Ethernet Switching Protocols

Link Layer Discovery Protocol - Media Endpoint Discovery Interoperability Test Suite

Version 1.2

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Contents

Modification Record

Version	Date	Editor(s)	Comments
1.0	2007-04-06	Andrew Corcoran	Initial Revision
1.1	2007-08-10	Andrew Corcoran	Additional Revisions
1.2	2016-07-26	Patrick Lee	Formatting Changes General Revisions Updated Procedures

Introduction

The University of New Hampshire's InterOperability Laboratory (UNH-IOL) operates with the primary focus to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. In addition to interoperability testing, this suite of tests has been developed to help implementers evaluate the operations/functionality of their LLDP-MED capable products. This suite of tests has been developed to help implementers evaluate the interoperability of their LLDP-MED capable products.

ANSI/TIA-1057-2006 states:
"LLDP is a Link-layer protocol that transmits advertisements containing device information, device capabilities and media specific configuration information periodically to neighbors attached to the same network. The LLDP agent operates only in an advertising mode, and hence does not support any means for soliciting information, or keeping state between two LLDP entities."

This Test Suite has been designed based on the set of clauses in IEEE Std 802.1AB™-2005 and ANSI/TIA-1057-2006 that pertain to LLDP-MED. The test suite is designed to help determine whether or not the DUT will behave in accordance with the standard during normal operation.

These Tests are not designed to evaluate performance. The relative performance of LLDP-MED capable devices (e.g. bridges, switches, IP phones, etc.) is beyond the scope of this document.

These Tests do not guarantee the DUT conforms to IEEE Std. 802.1AB™-2005, nor are they designed as interoperability tests. Rather, they provide one method to isolate problems within a LLDP-MED capable device that will affect interoperability. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other LLDPMED capable devices. However, combined with satisfactory completion of operations testing, these tests provide a reasonable level of confidence that the DUT will function well in most LLDP-MED capable environments.

Abbreviations and Acronyms

IEEE/ANSI

BPDU	Bridge Protocol Data Unit
LAN	Local Area Network
LLDP	Link Layer Discovery Protocol
LLDPDU	Link Layer Discovery Protocol Data Unit
MAC	Media Access Control
MED	Media Endpoint Discovery
MSTP	Multiple Spanning Tree
PHY	Physical Layer
PVID	Port VLAN ID
RSTP	Rapid Spanning Tree Protocol
STP	Spanning Tree Protocol
TLV	Type Length Value
VLAN	Virtual LAN

LLDP-MED Interoperability Test Suite

DUT	Device Under Test
DUT.TS	Port on the DUT connected to Test Station (ex.DUT.TS1 refers to the Port on the DUT connected to Test Station 1)
TS	Test Station (ex. TS1 refers to Test Station 1)

Test Organization

This document organizes tests by group based on related test methodology or goals. Each group begins with a brief set of comments pertaining to all tests within that group. This is followed by a series of description blocks; each block describes a single test. The format of the description block is as follows:

Test Label: The Test Label and title comprise the first line of the test block. The Test Label is the concatenation of the short test suite name, group number, and the test number within the group, separated by periods. The test label FDB.op.1.2 refers to the second test of the first group in the Filtering Database Conformance Test Suite.

Purpose: The Purpose is a short statement describing what the test attempts to achieve. It is usually phrased as a simple assertion of the feature or capability to be tested.

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

Resource Requirements: The Resource Requirements section specifies the software, hardware, and test equipment that will be needed to perform the test.

Discussion: The Discussion is a general discussion of the test and relevant sections of the specification, including any assumptions made in the design or implementation of the test as well as known limitations.

Test Setup: The Default Test Setup section describes the configuration of the DUT prior to the start of the test. The procedure may involve configuration steps that deviate from what is given in the test setup. If a value is not provided for a protocol parameter, then the protocol's default is used for that parameter.

Test Procedure: This section of the test description contains the step-by-step instructions for carrying out the test. These steps include such things as enabling interfaces, disconnecting links between devices, and sending MAC frames from a Test Station. The test procedure may also cues instruct the tester to make observations, which are interpreted in accordance with the observable results given for that test part.

Observable Results: This section lists observable results that can be examined by the tester to verify that the DUT is operating properly. When multiple observable results are possible, this section provides a short discussion on how to interpret them. The determination of a pass or fail for each test is usually based on how the behavior of the DUT compares to the results described in this section.

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

Group 1:   Basic LLDP-MED.io

Scope: To verify the behavior of the LLDP-MED capable DUT when placed in a Test Network with an LLDP-MED capable Link Partner.

Test LLDP.io.1.1 — Mandatory LLDP/LLDP-MED TLVs

Purpose: To verify that the DUT can properly exchange the mandatory LLDP TLVs and LLDP-MED TLVs with its Link Partner.

References: [1] ANSI TIA 1057: sub-section 9.1   [3] ANSI TIA 1057: sub-section 11.3
           [2] ANSI TIA 1057: sub-section 11.2

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: This test verifies that the DUT can properly exchange information with an LLDP-MED capable Link Partner, specifically the mandatory TLVs defined in IEEE Std. 802.1AB-Draft 13 Table 9-1.

The three defined mandatory TLVs that generate objects to be stored and retrieved are: Chassis ID TLV, Port ID TLV, and Time To Live TLV; the mandatory TLVs must be included in all LLDPDUs in the order listed above. In addition to the mandatory LLDP TLVs, the DUT must transmit all LLDP-MED TLVs mandated for the device class type that the DUT is a member of, per ANSI TIA 1057 6.1 and 6.2. All LLDPDUs must be terminated with the End Of LLDPDU TLV. The DUT and LLDP capable Link Partner must exchange information in the mandatory TLVs. Information exchanged in the TLVs must be stored in an accessible format, such as SNMP.

This test also verifies the proper operation of the adminStatus parameter, which controls the operating mode of the System's LLDP agent. The adminStatus parameter can be configured to one of the following values: enabledTxRx, enabledTxOnly, enabledRxOnly, disabled.

Parts B and C cannot be completed if the adminStatus parameter of the DUT cannot be configured.

Test Setup: Refer to the Default Test Setup in Appendix A.
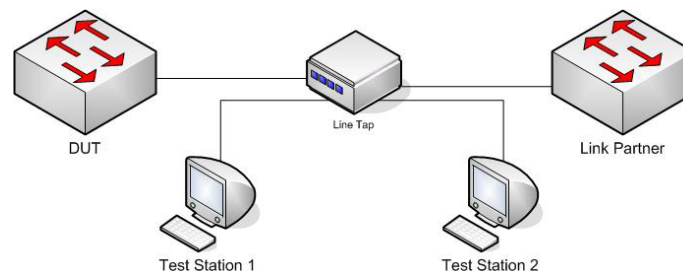
Test Procedure:

Part A: Mandatory LLDP and LLDP-MED TLVs - DUT adminStatus = enabledTxRx
  1. Ensure the DUT and LP are configured to the test setup as defined above.
  2. Wait 31 seconds.

Part B: Mandatory LLDP and LLDP-MED TLVs - DUT adminStatus = enabledTxOnly
  1. Ensure the DUT and LP are configured to the test setup as defined above.
  2. Set the DUT's adminStatus parameter to enabledTxOnly.
  3. Wait 31 seconds.

Part C: Mandatory LLDP and LLDP-MED TLVs - DUT adminStatus = enabledRxOnly
  1. Ensure the DUT and LP are configured to the test setup as defined above.
  2. Set the DUT's adminStatus parameter to enabledRxOnly.
  3. Wait 31 seconds.

Observable Results:

Part A:
- In step 2, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 2, the LLDP Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively.
- In step 2, the LLPD-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 2, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively.
- In step 2, TS1 and TS2 must capture properly formatted LLDPDUs containing the three mandatory TLVs, the LLDP-MED TLVs mandatory for the device class that each device is a member of, and the End Of LLDPDU TLV.

Part B:
- In step 3, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP.
- In step 3, the LLDP Remote System mandatory TLV information on the LP must contain the characteristics of the DUT.
- In step 3, the LLDP-MED Local System mandatory TLV information must correlate to the characteristics of the DUT and LP.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the LP must not contain the characteristics of the DUT.
- In step 3, TS1 and TS2 must capture properly formatted LLDPDUs containing the three mandatory TLVs, the LLDP-MED TLVs mandatory for the device class that each device is a member of, and the End of LLDPDU TLV.

Part C:
- In step 3, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP Remote System mandatory TLV information on the DUT must contain the characteristics of the LP.
- In step 3, the LLDP Remote System mandatory TLV information on the LP must not contain the characteristics of the DUT.
- In step 3, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT must contain the characteristics of the LP.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the LP must contain the characteristics of the DUT.
- In step 3, TS1 must not capture any LLDPDUs.
- In step 3, TS2 must capture properly formatted LLDPDUs containing the three mandatory TLVs, the LLDP-MED TLVs mandatory for the device class that each device is a member of, and the End Of LLDPDU TLV.

Possible Problems: None.

Test LLDP.io.1.2 — Optional LLDP/Mandatory LLDP-MED TLVs

Purpose: To verify that the DUT can properly exchange the optional TLVs with its Link Partner.

References: [1] ANSI TIA 1057: sub-section 9.1

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: This test verifies that the DUT can properly exchange information with an LLDP-MED capable Link Partner, specifically the optional TLVs defined in IEEE Std. 802.1AB-Draft 13 Table 9-1.

The five defined optional TLVs are: Port Description TLV, System TLV, System Description TLV, System Capabilities TLV and Management Address TLV; the optional TLVs may be included in the LLDPDU as determined by the implementer and/or device configuration. In addition to the mandatory LLDP TLVs, the DUT must transmit all LLDP-MED TLVs mandated for the device class type that the DUT is a member of, per ANSI TIA 1057 6.1 and 6.2. All LLDPDUs are terminated with the End Of LLDPDU TLV. The DUT and LLDP capable Link Partner must exchange the information contained in the optional TLVs supported by the DUT and LP. Information exchanged in the TLVs must be stored in an accessible format, such as SNMP.

This test applies most importantly to devices that are Communications Device Endpoints, or Class III endpoints, as the LLDP-MED standard mandates their implementation of the 802.1AB System Capabilities TLV.

This test also verifies the proper operation of the adminStatus parameter, which controls the operating mode of the System's LLDP agent. The adminStatus parameter can be configured to one of the following values: enabledTxRx, enabledTxOnly, enabledRxOnly, disabled.

Parts B and C cannot be completed if the DUT does not support configuration of the adminStatus parameter.

Test Setup: Refer to the Default Test Setup in Appendix A.
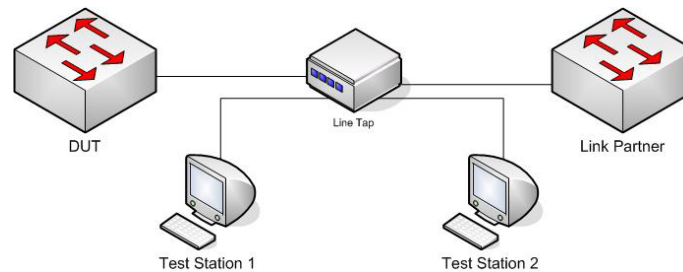
Test Procedure:

Part A: Optional LLDP/Mandatory LLDP-MED TLVs - DUT adminStatus = enabledTxRx
1. Ensure the DUT and LP are configured to the test setup as defined above.
2. Set all the DUT's optional TLVs to enabled for transmission.
3. Wait 31 seconds.

Part B: Optional LLDP/Mandatory LLDP-MED TLVs - DUT adminStatus = enabledTxOnly
1. Ensure the DUT and LP are configured to the test setup as defined above.
2. Set all the DUT's optional TLVs to enabled for transmission.
3. Set the DUT's adminStatus parameter to enabledTxOnly.
4. Wait 31 seconds.

Part C: Optional LLDP/Mandatory LLDP-MED TLVs - DUT adminStatus = enabledRxOnly
1. Ensure the DUT and LP are configured to the test setup as defined above.
2. Set all the DUT's optional TLVs to enabled for transmission.
3. Set the DUT's adminStatus parameter to enabledRxOnly.
4. Wait 31 seconds.

Observable Results:

Part A:
- In step 3, the LLDP Local System optional TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP Remote System optional TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively.
- In step 3, TS1 and TS2 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, the 5 optional LLDP TLVs, the mandatory LLDP-MED TLVs for the device classes that the DUT and LP are members of, and the End Of LLDPDU TLV.

Part B:
- In step 4, the LLDP Local System optional TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 4, the LLDP Remote System optional TLV information on the DUT must not contain the characteristics of the LP.
- In step 4, the LLDP Remote System optional TLV information on the LP must contain the characteristics of the DUT.
- In step 4, TS1 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, the five optional LLDP TLVs, and the End of LLDPDU TLV.
- In step 4, TS2 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, the five optional LLDP TLVs, the mandatory LLDP-MED TLVs for the group the LP is a member of, and the End of LLDPDU TLV.

Part C:
- In step 4, the LLDP Local System optional TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 4, the LLDP Remote System optional TLV information on the DUT must contain the characteristics of the LP.
- In step 4, the LLDP Remote System optional TLV information on the LP must not contain the characteristics of the DUT.
- In step 4, TS1 must not capture any TLVs.
- In step 4, TS2 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, the five optional LLDP TLVs, the mandatory LLDP-MED TLVs for the device class that the LP is a member of, and the End Of LLDPDU TLV.

Possible Problems: None.

Test LLDP.io.1.3 — Network (re)Initialization

Purpose: To verify that, during network (re)initialization, the DUT can properly exchange the mandatory LLDP and LLDP-MED TLVs with its Link Partner.

References: [1] ANSI TIA 1057: sub-section 9.1

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: This test verifies that, during network (re)initialization, the DUT can properly exchange information with an LLDPMED capable Link Partner, specifically the mandatory TLVs defined in IEEE Std. 802.1AB-Draft 13 Table 9-1.

The three defined mandatory TLVs that generate objects to be stored and retrieved are: Chassis ID TLV, Port ID TLV and Time To Live TLV; the mandatory TLVs must be included in all LLDPDUs in the order listed above. In addition to the mandatory LLDP TLVs, the DUT must transmit all LLDP-MED TLVs mandated for the device class type that the DUT is a member of, per ANSI TIA 1057 6.1 and 6.2. All LLDPDUs must be terminated with the End Of LLDPDU TLV. The DUT and LLDP-MED capable Link Partner must exchange the information contained in the mandatory TLVs. Information exchanged in the TLVs must be stored in an accessible format, such as SNMP.

Test Setup: Refer to the Default Test Setup in Appendix A.
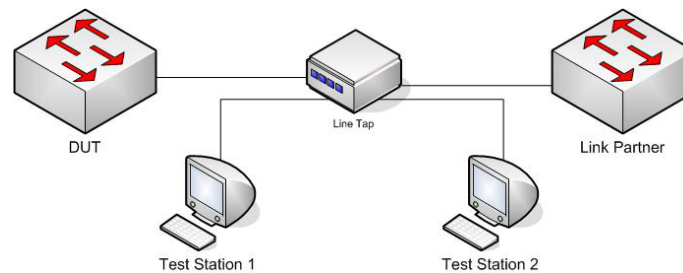
Test Procedure:

Part A: Network Initialization - Mandatory LLDP/LLDP-MED TLVs
1. Ensure the DUT and LP are configured to the test setup as defined above.
2. Reboot the DUT and LP.
3. After the DUT and LP have finished booting, wait 31 seconds.

Part B: DUT Initialization - Mandatory LLDP/LLDP-MED TLVs
1. Ensure the DUT and LP are configured to the test setup as defined above.
2. Disconnect power from the DUT.
3. Connect power to the DUT.
4. After the DUT has finished booting, wait 31 seconds.

Part C: LP Initialization - Mandatory LLDP/LLDP-MED TLVs
1. Ensure the DUT and LP are configured to the test setup as defined above.
2. Disconnect power from the LP.
3. Connect power to the LP.
4. After the LP has finished booting, wait 31 seconds.

Part D: Ageing of Information - Mandatory LLDP/LLDP-MED TLVs
1. Ensure the DUT and LP are configured to the test setup as defined above.
2. Disconnect power to the LP.
3. Wait 152 seconds.

Observable Results:

Part A:
- In step 3, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP respectively.
- In step 3, the LLDP Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively.
- In step 3, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively.
- In step 3, TS1 and TS2 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, the mandatory LLDP-MED TLVs for the device classes that the DUT and LP are members of, and the End Of LLDPDU TLV.

Part B:
- In step 2, the LLDP Local System mandatory TLV information on the LP must correlate to the characteristics of the LP.
- In step 2, the LLDP Remote System mandatory TLV information on the LP must correlate to the characteristics of the DUT.
- In step 2, the LLDP-MED Local System mandatory TLV information on the LP must correlate to the characteristics of the LP.
- In step 2, the LLDP-MED Remote System mandatory TLV information on the LP must correlate to the characteristics of the DUT.
- In step 4, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 4, the LLDP Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively.
- In step 4, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 4, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively.
- In step 4, TS1 and TS2 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, the mandatory LLDP-MED TLVs for the device classes that the DUT and LP are members of, and the End Of LLDPDU TLV.

Part C:
- In step 2, the LLDP Local System mandatory TLV information on the DUT must correlate to the characteristics of the DUT.
- In step 2, the LLDP Remote System mandatory TLV information on the DUT must correlate to the characteristics of the LP.
- In step 2, the LLDP-MED Local System mandatory TLV information on the DUT must correlate to the characteristics of the DUT.
- In step 2, the LLDP-MED Remote System mandatory TLV information on the DUT must correlate to the characteristics of the LP.
- In step 4, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 4, the LLDP Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively.
- In step 4, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 4, TS1 and TS2 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, the mandatory LLDP-MED TLVs for the device classes that the DUT and LP are members of, and the End Of LLDPDU TLV.

Part D:
- In part 3, the LLDP Local System mandatory TLV information on the DUT must correlate to the characteristics of the DUT.
- In part 3, the LLDP Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP.
- In part 3, the LLDPMED Local System on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP.
- In step 3, if the DUT is a Network Connectivity Device, TS1 should not capture any LLDPDUs that do not contain MED TLVs.
- In step 3, if the DUT is an Endpoint Device, TS1 should capture LLDPDUs containing MED TLVs.
- In step 3, TS2 should not capture any LLDPDUs.

Possible Problems: None.

Test LLDP.io.1.4 — Network Shutdown - Mandatory LLDP/LLDP-MED TLVs

Purpose: To verify that, during network shutdown, the DUT can properly exchange the mandatory LLDP and LLDP-MED TLVs with its Link Partner.

References: [1] ANSI TIA 1057: sub-section 9.1

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: This test verifies that, during network shutdown, the DUT can properly exchange information with an LLDP-MED capable Link Partner, specifically the mandatory TLVs defined in IEEE Std. 802.1AB-Draft 13 Table 9-1 and ANSI TIA 1057 10.2.

The three defined mandatory LLDP TLVs that generate objects to be stored and retrieved are: Chassis ID TLV, Port ID TLV and Time To Live TLV; the mandatory TLVs must be included in all LLDPDUs in the order listed above. The four defined mandatory LLDP-MED TLVs that generate objects to be stored and retrieved are: LLDP-MED Capabilities TLV, Network Policy TLV, Location Identification TLV, and Extended Power-via-MDI TLV. All LLDPDUs must be terminated with the End Of LLDPDU TLV. The DUT and LLDP-MED capable Link Partner must exchange the information contained in the mandatory TLVs. Information exchanged in the TLVs must be stored in an accessible format, such as SNMP.

This test also verifies the proper operations of the DUT's LLDP Shutdown Procedure and the adminStatus parameter, which controls the operating mode of the DUT's LLDP Agent. The LLDP Shutdown Procedure is invoked when the LLDP Agent determines that a Port is about to become non-operational. The LLDP Shutdown Procedure causes an LLDPDU to be transmitted with a TTL value of zero, indicating that the LP should clear the Remote System information associated with the non-operational Port. The adminStatus parameter can be configured to one of the following values: enabledTxRx, enabledTxOnly, enabledRxOnly, disabled. During this test, an adminStatus parameter value of disabled is used to simulate network shutdown.

These tests cannot be completed if the adminStatus variable on the DUT cannot be configured.

Test Setup: Refer to the Default Test Setup in Appendix A.
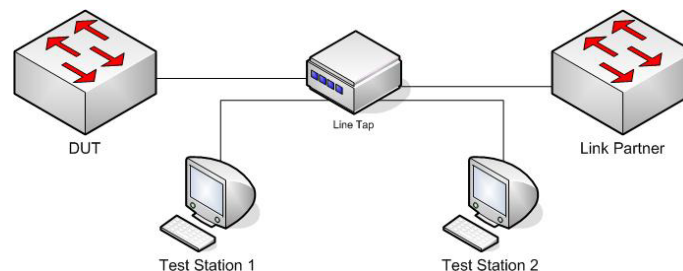
Test Procedure:

Part A: Mandatory LLDP/LLDP-MED TLVs - DUT adminStatus = disabled
    1. Ensure the DUT and LP are configured to the test setup as defined above.
    2. Set the DUT's adminStatus parameter to disabled.
    3. Wait 31 seconds.

Part B: Mandatory LLDP/LLDP-MED TLVs - LP adminStatus = disabled
    1. Ensure the DUT and LP are configured to the test setup as defined above.
    2. Set the LP's adminStatus parameter to disabled.
    3. Wait 31 seconds.

Observable Results:

Part A:

- In step 3, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP Remote System mandatory TLV information on the DUT must contain the characteristics of the LP.
- In step 3, the LLDP Remote System mandatory TLV information on the LP must not contain the characteristics of the DUT.
- In step 3, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT must contain the characteristics of the LP.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the LP must not contain the characteristics of the DUT.
- In step 3, TS1 must not capture any LLDPDUs.
- In step 3, TS2 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, the mandatory LLDP-MED TLVs for the class that the LP is a member of, and the End Of LLDPDU TLV.

Part B:

- In step 3, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP.
- In step 3, the LLDP Remote System mandatory TLV information of the LP must contain the characteristics of the DUT.
- In step 3, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the LP must contain the characteristics of the DUT.
- In step 3, TS1 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, and the End Of LLDPDU TLV.
- In step 3, TS2 must not capture any LLDPDUs.

Possible Problems: None.

**Test LLDP.io.1.5 — Port Failure - Mandatory LLDP/LLDP-MED TLVs**

Purpose: To verify the behavior of the DUT when a failure occurs on the link to its Link Partner.

References: [1] ANSI TIA 1057: sub-section 9.1   [3] ANSI TIA 1057: sub-section 11.3
                     [2] ANSI TIA 1057: sub-section 11.2

Resource Requirements: 3 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: This test verifies that the DUT exhibits the proper behavior when a failure occurs on the link to its LLDP-MED capable Link Partner. IEEE Std. 802.1AB-Draft 13 sub-clause 10.3.7 states that if a failure occurs on the link to the Remote System, before a shutdown LLDPDU is received, the LLDP agent shall not delete the Remote System information until the Port is re-initialized or the associated TTL timer expires. The DUT and LLDPMED capable Link Partner must exchange the information contained in the mandatory TLVs, prior to link failure. Information exchanged in the TLVs must be stored in an accessible format, such as SNMP, and appropriately maintained during link failure.

Test Setup: Refer to the Default Test Setup in Appendix A.
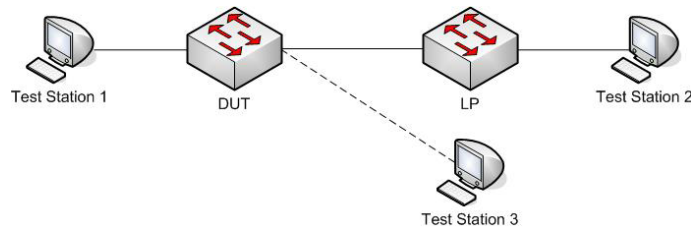
Test Procedure:

Part A: Link Failure
1. Ensure the DUT and LP are configured to the test setup as defined above.
2. Disconnect the link between the DUT and the LP.
3. Wait 31 seconds.

Part B: Link Re-Initialization
1. Ensure the DUT and LP are configured to the test setup as defined above.
2. Disconnect the link between the DUT and LP.
3. Connect TS3 to the port on the DUT that was connected to the LP.
4. Wait 31 seconds.

Observable Results:
Part A:
- In step 3, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively.
- In step 3, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively.
- In step 3, TS1 and TS2 must not capture any LLDPDUs.

Part B:
- In step 3, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP.
- In step 3, the LLDP Remote System mandatory TLV information on the LP must contain the characteristics of the DUT.
- In step 3, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the LP must contain the characteristics of the DUT.
- In step 3, TS1 and TS3 must capture properly formatted LLDPDUs containing the three mandatory LLDP TLVs and the End Of LLDPDU TLV.
- In step 3, TS2 should not capture any LLDPDUs.

Possible Problems: None.

Test LLDP.io.1.6 — Inventory Management TLV Interoperability

Purpose: To verify that the DUT can properly exchange Inventory Management TLVs with its Link Partner.

References: [1] ANSI TIA 1057: sub-section 9.1   [3] ANSI TIA 1057: sub-section 11.2
            [2] ANSI TIA 1057: sub-section 10.2.1.5   [4] ANSI TIA 1057: sub-section 11.3

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: This test verifies that the DUT can properly exchange information with an LLDP-MED capable Link Partner, specifically the Inventory Management TLV set defined in ANSI TIA 1057 sub-clause 10.2.6.

In order to implement the Inventory Management TLV set appropriately, the following TLVs must be implemented: Hardware Revision, Firmware Revision, Software Revision, Serial Number, Manufacturer Name, Model Name, and Asset ID. The DUT and LLDP capable Link Partner must exchange the information contained in the mandatory TLVs. Information exchanged in the TLVs must be stored in an accessible format, such as SNMP.

If the DUT does not support the Inventory Management TLV set, this test cannot be completed.

Test Setup: Refer to the Default Test Setup in Appendix A.
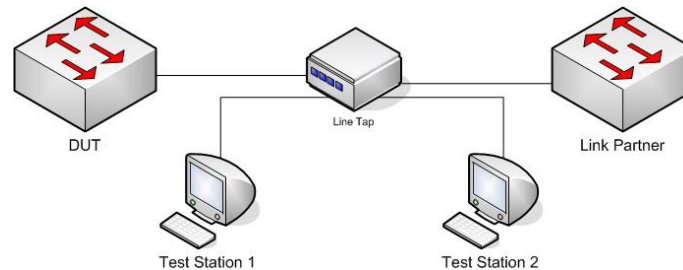
Test Procedure:

Part A: Inventory Management TLV Interoperability
1. Ensure the DUT and LP are configured to the test setup as defined above.
2. Enable transmission of the Inventory Management TLVs on the DUT.
3. Wait 31 seconds.

Observable Results:
Part A:
- In step 3, the LLDP-MED Local System Inventory Management TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP-MED Remote System Inventory Management TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively.
- In step 3, TS1 and TS2 must capture properly formed LLDPDUs containing the Hardware Revision TLV, Firmware Revision TLV, Software Revision TLV, Serial Number TLV, Manufacturer Name TLV, Model Name TLV, and Asset ID TLV.

Possible Problems: None.

Group 2:   LLDP-MED Device Class Verification

Scope: To ensure the DUT supports the requisite TLVs for the appropriate device class.

Test LLDP.io.2.1 — LLDP-MED Class I Device TLV Verification

Purpose: To verify that if the DUT is a Class I LLDP-MED Device, it supports all mandatory TLVs for Class I Devices.

References: [1] ANSI TIA 1057: sub-section 9.1   [3] ANSI TIA 1057: sub-section 11.2
                 [2] ANSI TIA 1057: sub-section 10.2.1.2   [4] ANSI TIA 1057: sub-section 11.3

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: This test verifies that the DUT supports the appropriate TLVs mandated for a Class I MED Device, as specified by the ANSI TIA 1057 standard. This test also verifies that the TLVs are properly formed, and that the DUT is capable of exchanging this information with the LP. ANSI TIA 1057 sub-clause 10.2.1.2 stipulates that Class I MED Device must implement the Endpoint Class I TLV Set, consisting of the LLDP-MED Capabilities TLV, and the Extended Power-via-MDI TLV, if Power over Ethernet is supported on the LLDP-MED capable ports. The DUT also may optionally support the Network Policy TLV.

These tests cannot be completed if the DUT is not a class I LLDP-MED device.

Part B cannot be completed if the DUT does not support Power Over Ethernet.

Part C cannot be completed if the DUT does not support transmission of the Network Policy TLV.

Test Setup: Refer to the Default Test Setup in Appendix A.
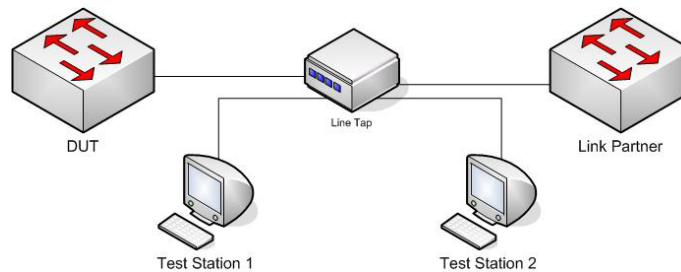
Test Procedure:

Part A: LLDP-MED Class I Device TLV Verification
   1. Ensure the DUT and LP are configured to the test setup as defined above.
   2. Wait 31 seconds.

Part B: LLDP-MED Class I Device TLV Verification
   1. Ensure the DUT and LP are configured to the test setup as defined above.
   2. Wait 31 seconds.

Part C: LLDP-MED Class I Device TLV Verification
   1. Ensure the DUT and LP are configured to the test setup as defined above.
   2. Wait 31 seconds.

Observable Results:
Part A:
   • In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
   • In step 2, the LLDP-MED Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the LP and DUT, respectively.
   • In step 2, TS1 must capture properly formed LLDPDUs from the DUT containing the LLDP-MED Capabilities TLV.
   • In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Part B:
- In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
- In step 2, the LLDP-MED Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the LP and DUT, respectively.
- In step 2, TS1 must capture properly formed LLDPDUs from the DUT containing the Extended Power-via-MDI TLVs.
- In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Part C:
- In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
- In step 2, the LLDP-MED Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the LP and DUT, respectively.
- In step 2, TS1 must capture properly formatted LLDPDUs from the DUT containing the Network Policy TLV.
- In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Possible Problems: None.

Test LLDP.io.2.2 — LLDP-MED Class II Device TLV Verification

Purpose: To verify that if the DUT is a Class II LLDP-MED Device, it supports all mandatory TLVs for Class II Devices.

References: [1] ANSI TIA 1057: sub-section 9.1   [3] ANSI TIA 1057: sub-section 11.2
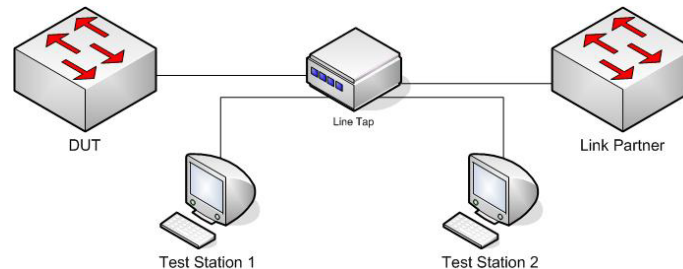   [2] ANSI TIA 1057: sub-section 10.2.1.3   [4] ANSI TIA 1057: sub-section 11.3

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: This test verifies that the DUT supports the appropriate TLVs mandated for a Class II MED Device, as specified by the ANSI TIA 1057 standard. This test also verifies that the TLVs are properly formed, and that the DUT is capable of exchanging this information with the LP. ANSI TIA 1057 sub-clause 10.2.1.2 stipulates that Class II MED Device must implement the Endpoint Class II TLV Set, consisting of the LLDP-MED Capabilities TLV, the Network Capabilities TLV, and, if Power over Ethernet is supported on the transmitting port, the Extended Powervia-MDI TLV.

This test cannot be completed if the DUT is not a class II LLDP-MED device.

Part B cannot be completed if the DUT does not support Power Over Ethernet.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: LLDP-MED Class II Device TLV Verification
  1. Ensure the DUT and LP are configured to the test setup as defined above.
  2. Wait 31 seconds.

Part B: LLDP-MED Class II Device TLV Verification
  1. Ensure the DUT and LP are configured to the test setup as defined above.
  2. Wait 31 seconds.

Observable Results:
Part A:
  • In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
  • In step 2, the LLDP-MED Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the LP and DUT, respectively.
  • In step 2, TS1 must capture properly formed LLDPDUs from the DUT containing the LLDP-MED Capabilities TLV, and Network Policy TLV.
  • In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Part B:
- In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
- In step 2, the LLDP-MEd Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the DUT and LP, respectively.
- In step 2, TS1 must capture properly formed LLDPDUs from the DUT containing the Extended Power-via-MDI TLVs.
- In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Possible Problems: None.

Test LLDP.io.2.3 — LLDP-MED Class III Device TLV Verification

Purpose: To verify that if the DUT is a Class III LLDP-MED Device, it supports all mandatory TLVs for Class III Devices.

References: [1] ANSI TIA 1057: sub-section 9.1   [3] ANSI TIA 1057: sub-section 11.2
              [2] ANSI TIA 1057: sub-section 10.2.1.4   [4] ANSI TIA 1057: sub-section 11.3

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.
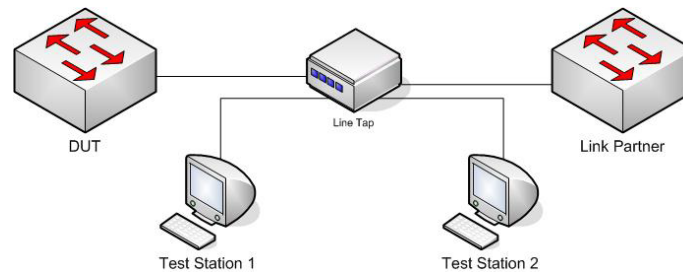
Discussion: This test verifies that the DUT supports the appropriate TLVs mandated for a Class III MED Device, as specified by the ANSI TIA 1057 standard. This test also verifies that the TLVs are properly formed, and that the DUT is capable of exchanging this information with the LP. ANSI TIA 1057 sub-clause 10.2.1.2 stipulates that Class III MED Device must implement the Endpoint Class I TLV Set, consisting of the LLDP-MED Capabilities TLV, the Network Capabilities TLV, and, if Power over Ethernet is supported on the transmitting port, the Extended Power-via-MDI TLV. The DUT may optionally implement the Location Identification TLV.

This test cannot be completed if the DUT is not a class III LLDP-MED device.

Part B cannot be completed if the DUT does not support Power Over Ethernet.

Part C cannot be completed if the DUT does not support transmission of the Location Identification TLV.

Test Setup: Refer to the Default Test Setup in Appendix A.

Test Procedure:

Part A: LLDP-MED Class III Device TLV Verification
   1. Ensure the DUT and LP are configured to the test setup as defined above.
   2. Wait 31 seconds.
Part B: LLDP-MED Class III Device TLV Verification
   1. Ensure the DUT and LP are configured to the test setup as defined above.
   2. Wait 31 seconds.
Part C: LLDP-MED Class III Device TLV Verification
   1. Ensure the DUT and LP are configured to the test setup as defined above.
   2. Wait 31 seconds.

Observable Results:
Part A:
   • In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
   • In step 2, the LLDP-MED Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the LP and DUT, respectively.
   • In step 2, TS1 must capture properly formed LLDPDUs from the DUT containing the LLDP-MED Capabilities TLV, and Network Policy TLV.
   • In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Part B:
- In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
- In step 2, the LLDP-MED Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the LP and DUT, respectively.
- In step 2, TS1 must capture properly formed LLDPDUs from the DUT containing the Extended Power-via-MDI TLVs.
- In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Part C:
- In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characterisctics of the DUT and LP, respectively.
- In step 2, the LLDP-MED Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the LP and DUT, respectively.
- In step 2, TS1 must capture properly formed LLDPDUs from the DUT containing the Location Identification TLV.
- In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Possible Problems: None.

Test LLDP.io.2.4 — LLDP-MED Network Connectivity Device TLV Verification

Purpose: To verify that if the DUT is a Network Connectivity LLDP-MED Device, it supports all mandatory TLVs for Network Connectivity Devices.

References: [1] ANSI TIA 1057: sub-section 9.1   [3] ANSI TIA 1057: sub-section 11.2
            [2] ANSI TIA 1057: sub-section 10.2.1.1   [4] ANSI TIA 1057: sub-section 11.3

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: This test verifies that the DUT supports the appropriate TLVs mandated for a Network Connectivity MED Device, as specified by the ANSI TIA 1057 standard. This test also verifies that the TLVs are properly formed, and that the DUT is capable of exchanging this information with the LP. ANSI TIA 1057 sub-clause 10.2.1.1 stipulates that Network Connectivity Device must implement the Network Connectivity Device TLV Set, consisting of the LLDPMED Capabilities TLV, the Network Capabilities TLV, the Location Identification TLV, and, if Power over Ethernet is supported on the transmitting port, the Extended Power-via-MDI TLV.

This test cannot be completed if the DUT is not a Network Connectivity Device.

Part B cannot be completed if the DUT does not support Power Over Ethernet.

Part C cannot be completed if the DUT does not support transmission of the Location Identification TLV.

Test Setup: Refer to the Default Test Setup in Appendix A.
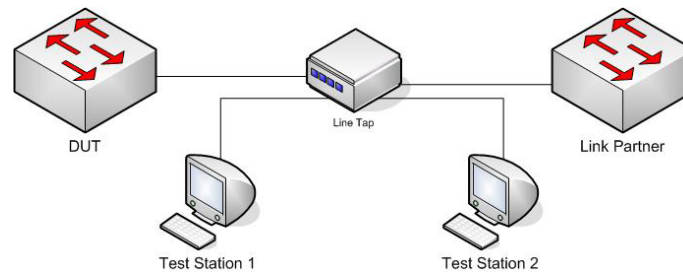
Test Procedure:

Part A: Network Connectivity Device TLV Verification
   1. Ensure the DUT and LP are configured to the test setup as defined above.
   2. Wait 31 seconds.

Part B: Network Connectivity Device TLV Verification
   1. Ensure the DUt and LP are configured to the test setup as defined above.
   2. Wait 31 seconds.

Part C: Network Connectivity Device TLV Verification
   1. Ensure the DUT and LP are configured to the test setup as defined above.
   2. Wait 31 seconds.

Observable Results:
Part A:
   • In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
   • In step 2, the LLDP-MED Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the LP and DUT, respectively.
   • In step 2, TS1 must capture properly formed LLDPDUs from the DUT containing the LLDP-MED Capabilities TLV, Network Policy TLV, and Location Identification TLV.
   • In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Part B:
- In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
- In step 2, the LLDP-MED Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the LP and DUT, respectively.
- In step 2, TS1 must capture properly formed LLDPDUs from the DUT containing the Extended Power-via-MDI TLVs.
- In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Part C:
- In step 2, the LLDP-MED Local System Mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
- In step 2, the LLDP-MED Remote System Mandatory TLV information on the DUT and LP should contain the characteristics of the LP and DUT, respectively.
- In step 2, TS1 must capture properly formed LLDPDUs from the DUT containing the Location Identification TLV.
- In step 2, TS2 must capture properly formed LLDPDUs from the LP.

Possible Problems: None.

Group 3:   LLDP-MED Fast Start Mechanism Interoperability

Scope: To ensure the DUT behaves appropriately during situations in which the Fasat Start Mechanism would be activated.

Test LLDP.io.3.1 — Fast Start - Protocol Initialization

Purpose: To ensure the DUT performs the appropriate actions to satisfy the Fast Start requirements of LLDP-MED upon protocol initialization.

References: [1] ANSI TIA 1057: sub-section 7.10   [3] ANSI TIA 1057: sub-section 11.2
   [2] ANSI TIA 1057: sub-section 9.1   [4] ANSI TIA 1057: sub-section 11.3

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The LLDP-MED standard dictates a Fast Start mechanism that allows for, upon protocol initialization, a short duration burst of LLDPDU transmissions. This allows connected devices to quickly learn the capabilities of one another, which facilitates the implementation of application-layer interactions with LLDP-MED to allow automatic configuration based on advertised capabilities.

Part A cannot be completed if the DUT is not a Network Connectivity Device.

Part B cannot be completed if the DUT is not an Endpoint Device.

Test Setup: Refer to the Default Test Setup in Appendix A.
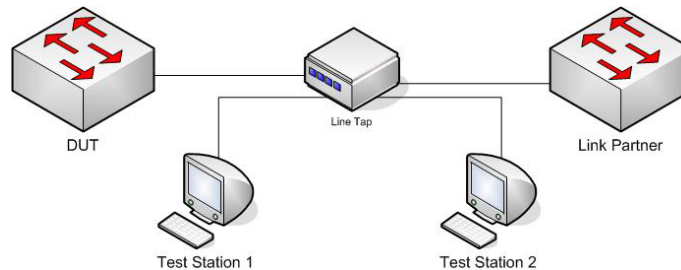
Test Procedure:

Part A: Fast Start - Protocol Re-Initialization
    1. Ensure the DUT and LP are configured to the test setup as defined above.
    2. Re-initialize the LLDP Service on the DUT.
    3. Wait 35 seconds.

Part B: Fast Start - Protocol Re-Initialization
    1. Ensure the DUT and LP are configured to the test setup as defined above.
    2. Re-initialize the LLDP Service on the DUT.
    3. Wait 35 seconds.

Observable Results:
Part A:
   • In step 3, the LLDP-MED Local System mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
   • In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT and LP should contain the characteristics of the DUT and LP, respectively.
   • In step 3, TS1 should receive properly formed LLDPDUs for three seconds at a rate of one per second after receiving the first LLDPDU from the LP.
   • In step 3, TS2 should receive properly formatted LLDPDUs at a rate of one per thirty seconds.

Part B:

- In step 3, the LLDP-MED Local System mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT an LP should contain the characteristics of the LP and DUT, respectively.
- In step 3, TS1 should receive three properly formed LLDPDUs for three seconds at a rate of one per second immediately after protocol re-initialization.
- In step 3, TS2 should receive properly formatted LLDPDUs at a rate of one per thirty seconds.

Possible Problems: None.

Test LLDP.io.3.2 — Fast Start - Link Reconfiguration

Purpose: To ensure the DUT performs the appropriate actions to satisfy the Fast Start requirements of LLDP-MED upon link reconfiguration.

References: [1] ANSI TIA 1057: sub-section 7.10   [3] ANSI TIA 1057: sub-section 11.2
                 [2] ANSI TIA 1057: sub-section 9.1   [4] ANSI TIA 1057: sub-section 11.3

Resource Requirements: 2 Test Stations capable of transmitting and receiving arbitrary MAC frames.

Discussion: The LLDP-MED standard dictates a Fast Start mechanism that allows for, upon link reconfiguration, a short duration burst of LLDPDU transmissions. This allows connected devices to quickly learn the capabilities of one another, which facilitates the implementation of application-layer interactions with LLDP-MED to allow automatic configuration based on advertised capabilities.

Part A cannot be completed if the DUT is not a Network Connectivity Device.

Part B cannot be completed if the DUT is not an Endpoint Device.

Test Setup: Refer to the Default Test Setup in Appendix A.
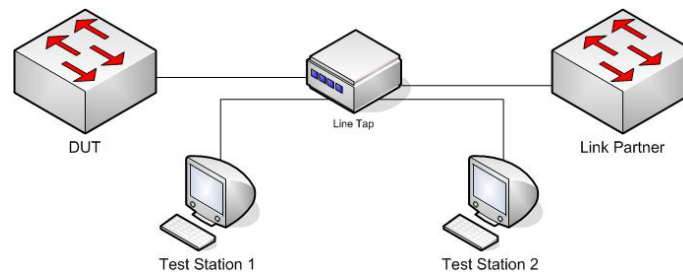
Test Procedure:

Part A: Link Reconfiguration
   1. Ensure the DUT and LP are configured to the test setup as defined above.
   2. Disconnect the link between the DUT and LP.
   3. Re-connect the link between the DUT and LP.
   4. Wait 31 seconds.

Part B: Link Reconfiguration
   1. Ensure the DUT and LP are configured to the test setup as defined above.
   2. Disconnect the link between the DUT and LP.
   3. Re-connect the link between the DUT and LP.
   4. Wait 31 seconds.

Observable Results:
Part A:
   • In step 3, the LLDP-MED Local System mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
   • In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT and LP should contain the characteristics of the DUT and LP, respectively.
   • In step 3, TS1 should receive properly formed LLDPDUs for three seconds at a rate of one per second after receiving the first LLDPDU from the LP.
   • In step 3, TS2 should receive properly formatted LLDPDUs at a rate of one per thirty seconds.

Part B:
- In step 3, the LLDP-MED Local System mandatory TLV information on the DUT and LP should correlate to the characteristics of the DUT and LP, respectively.
- In step 3, the LLDP-MED Remote System mandatory TLV information on the DUT an LP should contain the characteristics of the LP and DUT, respectively.
- In step 3, TS1 should receive three properly formed LLDPDUs for three seconds at a rate of one per second immediately after protocol re-initialization.
- In step 3, TS2 should receive properly formatted LLDPDUs at a rate of one per thirty seconds.

Possible Problems: None.

Appendix A

Unless otherwise specified, all tests in this group will use the following default values:

Default Settings: DUT and LP:

Bridge Settings:

802.1X operating state: **Disabled**
LLDP Bridge entity state: **Enabled**
STP operating state: **Disabled**
txTTL: **120 seconds (4 * 30 = 120)**
msgTxHold: **4**
msgTxInterval: **30 seconds**
reinitDelay: **2 seconds**
txDelay: **2 seconds**

Port Settings:

LLDP Port entity adminStatus parameter: **enabledTxRx**
Port VLAN ID: **1**
Name associated with VLAN 1: **Default**

Note - Port settings apply to all Ports on the DUT and LP