Bridge Functions Consortium

Link Layer Discovery Protocol – Media Endpoint Discovery (LLDP-MED)
Interoperability Test Suite
Version 1.1

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MODIFICATION RECORD

Version	Date	Editor(s)	Comments
1.0	4-6-2007	Andrew Corcoran	Initial Revision
1.1	8-10-2007	Andrew Corcoran	Additional Revisions

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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."[1]*

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 LLDP-MED 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.

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[1] ANSI/TIA-1057-2006, clause 5

REFERENCES

The following documents are referenced in this text:

[IEEE Std 802.1AB™-2005]   "Station and Media Access Control Connectivity Discovery", IEEE Computer Society, LAN/MAN Standards Committee

[ANSI/TIA-1057-2006]   "Link Layer Discovery Protocol for Media Endpoint Devices", Telecommunications Industry Association

ABBREVIATIONS AND ACRONYMS

IEEE 802.1	
LLDPDU	Link Layer Discovery Protocol Data Unit
ID	Identifier
LAN	Local Area Network
MAC	Medium Access Control
TLV	Type, Length Value

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)
LT	Link Tap

DEFINITION OF TERMS

IEEE 802.1	
Frame	A unit of data transmission on an IEEE 802 LAN MAC that conveys a PDU between MAC Service users. There are three types of frame; untagged, VLAN-tagged, and priority-tagged.
LAN	A Bridged LAN in which the existence of one or more VLAN-aware Bridges allows the definition, creation, and maintenance of VLANs.
Priority-tagged frame	A tagged frame whose tag header carries priority information, but carries no VLAN identification information.
Untagged frame	An untagged frame is a frame that does not contain a tag header immediately following the Source MAC Address field of the frame […].

LLDP-MED Interoperability Test Suite	
DUT	The Bridge on which the LLDP-MED.io test suite is being conducted.
TS	A tool that supports the generation and analysis of test traffic (i.e. MAC frames).
LT	Device used to capture and view packets on a link between two systems.
Local System	The LLDP capable system of concern.
msgTxHold	A multiplier used on the *msgTxInverval* to determine the TTL value transmitted in LLDPDUs.
msgTxInverval	Parameter used to determine the interval at which the LLDP agent tramsits LLDPDUs.
Network Initialization	Reboot of all systems in network; power down, power up.
Remote System	An LLDP capable system attached to the Local System of concern.
Service	A resource offered by a System (i.e. DHCP, FTP, HTTPS, etc.)
System	A device that is attached to a LAN by one or more ports. Examples of systems include end stations, IP phones, MAC Bridges, routers and servers.
Test Network	Network configured for use during testing; consists of TSs, DUT and LP(s).
TxDelay	Parameter used to determine the interval of transmission of LLDPDUs resulting from a change in value or status of the LLDP Local System MIB.
medFastStart	A timer indicating that the LLDP-MED Fast Start mechanism is active for a port.
medTransmitEnabled	An indication that LLDP-MED TLVs should be transmitted for a port.
medFastStartRepeatCount	A parameter which indicates the number of successive frame transmissions for one complete Fast Start interval. The recommended default value for medFastStartRepeatCount is 4.

Frame Types	
LLDPDU	Link Layer Discover Protocol Data Unit. A packet containing a series of Type, Length Values.

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 number is the group number and the test number, also separated by a period. So, test label LLDP-MED.io.1.2 refers to the second test of the first test group in the Link Layer Discovery Protocol – Media Endpoint Discovery Interoperability suite. The Test number is 1.2.

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

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

Test Layout: This diagram shows how the Test Systems, DUT, and any other Devices used should be connected for this test. Elements of the Procedure may change the Layout.

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 also cues 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.

TEST SETUP

Default Settings: DUT & LP(s)	
LLDP Bridge entity state	Enabled
Spanning Tree Protocol operating state	Disabled
txTTL	120 seconds
msgTxHold	4
msgTxInterval	30 seconds
reinitDelay	2 seconds
txDelay	2 seconds

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

Note – Port settings apply to all ports on the DUT and LP(s).

GROUP 1: Basic LLDP-MED Interoperability

Scope

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

Overview

> These tests help determine whether the DUT can properly exchange LLDP-MED TLVs, via LLDPDUs, when connected in Test Networks with other LLDP-MED capable Link Partners.

> LLDP-MED capable Systems transmit Local System information in LLDPDUs and store Remote System information received in LLDPDUs from directly connected Link Partners. Local System information and Remote System information exchanged via LLDPDUs must be stored in a format that can be retrieved by the network administrator.

> IEEE Std. 802.1AB-Draft 13 Clause 12 specifies a method for storing LLDP obtained information in SNMP MIBs and a method for retrieving LLDP obtained information using SNMP. If the LLDP capable System does not support SNMP, the System shall provide storage and retrieval capability equivalent to the functionality specified in IEEE Std. 802.1AB-Draft 13 Clause 11.

LLDP-MED.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, and LLDP-MED capable System.

References:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements
- ANSI TIA 1057: 11.2 Network Connectivity Device Protocol Interactions
- ANSI TIA 1057: 11.3 Endpoint Device Protocol Interactions

Resource Requirements:

- DUT
- LLDP-MED capable LPs
- 2 Test Stations
- 1 Link Tap

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. In this Test 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*.

Note: During this Test, the LP's adminStatus parameter is set to enabledTxRx.

Test Layout:
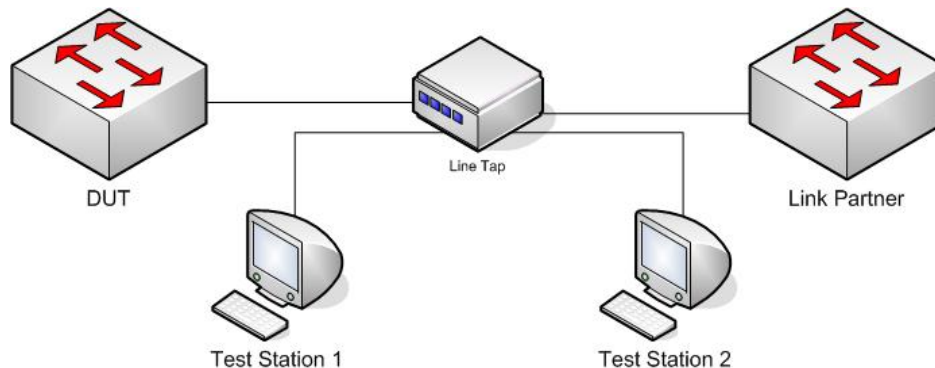
Procedure:

Part A: Mandatory LLDP and LLDP-MED TLVs – DUT adminStatus = enabledTxRx
1. Ensure that the default values are configured on the DUT.
2. Start capture on Test Stations 1 and 2.
3. Wait 31 seconds.
4. Attempt to extract LLDP Local System mandatory TLV information from DUT and LP.
5. Attempt to extract LLDP Remote System mandatory TLV information from DUT and LP.
6. Attempt to extract LLDP-MED Local System mandatory TLV information from DUT and LP.
7. Attempt to extract LLDP-MED Remote System mandatory TLV information from DUT and LP.
8. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Part B: Mandatory LLDP and LLDP-MED TLVs – DUT adminStatus = enabledTxOnly
9. Ensure that the default values are configured on the DUT.
10. Set the DUT's adminStatus parameter to *enabledTxOnly*
11. Start capture on Test Stations 1 and 2.
12. Wait 31 seconds.
13. Attempt to extract LLDP Local System mandatory TLV information from DUT and LP.
14. Attempt to extract LLDP Remote System mandatory TLV information from DUT and LP.
15. Attempt to extract LLDP-MED Local System mandatory TLV information from DUT and LP.
16. Attempt to extract LLDP-MED Remote System mandatory TLV information from DUT and LP.
17. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Part C: Mandatory LLDP and LLDP-MED TLVs – DUT adminStatus = enabledRxOnly
18. Ensure that the default values are configured on the DUT.
19. Set the DUT's adminStatus parameter to *enabledRxOnly*
20. Start capture on Test Stations 1 and 2.
21. Wait 31 seconds.
22. Attempt to extract LLDP Local System mandatory TLV information from DUT and LP.
23. Attempt to extract LLDP Remote System mandatory TLV information from DUT and LP.
24. Attempt to extract LLDP-MED Local System mandatory TLV information from DUT and LP.
25. Attempt to extract LLDP-MED Remote System mandatory TLV information from DUT and LP.
26. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Observable Results:

- In Part A, during 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. During Step 5, the LLDP Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively. During Step 6, the LLPD-MED Local System mandatory TLV information on the DUT and LP correlate to the characteristics of the DUT and LP, respectively. During Step 7, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively. During Step 8, Test Stations 1 and 2 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.
- In Part B, during Step 13, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 14, the LLDP Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP. During Step 14, the LLDP Remote System mandatory TLV information on the LP must contain the characteristics of the DUT. During Step 15, the LLDP-MED Local System mandatory TLV information must correlate to the characteristics of the DUT and LP. During Step 16, the LLDP-MED Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP. During Step 16, the LLDP-MED Remote System mandatory TLV information on the LP must not contain the characteristics of the DUT. During Step 17, Test Stations 1 must capture properly formatted LLDPDUs containing the three mandatory TLVs, and the End Of LLDPDU TLV. During Step 17, Test Station 2 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.

- In Part C, during Step 22, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 23, the LLDP Remote System mandatory TLV information on the DUT must contain the characteristics of the LP. During Step 23, the LLDP Remote System mandatory TLV information on the LP must not contain the characteristics of the DUT. During Step 24, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 25, the LLDP-MED Remote System mandatory TLV information on the DUT must contain the characteristics of the LP. During Step 25, the LLDP-MED Remote System mandatory TLV information on the LP must contain the characteristics of the DUT. During Step 26, Test Station 1 must not capture any LLDPDUs. During Step 26, Test Stations 2 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:

- If the *adminStatus* parameter of the DUT cannot be configured, Parts B and C cannot be completed.

LLDP-MED.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, an LLDP-MED capable System.

References:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements

Resource Requirements:

- DUT
- LLDP-MED capable LPs
- 2 Test Stations
- 1 Link Tap

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. In this Test 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.

Note: The LP's adminStatus parameter is set to enabledTxRx, during the entire Test.

Test Layout:

Line Tap

DUT

Test Station 1

Test Station 2

Link Partner
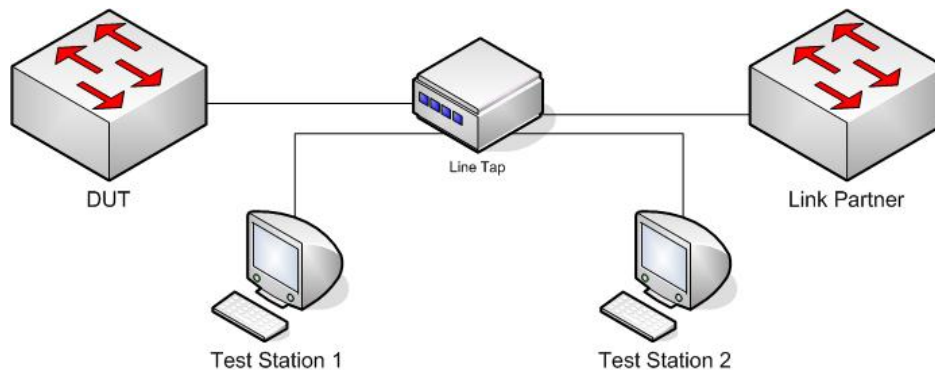
Procedure:

Part A: Optional LLDP/Mandatory LLDP-MED TLVs – DUT adminStatus = enabledTxRx
1. Ensure that the default values are configured on the DUT.
2. Set all the DUT's optional TLVs to enabled for transmission.
3. Start capture on Test Stations 1 and 2.
4. Wait 31 seconds.
5. Attempt to extract LLDP Local System optional TLV information from DUT and LP.
6. Attempt to extract LLDP Remote System optional TLV information from DUT and LP.
7. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Part B: Optional LLDP/Mandatory LLDP-MED TLVs – DUT adminStatus = enabledTxOnly
8. Ensure that the default values are configured on the DUT.
9. Set all the DUT's optional TLVs to enabled for transmission.
10. Set the DUT's *adminStatus* parameter to *enabledTxOnly.*
11. Start capture on Test Stations 1 and 2.
12. Wait 31 seconds.
13. Attempt to extract LLDP Local System optional TLV information from DUT and LP.
14. Attempt to extract LLDP Remote System optional TLV information from DUT and LP.
15. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Part C: Optional LLDP/Mandatory LLDP-MED TLVs – DUT adminStatus = enabledRxOnly
16. Ensure that the default values are configured on the DUT.
17. Set all the DUT's optional TLVs to enabled for transmission.
18. Set the DUT's *adminStatus* parameter to *enabledRxOnly.*
19. Start capture on Test Stations 1 and 2.
20. Wait 31 seconds.
21. Attempt to extract LLDP Local System optional TLV information from DUT and LP.
22. Attempt to extract LLDP Remote System optional TLV information from DUT and LP.
23. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Observable Results:

- In Part A, during Step 5, the LLDP Local System optional TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 6, the LLDP Remote System optional TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively. During step 7, Test Stations 1 and 2 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.

- In Part B, during Step 13, the LLDP Local System optional TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 14, the LLDP Remote System optional TLV information on the DUT must not contain the characteristics of the LP. During Step 14, the LLDP Remote System optional TLV information on the LP must contain the characteristics of the DUT. During Step 15, Test Station 1 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, the five optional LLDP TLVs, and the End of LLDPDU TLV. During Step 15, Test Station 2 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.

- In Part C, during Step 21, the LLDP Local System optional TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 22, the LLDP Remote System optional TLV information on the DUT must contain the characteristics of the LP. During Step 22, the LLDP Remote System optional TLV information on the LP must not contain the characteristics of the DUT. During Step 23, Test Station 1 must not capture any TLVs. During Step 23, Test Station 2 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:

- If the DUT does not support configuration of the *adminStatus* parameter, Parts B and C cannot be completed.

LLDP-MED.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, an LLDP-MED capable System.

References:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements

Resource Requirements:

- DUT
- LLDP-MED capable LPs
- 2 Test Stations
- Link Tap

Discussion:

This Test verifies that, during network (re)initialization, 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. In this Test 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.

Note: The DUT's and LP's adminStatus parameters are set to enabledTxRx, during the entire Test.

Test Layout:
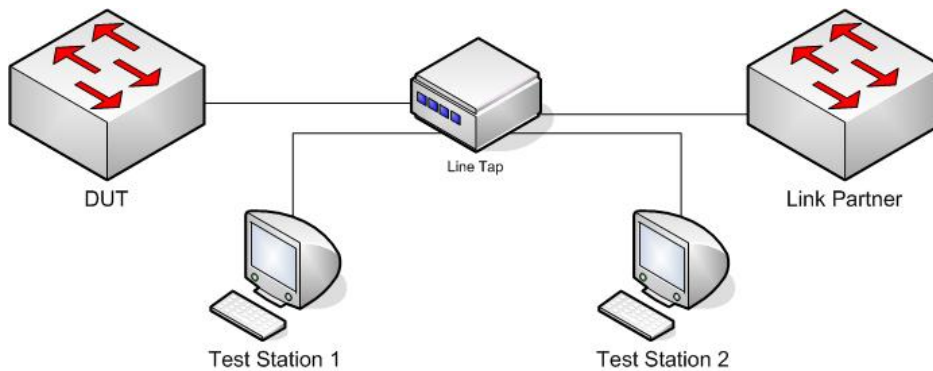
Procedure:

Part A: Network Initialization – Mandatory LLDP/LLDP-MED TLVs
1. Ensure that the default values are configured on the DUT.
2. Wait 31 seconds.
3. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
4. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
5. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
6. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
7. Reboot the DUT and LP.
8. Start capture on Test Stations 1 and 2.
9. Wait 31 seconds.
10. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
11. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
12. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
13. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
14. Stop capture on Test Stations 1 and 2, and observe captured frames (if any).

Part B: DUT Initialization – Mandatory LLDP/LLDP-MED TLVs
15. Ensure that the default values are configured on the DUT.
16. Wait 31 seconds.
17. Disconnect power from the DUT.
18. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
19. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
20. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
21. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
22. Connect power to the DUT.
23. Start capture on Test Stations 1 and 2.
24. Wait 31 seconds.
25. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
26. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
27. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
28. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
29. Stop capture on Test Stations 1 and 2, and observe captured frames (if any).

Part C: LP Initialization – Mandatory LLDP/LLDP-MED TLVs
30. Ensure that the default values are configured on the DUT.
31. Wait 31 seconds.
32. Disconnect power from the LP.
33. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
34. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
35. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
36. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
37. Connect power to the LP.
38. Start capture on Test Stations 1 and 2.
39. Wait 31 seconds.
40. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
41. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
42. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
43. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
44. Stop capture on Test Stations 1 and 2, and observe captured frames (if any).

Part D: Ageing of Information – Mandatory LLDP/LLDP-MED TLVs
45. Ensure that the default values are configured on the DUT.
46. Wait 31 seconds.
47. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
48. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
49. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
50. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.

51. Disconnect power to the LP.
52. Wait 121 seconds.
53. Start capture on Test Stations 1 and 2.
54. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
55. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
56. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
57. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
58. Stop capture on Test Stations 1 and 2, and observe captured frames (if any).

Observable Results:

- In Part A, during Steps 3 and 10, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP respectively. During Steps 4 and 11, the LLDP Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively. During Steps 5 and 12, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Steps 6 and 13, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively. During Step 14, Test Stations 1 and 2 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.

- In Part B, during Step 18, the LLDP Local System mandatory TLV information on the DUT must not be accessible. During Step 18, the LLDP Local System mandatory TLV information on the LP must correlate to the characteristics of the LP. During Step 19, the LLDP Remote System mandatory TLV information on the DUT must not be accessible. During Step 19, the LLDP Remote System mandatory TLV information on the LP must correlate to the characteristics of the DUT. During Step 20, the LLDP-MED Local System mandatory TLV information on the DUT must not be accessible. During Step 20, the LLDP-MED Local System mandatory TLV information on the LP must correlate to the characteristics of the LP. During Step 21, the LLDP-MED Remote System mandatory TLV information on the DUT must not be accessible. During Step 21, the LLDP-MED Remote System mandatory TLV information on the LP must correlate to the characteristics of the DUT. During Step 25, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 26, the LLDP Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively. During Step 27, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 28, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively. During Step 29, Test Stations 1 and 2 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.

- In Part C, during Step 33, the LLDP Local System mandatory TLV information on the DUT must correlate to the characteristics of the DUT. During Step 33, the LLDP Local System mandatory TLV information on the LP must not be accessible. During Step 34, the LLDP Remote System mandatory TLV information on the DUT must correlate to the characteristics of the LP. During Step 34, the LLDP Remote System mandatory TLV information on the LP must not be accessible. During Step 35, the LLDP-MED Local System mandatory TLV information on the DUT must correlate to the characteristics of the DUT. During Step 35, the LLDP-MED Local System mandatory TLV information on the LP must not be available. During Step 36, the LLDP-MED Remote System mandatory TLV information on the DUT must correlate to the characteristics of the LP. During Step 36, the LLDP-MED Remote System mandatory TLV information on the LP must not be accessible. During Step 40, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 41, the LLDP Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively. During Step 42, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 43, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively. During Step 44, Test Stations

1 and 2 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.

- In Part D, during Step 47, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 48, the LLDP Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively. During Step 49, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 50, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must correlate to the characteristics of the LP and DUT, respectively. During Step 54, the LLDP Local System mandatory TLV information on the DUT must correlate to the characteristics of the DUT. During Step 54, the LLDP Local System mandatory TLV information on the LP must not be accessible. During Step 55, the LLDP Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP. During Step 55, the LLDP Remote System mandatory TLV information on the LP must not be accessible. During Step 56, the LLDP-MED Local System on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 57, the LLDP-MED Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP. During Step 57, the LLDP-MED Remote System mandatory TLV information on the LP must not be accessible. During Step 58, if the DUT is a Network Connectivity Device, Test Station 1 should not capture any LLDPDUs that do not contain MED TLVs. During Step 58, if the DUT is an Endpoint Device, Test Station 1 should capture LLDPDUs containing MED TLVs. During Step 58, Test Station 2 should not capture any LLDPDUs.

Possible Problems:

- None.

LLDP-MED.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, an LLDP-MED capable system.

References:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements

Resource Requirements:

- DUT
- LLDP-MED capable LPs
- 2 Test Stations
- Link Tap

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. In this Test 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.

Note: The LP's adminStatus parameter is set to enabledTxRx, during the entire Test.
Note: The DUT's adminStatus parameter is initialized to enabledTxRx, during the entire Test.

Test Layout:
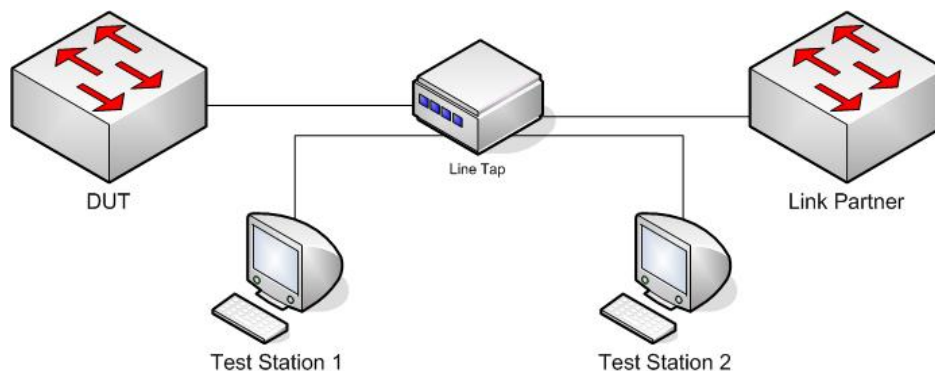
Procedure:

Part A: Mandatory LLDP/LLDP-MED TLVs – DUT adminStatus = disabled
1. Ensure that the default values are configured on the DUT.
2. Wait 31 seconds.
3. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
4. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
5. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
6. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
7. Set the DUT's *adminStatus* parameter to *disabled*.
8. Start capture on Test Stations 1 and 2.
9. Wait 31 seconds.
10. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
11. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
12. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
13. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
14. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Part B: Mandatory LLDP/LLDP-MED TLVs – LP adminStatus = disabled
15. Ensure that the default values are configured on the DUT.
16. Wait 31 seconds.
17. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
18. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
19. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
20. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
21. Set the LP's *adminStatus* parameter to *disabled*.
22. Start capture on Test Stations 1 and 2.
23. Wait 31 seconds.
24. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
25. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
26. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
27. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
28. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Observable Results:

- In Part A, during 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. During Step 4, the LLDP Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively. During Step 5, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 6, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively. During Step 10, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 11, the LLDP Remote System mandatory TLV information on the DUT must contain the characteristics of the LP. During Step 11, the LLDP Remote System mandatory TLV information on the LP must not contain the characteristics of the DUT. During Step 12, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 13, the LLDP-MED Remote System mandatory TLV information on the DUT must contain the characteristics of the LP. During Step 13, the LLDP-MED Remote System mandatory TLV information on the LP must not contain the characteristics of the DUT. During Step 14, Test Station 1 must not capture any LLDPDUs. During Step 14, Test Station 2 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.
- In Part B, during Step 17, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 18, the LLDP Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT,

respectively. During Step 19, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 20, 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 24, 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 25, the LLDP Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP. In Step 25, the LLDP Remote System mandatory TLV information of the LP must contain the characteristics of the DUT. In Step 26, 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 27, the LLDP-MED Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP. In Step 27, the LLDP-MED Remote System mandatory TLV information on the LP must contain the characteristics of the DUT. In Step 28, Test Station 1 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs, and the End Of LLDPDU TLV. In Step 28, Test Station 2 must not capture any LLDPDUs.

Possible Problems:

- If the *adminStatus* variable on the DUT cannot be configured, these tests cannot be completed.

LLDP-MED.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, an LLDP-MED capable System.

References:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements
- ANSI TIA 1057: 11.2 Network Connectivity Device Protocol Interactions
- ANSI TIA 1057: 11.3 Endpoint Device Protocol Interactions

Resource Requirements:

- DUT
- LLDP-MED capable LPs
- 3 Test Stations

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. In this Test the DUT and LLDP-MED 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 Layout:
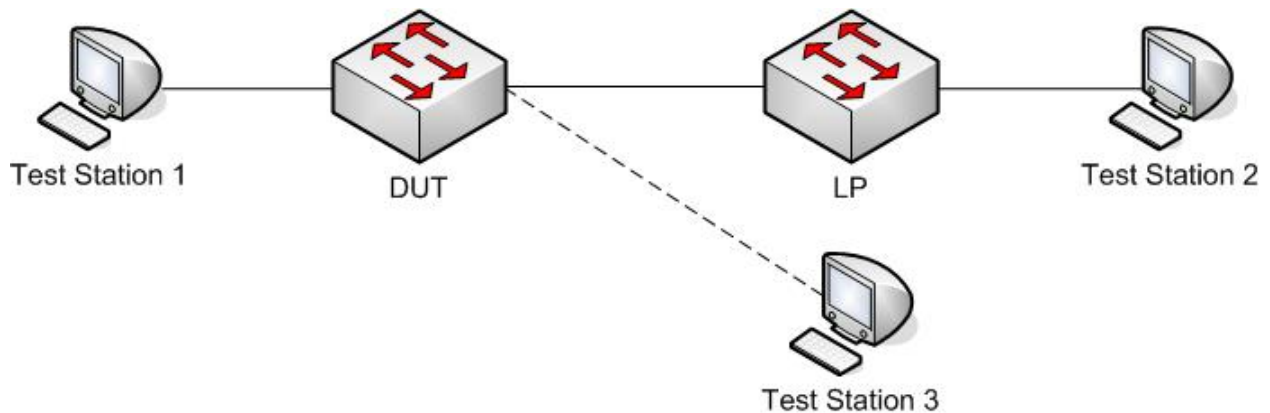
Procedure:

Part A: Link Failure
1. Ensure that the <u>default</u> values are configured on the DUT.
2. Wait 31 seconds.
3. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
4. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
5. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
6. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
7. Disconnect the link between the DUT and the LP.
8. Start capture on Test Stations 1 and 2.
9. Wait 31 seconds.
10. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
11. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
12. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
13. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
14. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Part B: Link Re-initialization
15. Ensure that the <u>default</u> values are configured on the DUT.
16. Wait 31 seconds.
17. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
18. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
19. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
20. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
21. Start capture on Test Stations 1, 2 and 3.
22. Disconnect the link between the DUT and LP, and connect Test Station 3 to the port on the DUT that was connected to the LP.
23. Wait 31 seconds.
24. Attempt to extract LLDP Local System mandatory TLV information from the DUT and LP.
25. Attempt to extract LLDP Remote System mandatory TLV information from the DUT and LP.
26. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
27. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
28. Stop capture on Test Stations 1, 2 and 3, and observe the captured frames (if any).

Observable Results:

- In Part A, during 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. During Step 4, the LLDP Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively. During Step 5, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the DUT and LP, respectively. During Step 6, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively. During Step 10, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 11, the LLDP Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively. During Step 12, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 13, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively. During Step 14, Test Stations 1 and 2 must not capture any LLDPDUs.
- In Part B, during Step 17, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 18, the LLDP Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP and DUT, respectively. During Step 19, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 20, the LLDP-MED Remote System mandatory TLV information on the DUT and LP must contain the characteristics of the LP

and DUT, respectively. During Step 24, the LLDP Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 25, the LLDP Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP. During Step 25, the LLDP Remote System mandatory TLV information on the LP must contain the characteristics of the DUT. During Step 26, the LLDP-MED Local System mandatory TLV information on the DUT and LP must correlate to the characteristics of the DUT and LP, respectively. During Step 27, the LLDP-MED Remote System mandatory TLV information on the DUT must not contain the characteristics of the LP. During Step 27, the LLDP-MED Remote System mandatory TLV information on the LP must contain the characteristics of the DUT. During Step 28, Test Stations 1 and 3 must capture properly formed LLDPDUs containing the three mandatory LLDP TLVs and the End Of LLDPDU TLV. During Step 28, Test Station 2 must not capture LLDPDUs.

Possible Problems:

- None.

LLDP-MED.io.1.6 : Inventory Management TLV Interoperability

Purpose: To verify that the DUT can properly exchange Inventory Management TLVs with its Link Partner, an LLDP-MED capable device.

References:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements
- ANSI TIA 1057: 11.2 Network Connectivity Device Protocol Interactions
- ANSI TIA 1057: 11.3 Endpoint Device Protocol Interactions
- ANSI TIA 1057: 10.2.1.5

Resource Requirements:

- DUT
- LLDP-MED capable LP
- 2 Test Stations
- Link Taps

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. In this Test 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.

Test Layout:
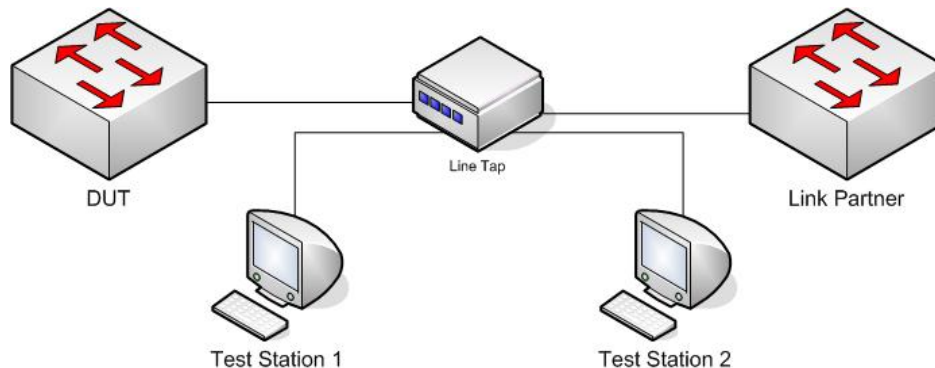
Procedure:

Part A: Inventory Management TLV Interoperability
1. Ensure that the default values are configured on the DUT.
2. Enable transmission of the Inventory Management TLVs on the DUT.
3. Start capture on Test Stations 1 and 2.
4. Wait 31 seconds.
5. Attempt to extract LLDP-MED Local System Inventory Management TLV information from the DUT and LP.
6. Attempt to extract LLDP-MED Remote System Inventory Management TLV information from the DUT and LP.
7. Stop capture on Test Stations 1 and 2, and observe frames (if any).

Observable Results:

- In Step 5, 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 6, 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 7, Test Stations 1 and 2 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:

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

GROUP 2: LLDP-MED Device Class Verification

Scope

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

Overview

These tests help determine whether the DUT supports the requisite TLVs for the Device Class of which the DUT is a member.

Four Device Classes exist. The Network Connectivity Device category entails any form of 802 based LAN infrastructure device, such as bridges, switches and routers. Class I Endpoint Devices are such that they do not act as an end-user communication appliance. Class II Endpoint Devices consist of endpoint products that are not limited to a particular end user. Class III Endpoint Devices are any devices that act as end user communications appliances.

Each Device Class has a mandatory set of TLVs that members of the Device Class must support. These tests also ensure the DUT can properly exchange LLDP-MED TLVs, via LLDPDUs, when connected in Test Networks with other LLDP-MED capable Link Partners.

IEEE Std. 802.1AB-Draft 13 Clause 12 specifies a method for storing LLDP obtained information in SNMP MIBs and a method for retrieving LLDP obtained information using SNMP. If the LLDP capable System does not support SNMP, the System shall provide storage and retrieval capability equivalent to the functionality specified in IEEE Std. 802.1AB-Draft 13 Clause 11.

LLDP-MED.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:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements
- ANSI TIA 1057: 11.2 Network Connectivity Device Protocol Interactions
- ANSI TIA 1057: 11.3 Endpoint Device Protocol Interactions
- ANSI TIA 1057: 10.2.1.2

Resource Requirements:

- DUT
- LLDP-MED capable LPs
- 2 Test Stations
- Line Taps

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.

Test Layout:

Procedure:

Part A: LLDP-MED Class I Device TLV Verification
1. Ensure that the <u>default</u> values are configured on the DUT.
2. Start capture on Test Stations 1 and 2.
3. Wait 31 seconds.
4. Attempt to extract LLDP-MED Local System Mandatory TLV information from the DUT and LP.
5. Attempt to extract LLDP-MED Remote System Mandatory TLV information from the DUT and LP.
6. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Observable Results:

- In Step 4, 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 5, 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 6, Test Stations 1 must capture properly formed LLDPDUs from the DUT containing the LLDP-MED Capabilities TLV. These LLDPDUs must contain Extended Power-via-MDI TLVs if the port on the DUT from which they are transmitted has Power over Ethernet capabilities. These LLDPDUs may optionally contain the Network Policy TLV. In Step 6, Test Station 2 must capture properly formed LLDPDUs from the LP.

Possible Problems:

- None.

LLDP-MED.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:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements
- ANSI TIA 1057: 11.2 Network Connectivity Device Protocol Interactions
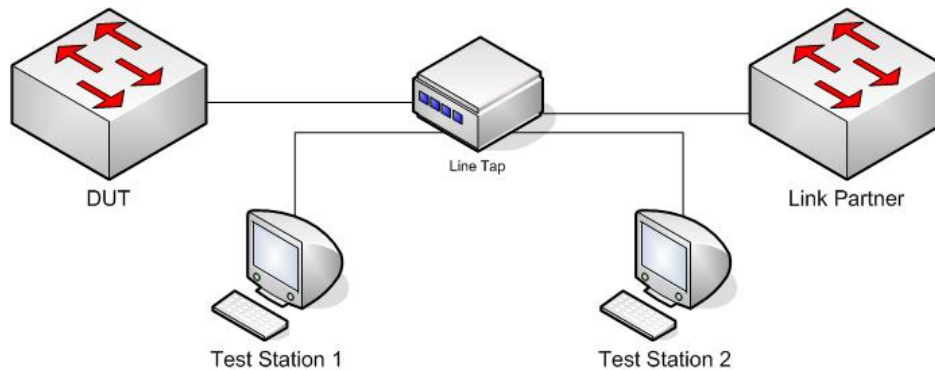- ANSI TIA 1057: 11.3 Endpoint Device Protocol Interactions
- ANSI TIA 1057: 10.2.1.3

Resource Requirements:

- DUT
- LLDP-MED capable LPs
- 2 Test Stations
- Line Taps

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 Power-via-MDI TLV.

Test Layout:

Procedure:

Part A: LLDP-MED Class II Device TLV Verification
1. Ensure that the <u>default</u> values are configured on the DUT.
2. Start capture on Test Stations 1 and 2.
3. Wait 31 seconds.
4. Attempt to extract LLDP-MED Local System Mandatory TLV information from the DUT and LP.
5. Attempt to extract LLDP-MED Remote System Mandatory TLV information from the DUT and LP.
6. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Observable Results:

- In Step 4, 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 5, 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 6, Test Stations 1 must capture properly formed LLDPDUs from the DUT containing the LLDP-MED Capabilities TLV, and Network Policy TLV. These LLDPDUs must contain Extended Power-via-MDI TLVs if the port on the DUT from which they are transmitted has Power over Ethernet capabilities. In Step 6, Test Station 2 must capture properly formed LLDPDUs from the LP.

Possible Problems:

- None.

LLDP-MED.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:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements
- ANSI TIA 1057: 11.2 Network Connectivity Device Protocol Interactions
- ANSI TIA 1057: 11.3 Endpoint Device Protocol Interactions
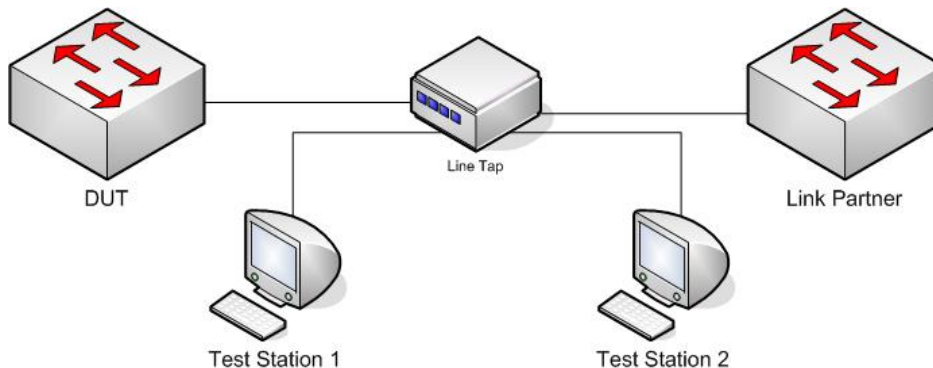- ANSI TIA 1057: 10.2.1.4

Resource Requirements:

- DUT
- LLDP-MED capable LPs
- 2 Test Stations
- Line Taps

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.

Test Layout:

Procedure:

Part A: LLDP-MED Class III Device TLV Verification
1. Ensure that the default values are configured on the DUT.
2. Start capture on Test Stations 1 and 2.
3. Wait 31 seconds.
4. Attempt to extract LLDP-MED Local System Mandatory TLV information from the DUT and LP.
5. Attempt to extract LLDP-MED Remote System Mandatory TLV information from the DUT and LP.
6. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Observable Results:

- In Step 4, 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 5, 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 6, Test Stations 1 must capture properly formed LLDPDUs from the DUT containing the LLDP-MED Capabilities TLV, and Network Policy TLV. These LLDPDUs must contain Extended Power-via-MDI TLVs if the port on the DUT from which they are transmitted has Power over Ethernet capabilities. These LLDPDUs may optionally contain the Location Identification TLV.   In Step 6, Test Station 2 must capture properly formed LLDPDUs from the LP.

Possible Problems:

- None.

LLDP-MED.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:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements
- ANSI TIA 1057: 11.2 Network Connectivity Device Protocol Interactions
- ANSI TIA 1057: 11.3 Endpoint Device Protocol Interactions
- ANSI TIA 1057: 10.2.1.1

Resource Requirements:

- DUT
- LLDP-MED capable LPs
- 2 Test Stations
- Line Taps

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 LLDP-MED 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.

Test Layout:
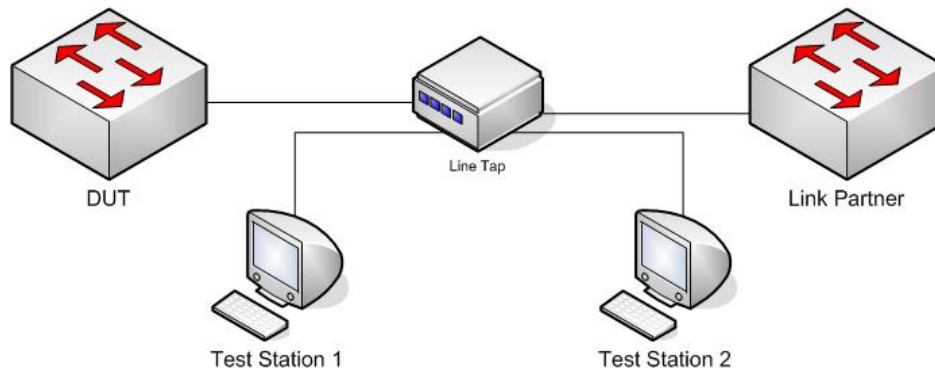
Procedure:

Part A: Network Connectivity Device TLV Verification
1. Ensure that the default values are configured on the DUT.
2. Start capture on Test Stations 1 and 2.
3. Wait 31 seconds.
4. Attempt to extract LLDP-MED Local System Mandatory TLV information from the DUT and LP.
5. Attempt to extract LLDP-MED Remote System Mandatory TLV information from the DUT and LP.
6. Stop capture on Test Stations 1 and 2, and observe the captured frames (if any).

Observable Results:

- In Step 4, 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 5, 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 6, Test Stations 1 must capture properly formed LLDPDUs from the DUT containing the LLDP-MED Capabilities TLV, Network Policy TLV, and Location Identification TLV. These LLDPDUs must contain Extended Power-via-MDI TLVs if the port on the DUT from which they are transmitted has Power over Ethernet capabilities and Power over Ethernet is enabled on the port. These LLDPDUs may optionally contain the Location Identification TLV. In Step 6, Test Station 2 must capture properly formed LLDPDUs from the LP.

Possible Problems:

- If the DUT is not a Network Connectivity Device, this test cannot be completed.

GROUP 3: LLDP-MED Fast Start Mechanism Interoperability

Scope

> To ensure the DUT behaves appropriately during situations in which the Fast Start Mechanism would be activated.

Overview

> The Fast Start Mechanism helps LLDP-MED capable devices advertise their capabilities faster on initial connection, to hasten the process of learning the capabilities of neighbors. When the Fast Start Mechanism is activated, the DUT should transmit LLDPDUs at a rate of one LLDPDU per second. The Fast Start Mechanism will transmit LLDPDUs at this rate for *medFastStartRepeatCount* seconds, upon which it resume transmitting one LLDPDU per *txDelayWhile* seconds. These tests also ensure the DUT can properly exchange LLDP-MED TLVs, via LLDPDUs, when connected in Test Networks with other LLDP-MED capable Link Partners.

> IEEE Std. 802.1AB-Draft 13 Clause 12 specifies a method for storing LLDP obtained information in SNMP MIBs and a method for retrieving LLDP obtained information using SNMP. If the LLDP capable System does not support SNMP, the System shall provide storage and retrieval capability equivalent to the functionality specified in IEEE Std. 802.1AB-Draft 13 Clause 11.

LLDP-MED.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:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements
- ANSI TIA 1057: 11.2 Network Connectivity Device Protocol Interactions
- ANSI TIA 1057: 11.3 Endpoint Device Protocol Interactions
- ANSI TIA 1057: 7.10 LLDP-MED Fast Start Protocol Behavior

Resource Requirements:

- DUT
- LLDP-MED capable Link Partner
- 2 Test Stations
- Link Taps

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.

Test Layout:
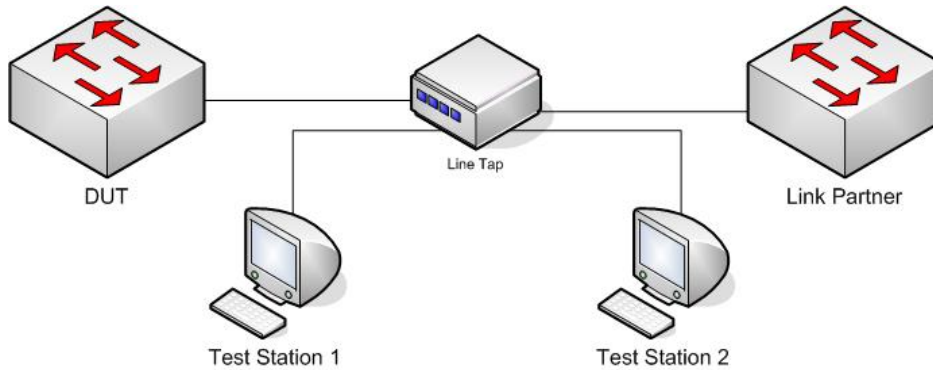
Procedure:

Part A: Fast Start – Protocol Re-initialization
1. Ensure that the <u>default</u> values are configured on the DUT.
2. Start capture on Test Stations 1 and 2.
3. Re-initialize the LLDP Service on the DUT.
4. Wait 35 seconds.
5. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
6. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
7. Stop capture on Test Stations 1 and 2, and observe the capture frames (if any).

Observable Results:

- In Step 5, 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 6, 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 7, if the DUT is a Network Connectivity Device, Test Station 1 should receive properly formed LLDPDUs. After receiving the first LLDPDU from the LP, Test Station 1 should receive properly formed LLDPDUs for three seconds at the rate of one per second. Following this, Test Station 1 should receive properly formed LLDPDUs at the ordinary rate of one per thirty seconds. Test Station 2 should receive properly formed LLDPDUs at the rate of one per thirty seconds.
- In Step 7, if the DUT is an Endpoint Device, Test Station 1 should receive three properly formed LLDPDUs at the rate of one per second for the first three seconds immediately after protocol reinitialization. Following this, Test Station 1 should receive properly formed LLDPDUs at the ordinary rate of one per thirty seconds. Test Station 2 should receive properly formed LLDPDUs at the rate of one per thirty seconds.

Possible Problems:

- None

LLDP-MED.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:

- ANSI TIA 1057: 9.1 Usage of IEEE 802.1AB Specification Mandatory Elements
- ANSI TIA 1057: 11.2 Network Connectivity Device Protocol Interactions
- ANSI TIA 1057: 11.3 Endpoint Device Protocol Interactions
- ANSI TIA 1057: 7.10 LLDP-MED Fast Start Protocol Behavior

Resource Requirements:

- DUT
- LLDP-MED capable LP
- 2 Test Stations
- Link Taps

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.

Test Layout:
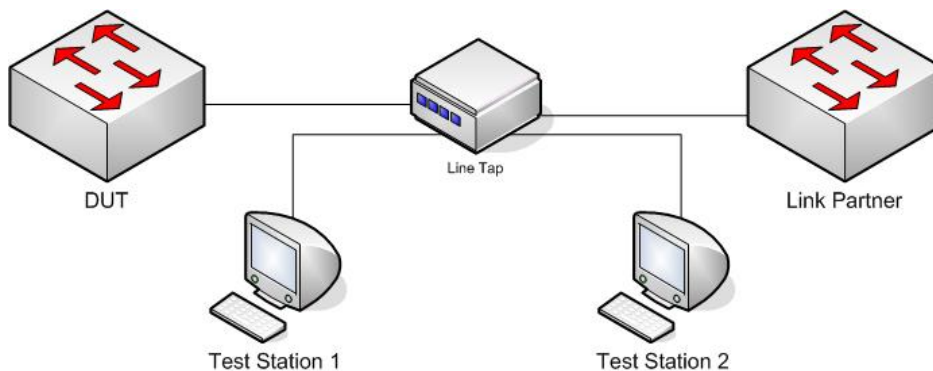
Procedure:

Part A: Fast Start – Link Reconfiguration
1. Ensure that the default values are configured on the DUT.
2. Start capture on Test Stations 1 and 2.
3. Disconnect the link between the DUT and LP.
4. Reconnect the link between the DUT and LP.
5. Wait 31 seconds.
6. Attempt to extract LLDP-MED Local System mandatory TLV information from the DUT and LP.
7. Attempt to extract LLDP-MED Remote System mandatory TLV information from the DUT and LP.
8. Stop capture on Test Stations 1 and 2, and observe captured frames (if any).

Observable Results:

- In Step 6, 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 7, 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 8, if the DUT is a Network Connectivity Device, Test Station 1 should receive properly formed LLDPDUs. After receiving the first LLDPDU from the LP, Test Station 1 should receive properly formed LLDPDUs for three seconds at the rate of one per second. Following this, Test Station 1 should receive properly formed LLDPDUs at the ordinary rate of one per thirty seconds. Test Station 2 should receive properly formed LLDPDUs at the rate of one per thirty seconds.
- In Step 8, if the DUT is an Endpoint Device, Test Station 1 should receive three properly formed LLDPDUs at the rate of one per second for the first three seconds immediately after link reconfiguration. Following this, Test Station 1 should receive properly formed LLDPDUs at the ordinary rate of one per thirty seconds. Test Station 2 should receive properly formed LLDPDUs at the rate of one per thirty seconds.

Possible Problems:

- None.