Power over Ethernet

Clause 33 PD
Data Link Layer Classification Test Suite
Version 1.0

Technical Document

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MODIFICATION RECORD

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Gerard Nadeau University of New Hampshire

INTRODUCTION

Overview
The University of New Hampshire's InterOperability Laboratory (IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. This suite of tests has been developed to help implementers evaluate the functionality of their IEEE Std 802.3-2009 based products. The tests do not determine if a product conforms to the IEEE Std 802.3-2009, not definitively. Successful completion of all tests contained in this suite does not guarantee that the tested device will operate with other Power over Ethernet capable devices. However, combined with satisfactory operation in the IOL's interoperability test bed, these tests provide a reasonable level of confidence that the Device Under Test (DUT) will function well in many Power over Ethernet environments.

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

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

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

References
The references section lists cross-references to the IEEE Std 802.3-2009 and other documentation that might be helpful in understanding and evaluating the test and results.

Resource Requirements
The requirements section specifies the hardware, and test equipment that will be needed to perform the test. The items contained in this section are special test devices or other facilities, which may not be available on all devices.

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

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

Test Setup
The setup section describes the configuration of the test environment. Small changes in the configuration should be included in the test procedure.

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

Observable Results
The observable results section lists specific items that can be examined by the tester to verify that the DUT is operating properly. When multiple values are possible for an observable result, this section provides a short discussion on how to interpret them. The determination of a pass or fail for a certain test is often based on the successful (or unsuccessful) detection of a certain observable result.

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

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GROUP 1: PD DATA LINK LAYER CLASSIFICATION

Scope: The following tests cover data link layer classification tests specific to Type 1 and Type 2 Powered Devices (PDs).

Overview: The following group of tests pertains to the determination of various parametric values as defined in IEEE Std 802.3-2009. Note, successfully passing these tests, or failing these tests does not necessarily indicate that the DUT will, or will not, be interoperable. Devices that pass these tests are more inclined to be interoperable with, not only existing products, but also all future standard compliant devices.

33.1.1: TLV Frame Definition

Purpose: To verify that DTE Power via MDI TLV frames are properly formatted.

Reference:

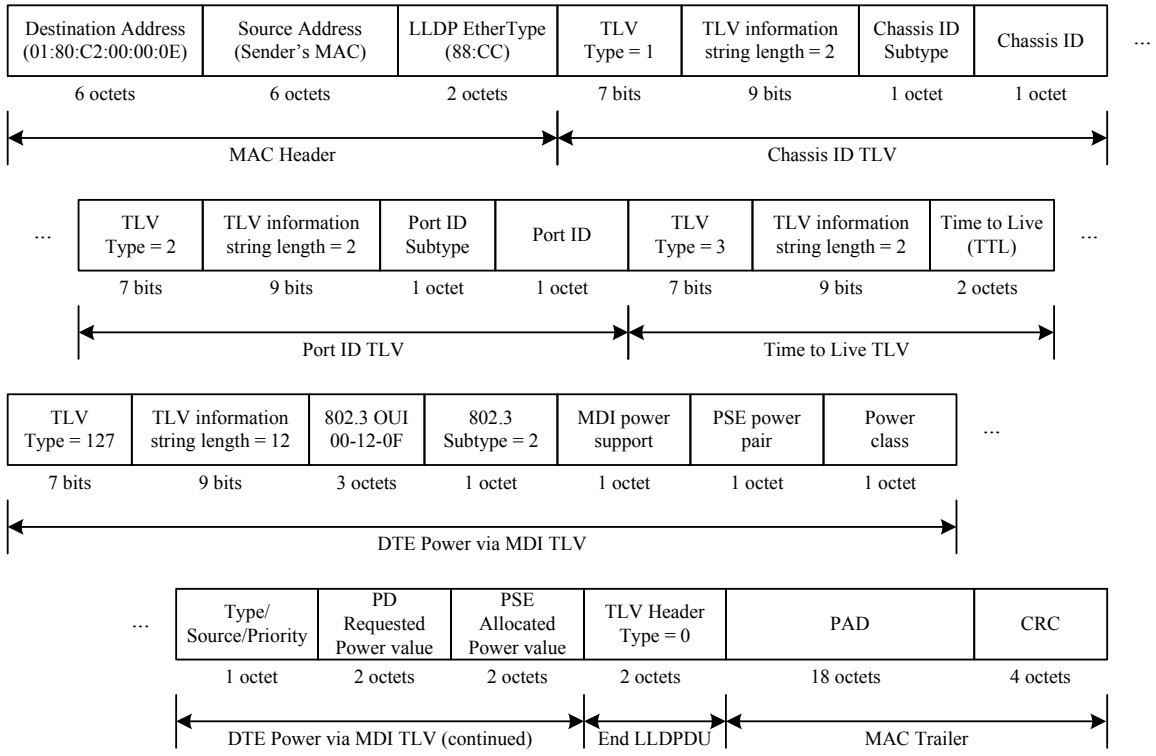
[1] IEEE Std 802.3at-2009 Subclause 33.6.1
[2] IEEE Std 802.3at-2009 Subclause 79.3.2
[3] IEEE Std 802.1AB-20XX
[4] IEEE Std 802.1AB-2005

Resource Requirements:

- A testing station capable of sending, receiving and decoding LLDPDU frames

Last Modification: May 19, 2010

Discussion: A device that supports data link layer classification must meet the specified frame definition in order to ensure interoperability. The DTE Power via MDI TLV is contained within an LLDPDU. The LLDPDU has three mandatory TLVs followed by the DTE Power via MDI TLV. Within the DTE Power via MDI TLV there are several defined fields within the TLV header and TLV information string. Each of these fields must be properly formatted to included length and proper bit maps so they may be properly interpreted.



DTE Power via MDI TLV Format

Test Setup: Connect the DUT to the testing station with appropriate cabling.

Procedure:

1. Capture a LLDPDU DTE Power via MDI TLV exchange between the DUT and the testing station.
2. Verify that the DTE Power via MDI TLV frame is properly formatted.

Observable Results:

a. The fields of the LLDPDU DTE Power via MDI TLV should be as follows:

MAC Header		
Destination Address	01:80:C2:00:00:0E	The Destination Address field specifies the station(s) for which the frame is intended, in this case the LLDP multicast address
Source Address	XX:XX:XX:XX:XX:XX	The Source Address field specifies the station sending the frame.
LLDP EtherType	88:CC	The Length/Type field indicates the nature of the MAC client protocol, in this case the LLDP Ethertype.
Chassis ID TLV		
Chassis ID TLV	**TLV type** Type = 1 **TLV information string length** Length = 2 (octets) **Chassis ID subtype** 0 = Reserved 1 = Chassis component 2 = Interface alias 3 = Port component 4 = MAC address 5 = Network address 6 = Interface name 7 = Locally assigned 8 – 255 = Reserved **Chassis ID** 1 to 255 octets	The Chassis ID TLV is a mandatory TLV that identifies the chassis containing the IEEE 802 LAN station associated with the transmitting LLDP agent. The Chassis ID TLV shall be the first TLV in the LLDPDU. The TLV information string length field shall indicate the exact length, in octets. The chassis ID subtype field shall contain an integer value indicating the basis for the chassis ID entity that is listed in the chassis ID field. The chassis ID field shall contain an octet string indicating the specific identifier for the particular chassis in this system. An LLDPDU shall contain exactly one Chassis ID TLV.
Port ID TLV		
Port ID TLV	**TLV type** Type = 2 **TLV information string length** Length = 2 (octets) **Port ID subtype** 0 = Reserved 1 = Interface alias 2 = Port component	The Port ID TLV is a mandatory TLV that identifies the port component of the MSAP identifier associated with the transmitting LLDP agent. The Port ID TLV shall be the second TLV in the LLDPDU. The TLV information string length field shall indicate the length, in octets.

	3 = MAC address 4 = Network address 5 = Interface name 6 = Agent circuit ID 7 = Locally assigned 8 – 255 = Reserved **Port ID** 1 to 255 octets	The port ID subtype field shall contain an integer value indicating the basis for the identifier that is listed in the port ID field. The port ID field is an alpha-numeric string that contains the specific identifier for the port from which this LLDPDU was transmitted. An LLDPDU shall contain exactly one Port ID TLV.
Time to Live TLV		
Time to Live TLV	**TLV type** Type = 3 **TLV information string length** Length = 2 (octets) **Time to Live (TTL)** An integer value in the range $0 \leq t \leq 65535$ in seconds	The Time To Live TLV indicates the number of seconds that the recipient LLDP agent is to regard the information associated with this MSAP identifier to be valid. The Time To Live TLV is mandatory and shall be the third TLV in the LLDPDU. The TTL field shall contain an integer value in the range $0 \leq t \leq 65535$ seconds and shall be set to the computed value of txTTL at the time the LLDPDU is constructed. An LLDPDU shall contain exactly one Time To Live TLV.
DTE Power via MDI TLV		
TLV type & Information String Length	**TLV Type** Type = 127 **TLV information string length** Length = 12 (octets)	An LLDPDU should contain no more than one Power Via MDI TLV.
802.3 OUI	00:12:0F	3-octet organizationally unique identifier.
802.3 subtype	02	1-octet organizationally defined subtype.
MDI power support	**Reserved: Bits 7:4** **PSE Pair Control Ability Supported: Bit 3** 0 = Not supported 1 = Supported **PSE MDI Power State Enabled: Bit 2** 0 = Disabled 1 = Enabled **PSE MDI Power Support: Bit 1** 0 = Not supported 1 = Supported **Port Class: Bit 0** 0 = PD 1 = PSE	The MDI power support field shall contain a bit-map of the MDI power capabilities and status.
PSE power pair	Alternative A = 01 Alternative B = 02	The PSE power pair field shall contain an integer value as defined by the

		pethPsePortPowerPairs object in IETF RFC 3621.
Power class	Class 0 = 01 Class 1 = 02 Class 2 = 03 Class 3 = 04 Class 4 = 05	The power class field shall contain an integer value as defined by the pethPsePortPowerClassifications object in IETF RFC 3621.
Type/source/priority	**Power type: Bits 7:6** 11 = Type 1 PD 10 = Type 1 PSE 01 = Type 2 PD 00 = Type 2 PSE **Power source: Bits 5:4** ***Where power type = PD*** 11 = PSE and local 10 = Local 01 = PSE 00 = Unknown ***Where power type = PSE*** 11 = Reserved 10 = Backup source 01 = Primary power source 00 = Unknown **Reserved: Bits 3:2** **Power Priority: Bits 1:0** 11 = Low 10 = High 01 = Critical 00 = Unknown (default)	The power type/source/priority field shall contain a bit-map of the power type, source and priority.
PD requested power value	Power = 0.1 × (decimal value of bits) Watts.	Valid values for these bits are decimal 1 through 255.
PSE allocated power value	Power = 0.1 × (decimal value of bits) Watts.	Valid values for these bits are decimal 1 through 255.
End of LLDPDU TLV		
End of LLDPDU TLV	**TLV Type** Type = 0	A 2 octet, all-zero TLV used to mark the end of the TLV sequence in LLDPDUs.
MAC Trailer		
MAC Pad	All zeros	If necessary, the data field is extended by appending extra bits (that is, a pad) in units of octets after the data field but prior to calculating and appending the FCS.
CRC	32 bit Frame Check Sequence	A cyclic redundancy check (CRC) is used by the transmit and receive algorithms to generate a CRC value for the FCS field.

Possible Problem: None

33.1.2: Type-2 PD Classification Implementation

Purpose: To verify that a Type-2 PD supports both 2-Event Physical Layer Classification and Data Link Layer Classification and no other permutations.

Reference:

[1] IEEE Std 802.3at-2009 Subclause 33.6
[2] IEEE Std 802.3at-2009 Table 33–8

Resource Requirements:

- A testing station capable of sending, receiving and decoding LLDPDU frames and performing 2-Event physical layer classification.

Last Modification: June 1, 2010

Discussion: The only allowed implementation for Type-2 PD is ones that support both 2-Event Physical Layer and Data Link Layer Classification. Any other combination of none, 1-Event or 2-Event Physical layer and Data Link Layer implementations are not allowed.

Test Setup: Connect the DUT to the testing station with appropriate cabling.

Procedure:

1. Configure the testing station to perform a 1-Event physical layer classification after detection has been completed transmit a Power via MDI TLV with the PSE allocated power field equivalent set to 12.95 watts and observe results.
2. Configure the testing station to perform a 2-Event physical layer classification after detection has been completed transmit a Power via MDI TLV with the PSE allocated power field equivalent set to 12.95 watts and observe results.
3. Capture the resulting LLDPDU exchange.

Observable Results:

a. A Type-2 PD should only power up when both 2-Event Physical Layer and Data Link Layer Classification mechanisms are implemented.

Possible Problem: None.

33.1.3: Set pd_dll_ready

Purpose: To verify that a PD sets pd_dll_ready variable within 5 minutes of Data Link Layer classification being enabled.

Reference:

[1] IEEE Std 802.3at-2009 Subclause 33.6.2

Resource Requirements:

- A testing station capable of sending, receiving and decoding LLDPDU frames

Last Modification: June 15, 2010

Discussion: All Type 1 PDs that implement Data Link Layer classification and Type 2 PDs shall set the state variable pd_dll_ready within 5 minutes of Data Link Layer classification being enabled in a PD as indicated by the variable pd_dll_enabled (33.3.3.3, 33.6.3.3).

Test Setup: Connect the DUT to the testing station with appropriate cabling.

Procedure:

1. Power on the DUT.
2. Perform a data link layer classification exchange between the testing station and the DUT within 5 minutes of powering the DUT.

Observable Results:

a. The PD should set the pd_dll_ready variable within 5 minutes of data link layer classification being enabled.

Possible Problem: It may not be possible to observe the state of the pd_dll_ready variable directly.

33.1.4: "PSE allocated power value" field changed

Purpose: To verify that a PD transmits an updated LLDPDU within 10 seconds upon receipt of an updated "PSE allocated power value".

Reference:

[1] IEEE Std 802.3at-2009 Subclause 33.6.2
[2] IEEE Std 802.3at-2009 Figure 33–28

Resource Requirements:

- A testing station capable of sending, receiving and decoding LLDPDU frames

Last Modification: June 15, 2010

Discussion: Under normal operation, an LLDPDU containing a Power via MDI TLV with an updated value for the "PD requested power value" field shall be sent within 10 seconds of receipt of an LLDPDU containing a Power via MDI TLV where the "PSE allocated power value" field is different from the previously communicated value.

Test Setup: Connect the DUT to the testing station with appropriate cabling.

Procedure:

1. Instruct the testing station to transmit a Power via MDI TLV with a PSE allocated power value different than the previously communicated value.
2. Capture the resulting LLDPDU exchange.

Observable Results:

a. The DUT should transmit a Power via MDI TLV with an updated PD requested power value within 10 seconds upon receipt of the TLV from the testing station.

Possible Problem: None.

33.1.5: PD in Sync with PSE

Purpose: To verify that the PD changes its maximum power draw or requested power only when it is in sync with the PSE.

Reference:

[1] IEEE Std 802.3at-2009 Subclause 33.6.4.2
[2] IEEE Std 802.3at-2009 Figure 33–28

Resource Requirements:

- A testing station capable of sending, receiving and decoding LLDPDU frames

Last Modification: June 15, 2010

Discussion: A PD is considered to be in sync with the PSE when the value of PDRequestedPowerValue matches the value of MirroredPDRequestedPowerValueEcho. The PD is not allowed to change its maximum power draw or the requested power value when it is not in sync with the PSE.

Test Setup: Connect the DUT to the testing station with appropriate cabling.

Procedure:

1. Instruct the testing station to transmit a Power via MDI TLV with a PD requested power value different than the previously communicated value.
2. Capture the resulting LLDPDU exchange.
3. Repeat steps 1 and 2 with varying values for PD requested power value.

Observable Results:

a. The DUT should only change its maximum power draw when it is in sync with the PSE.

Possible Problem: None.