.3 – Page 113

Resource Requirements:
- A Testing Station capable of transmitting user-defined FCoE Frames
- A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
A VN_Port to VN_Port Virtual Link is explicitly deinstantiated by performing a FIP LOGO, that deinstantiates the FCoE_LEPs and performs a N_Port logout. The S_ID and D_ID on the encapsulated LOGO ELS shall be set to the Locally Unique N_Port_IDs of the involved VN2VN_Ports.

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
1. The Testing Station is instructed to log into the DUT using FIP.
2. The DUT is expected to then proceed into preforming Fabric login.
3. The Testing Station transmits a FIP LOGO frame to the DUT.
4. Traffic is monitored and captured.

Observable Results:
Verify that the DUT responds with an encapsulated LOGO ELS and that the S_ID and D_ID values are set to the Locally Unique N_Port_IDs of the involved VN2VN_Ports.

Possible Problems: None.

Group 2: VN_Port to VN_Port Virtual Link Maintenance

Overview: The following tests exercise the DUT's ability to maintain VN_Port to VN_Port virtual links.

Test #7.2.1: Physical Layer Disconnect

Purpose: To verify that, when the physical layer of the DUT becomes non-operational due to a local fault, it will deinstantiate all of its links.

References:
> FC-BB-6 – Clause 7.9.5.4 – Page 116

Resource Requirements:
- A Testing Station capable of transmitting user-defined FCoE Frames
- A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
> To deal with local physical layer faults, a VN2VN ENode MAC shall deinstantiate all its VN_Port to VN_Port Virtual Links upon detecting that its physical layer is not operational.

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
1. The Testing Station is instructed to log into the DUT using FIP.
2. The fiber connecting the DUT and the testing station is disconnected.
3. Traffic is monitored and captured.

Observable Results:
> Verify in the DUT's management that, after the fiber is disconnected, the DUT deinstantiates all of its VN_Port to VN_Port virtual links.

Possible Problems: None.

Test #7.2.2: Reception of N_Port_ID Beacon

Purpose: To verify that, when the physical layer of the DUT becomes non-operational due to a non-local fault, it will deinstantiate all of its links.

References:
FC-BB-6 – Clause 7.9.5.4 – Pages 116-117

Resource Requirements:
- A Testing Station capable of transmitting user-defined FCoE Frames
- A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
To deal with non-local faults, the FCoE Controller of a VN2VN ENode MAC operating in multipoint mode shall continuously verify the state of the VN_Port to VN_Port Virtual Links by verifying received N_Port_ID Beacons per each VN2VN_Port in the VN2VN Login Set. The FCoE Controller of a VN2VN ENode MAC operating in point-to-point mode shall continuously verify the state of the VN_Port to VN_Port Virtual Link by verifying received N_Port_ID P2P Beacons per the VN2VN_Port in the VN2VN Login Set.

N_Port_ID Beacons and N_Port_ID P2P Beacons are expected to be received every BEACON_PERIOD. If N_Port_ID Beacons or N_Port_ID P2P Beacons from a VN2VN_Port are not received within 2.5 * BEACON_PERIOD, that VN2VN_Port shall be removed from the VN2VN Neighbor Set and from the VN2VN Login Set and VN_Port to VN_Port Virtual Links with that remote VN2VN_Port, if any, shall be implicitly deinstantiated.

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
1. The Testing Station is instructed to log into the DUT using FIP.
2. The Testing Station then transmits one N_Port_ID Beacon every BEACON_PERIOD for five BEACON_PERIODs.
3. The Testing Station halts transmission of N_Port_ID Beacons for a duration exceeding 2.5 * BEACON_PERIOD.
4. Traffic is monitored and captured.

Observable Results:
Verify that the DUT deinstantiates the link with the Testing Station after not receiving an N_Port_ID Beacon for a duration of 2.5 * BEACON_PERIOD.

Possible Problems: None.

Test #7.2.3: Transmission of N_Port_ID Beacon

Purpose: To verify that the DUT transmits an N_Port_ID Beacons within 2.5 * BEACON_PERIOD.

References:
FC-BB-6 – Clause 7.9.5.4 – Pages 116-117

Resource Requirements:
- A Testing Station capable of transmitting user-defined FCoE Frames
- A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
N_Port_ID Beacons and N_Port_ID P2P Beacons are expected to be received every BEACON_PERIOD. If N_Port_ID Beacons or N_Port_ID P2P Beacons from a VN2VN_Port are not received within 2.5 * BEACON_PERIOD, that VN2VN_Port shall be removed from the VN2VN Neighbor Set and from the VN2VN Login Set and VN_Port to VN_Port Virtual Links with that remote VN2VN_Port, if any, shall be implicitly deinstantiated.

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
1. The Testing Station is instructed to log into the DUT using FIP.
2. Traffic is monitored and captured for five minutes.

Observable Results:
Verify that the DUT transmits N_Port_ID Beacons within 2.5 * BEACON_PERIOD of the previous N_Port_ID Beacon.

Possible Problems: None.

Group 3: VN_Port to VN_Port Functional Model

Overview: The following tests verify the DUT's ability to properly operate in a VN2VN_Port network.

Test #7.3.1: Unique N_Port_ID

Purpose: To verify that the DUT has a unique N_Port_ID during the login process.

References:
FC-BB-6 – Clause 7.4 – Page 93

Resource Requirements:
- A Testing Station capable of transmitting user-defined FCoE Frames
- A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
N_Port_IDs used for VN_Port to VN_Port Virtual Links shall be unique over the Lossless Ethernet network to which VN2VN ENode MACs are connected and are suitable to be used only for communications over that Lossless Ethernet network. These N_Port_IDs are called Locally Unique N_Port_IDs.

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
1. The Testing Station is instructed to log into the DUT using FIP.
2. The Testing Station is instructed to log into the DUT again using the N_Port_ID that the DUT used during the previous login.
3. Traffic is monitored and captured.

Observable Results:
Verify that the DUT has a different N_Port_ID during the second login than what was used during the first login.

Possible Problems: None.

Test #7.3.2: Properly Formed Fabric Provided MAC Address

Purpose: To verify that the DUT uses a properly formatted FPMA.

References:
    FC-BB-6 – Clause 7.4 – Page 93

Resource Requirements:
- A Testing Station capable of transmitting user-defined FCoE Frames
- A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
    The FPMA used as VN_Port MAC address for a VN2VN_Port is determined by concatenating its Locally Unique N_Port_ID to the constant VN2VN-FC-MAP. The constant VN2VN-FC-MAP has the value 0EFD00h. This enables easy recognition of the MAC addresses used by FCoE for VN_Port to VN_Port communications, because they all share the same VN2VN-FC-MAP prefix. The value VN2VN-FC-MAP shall not be used as a Fabric FC-MAP.

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
1. The Testing Station is instructed to log into the DUT using FIP.
2. Traffic is monitored and captured.

Observable Results:
    Verify that the FPMA of the DUT is its MAC address concatenated with the constant 0EFD00h.

Possible Problems: None.

Test #7.3.3: Valid N_Port_ID Range

Purpose: To verify that the DUT uses an N_Port_ID within the range of 000001h – 00FFFEh.

References:
    FC-BB-6 – Clause 7.4 – Page 94

Resource Requirements:
    • A Testing Station capable of transmitting user-defined FCoE Frames
    • A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
    Locally Unique N_Port_IDs shall belong to the range 000001h to 00FFFEh. This ensures that they do not conflict with N_Port_IDs assigned by a Fibre Channel Fabric, because a Fabric does not assign N_Port_IDs with Domain_ID zero.

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
    1. The Testing Station is instructed to log into the DUT using FIP.
    2. Traffic is monitored and captured.

Observable Results:
    Verify that the N_Port_ID of the DUT is within the range of 000001h – 00FFFEh.

Possible Problems: None.

Test #7.3.4: Valid Destination and Source MAC Addresses

Purpose: To verify that the DUT accepts FCoE frames with properly formed Destination and Source MAC Addresses while discarding all other frames.

References:
    FC-BB-6 – Clause 7.4 – Page 94

Resource Requirements:
   •   A Testing Station capable of transmitting user-defined FCoE Frames
   •   A Monitor capable of capturing FCoE traffic.

Last Updated: April 8, 2013

Discussion:
    For an FCoE_LEP associated with a VN2VN_Port, the MAC address of the local link end-point is the FPMA associated with that VN2VN_Port and the remote link end-point address is the FPMA associated with the remote VN2VN_Port. Therefore the source MAC address of FCoE frames used for VN_Port to VN_Port Virtual Links is 'VN2VN-FC-MAP || S_ID' and the destination MAC address is 'VN2VN-FC-MAP || D_ID'. On receiving an FCoE frame, the FCoE_LEP associated with a VN2VN_Port shall verify that the least significant 24 bits of the source MAC address are equal to the S_ID of the encapsulated FC frame and that the least significant 24 bits of the destination MAC address are equal to the D_ID of the encapsulated FC frame. If any check fails the FCoE frame shall be discarded.

Test Setup: *Test Setup 1*. Connect the Testing Station and DUT as shown. The DUT is powered on and has not logged in.

Procedure:
Part A
   1.   The Testing Station is instructed to log into the DUT using FIP.
   2.   Traffic is monitored and captured.
Part B
   1.   The Testing Station is instructed to log into the DUT using FIP.
   2.   The Testing Station is instructed to transmit FCoE frames with a source MAC address of 00:01:02:03:04:05.
   3.   Traffic is monitored and captured.
Part C
   1.   The Testing Station is instructed to log into the DUT using FIP.
   2.   The Testing Station is instructed to transmit an FCoE frame with a destination MAC address of 00:01:02:03:04:05.
   3.   Traffic is monitored and captured.

Observable Results:
    For Part A, verify that the source MAC address of the FCoE frames transmitted from the Testing Station is 'VN2VN-FC-MAP || S_ID', the destination MAC address is 'VN2VN-FC-MAP || D_ID', and that the DUT accepts these frames. For Parts B and C, verify that the DUT discards the FCoE frames.

Possible Problems: None.