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IEEE Standard for

Local and metropolitan area networks—

Station and Media Access Control Connectivity Discovery

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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Approved 11 September 2009

IEEE-SA Standards Board

Abstract: This document defines a protocol and a set of managed objects that can be used for discovering the physical topology from adjacent stations in IEEE 802® LANs.

Keywords: link layer discovery protocol, management information base, topology discovery, topology information

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1. Overview

The Link Layer Discovery Protocol (LLDP) specified in this standard allows stations attached to an IEEE 802® LAN to advertise, to other stations attached to the same IEEE 802 LAN, the major capabilities provided by the system incorporating that station, the management address or addresses of the entity or entities that provide management of those capabilities, and the identification of the station's point of attachment to the IEEE 802 LAN required by those management entity or entities.

The information distributed via this protocol is stored by its recipients in a standard Management Information Base (MIB), making it possible for the information to be accessed by a Network Management System (NMS) using a management protocol such as the Simple Network Management Protocol (SNMP).

1.1 Scope

The scope of this standard is to define a protocol and management elements, suitable for advertising information to stations attached to the same IEEE 802 LAN, for the purpose of populating physical topology and device discovery management information databases. The protocol facilitates the identification of stations connected by IEEE 802 LANs/MANs, their points of interconnection, and access points for management protocols.

This standard defines a protocol that

a) Advertises connectivity and management information about the local station to adjacent stations on the same IEEE 802 LAN.
b) Receives network management information from adjacent stations on the same IEEE 802 LAN.
c) Operates with all IEEE 802 access protocols and network media.
d) Establishes a network management information schema and object definitions that are suitable for storing connection information about adjacent stations.
e) Provides compatibility with the IETF PTOPO MIB (IETF RFC 2922 [B14]).[1]

1.2 Purpose

An IETF MIB (IETF RFC 2922 [B14]), as well as a number of vendor specific MIBs, have been created to describe a network's physical topology and associated systems within that topology.

This standard specifies the necessary protocol and management elements to

a) Facilitate multi-vendor inter-operability and the use of standard management tools to discover and make available physical topology information for network management.
b) Make it possible for network management to discover certain configuration inconsistencies or malfunctions that can result in impaired communication at higher layers.
c) Provide information to assist network management in making resource changes and/or re-configurations that correct configuration inconsistencies or malfunctions identified in b) above.

[1] The numbers in brackets correspond to those in the bibliography in Annex G.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in the text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

IEEE Std 802®, IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture.[2, 3]

IEEE Std 802a™, IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture—Amendment 1: Ethertypes for Prototype and Vendor-Specific Protocol Development.

IEEE Std 802.1AE™, IEEE Standard for Local and Metropolitan Area Networks—Media Access Control (MAC) Security.

IEEE Std 802.1AX™, IEEE Standard for Local and Metropolitan Area Networks—Link Aggregation.

IEEE Std 802.1D™, IEEE Standard for Local and Metropolitan Area Networks: Media Access Control (MAC) Bridges.

IEEE Std 802.1Q™, IEEE Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks.

IEEE Std 802.1X™, IEEE Standard for Local and Metropolitan Area Networks—Port-Based Network Access Control.

IEEE Std 802.3™, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.

IETF RFC 1812, Requirements for IP Version 4 Routers, Baker, F., June 1995.[4]

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IETF RFC 3232, Assigned Numbers: RFC 1700 is Replaced by an On-line Database, Reynolds, J., January 2002.[5]

IETF RFC 3410, Introduction and Applicability Statements for Internet Standard Management Framework, Case, J., Mundy, R.,Partain, D., and Stewart, B., December 2002.

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[4] Internet RFCs are retrievable by FTP at ftp://ftp.rfc-editor.org/in-notes/rfcnnnn.txt, or by Web browser at http://www.rfc-editor.org/rfcNNNN.txt (where NNNN is the RFC number prefixed with zeroes as necessary to make a four digit number). If the RFC number is not known, there is a search facility at http://www.rfc-editor.org/.

[5] The IETF RFC 3232 ianaAddressFamilyNumbers on-line database module is accessible through a web page (currently, http://www.iana.org).

IETF RFC 3417, Transport Mappings for the Simple Network Management Protocol (SNMP), Presuhn, R., Case, J., McCloghrie, K., Rose, M., Waldbusser, S., December 2002.

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IETF RFC 4293, Management Information Base for the Internet Protocol (IP), S. Routhier, Ed., April 2006.

IETF RFC 4363, Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering, and Virtual LAN Extensions, D. Levi, D. Harrington, January 2006.

IETF RFC 4502, Remote Network Monitoring Management Information Base Version 2, Waldbusser, S., May 2006.

IETF RFC 4546, Radio Frequency (RF) Interface Management Information Base for Data over Cable Service Interface Specifications (DOCSIS) 2.0 Compliant RF Interfaces, D. Raftus, E. Cardona, June 2006.

IETF RFC 4639, Cable Device Management Information Base for Data-Over-Cable Service Interface Specification (DOCSIS) Compliant Cable Modems and Cable Modem Termination Systems, R. Woundy, K. Marez, December 2006.

IETF RFC 4789, Simple Network Management Protocol (SNMP) over IEEE 802 Networks, J. Schoenwaelder, T. Jeffree, November 2006.

IETF RFC 4836, Definitions of Managed Objects for IEEE 802.3 Medium Attachment Units (MAUs), E. Beili, April 2007.

ISO/IEC 8824-1 [ITU-T Rec. X.680 (2002)], Abstract Syntax Notation One (ASN.1): Specification of Basic Notation.[6]

[6] ASN.1 standards are available on-line by Web browser at http://asn1.elibel.tm.fr/en/standards/index.htm#asn1.

3. Definitions and numerical representation

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary: Glossary of Terms & Definitions* should be referenced for terms not defined in this clause.[7]

alpha-numeric information: Information that is encoded using the 8-bit Universal Character Set (UCS)/ Unicode Transformation Format (UTF-8) octet sequence [IETF RFC 3629].

chassis: A physical component incorporating one or more IEEE 802® LAN stations and their associated application functionality.

chassis identifier: An administratively assigned name that identifies the particular chassis within the context of an administrative domain that comprises one or more networks.

IEEE 802® LAN: Local area network (LAN) technologies that provide a media access control (MAC) Service equivalent to the MAC Service defined in ISO/IEC 15802-1. IEEE 802 LANs include IEEE Std 802.3™, IEEE Std 802.5™ [B3], IEEE Std 802.11™ [B4], IEEE Std 802.16™ [B5], IEEE Std 802.17™ [B6], and ISO 9314-2 LANs.

IEEE 802® LAN station: An IEEE 802-compatible entity that incorporates all the necessary mechanisms to participate in media access control of an IEEE 802 LAN, and that is at least capable of providing the MAC service plus the mandatory capabilities of the LLC.

NOTE—For example, routers and host computers are stations in a bridged network. Bridges, in addition to their relay function, also include station capabilities.[8]

Link Layer Discovery Protocol (LLDP): A media-independent protocol capable of running on all IEEE 802® LAN stations and to allow an LLDP agent to learn the connectivity and management information from adjacent stations.

LLDP agent: The protocol entity that implements LLDP for a particular MSAP associated with a Port.

MAC service access point (MSAP): The access point for MAC services provided to the LLC sublayer.

MSAP identifier: The identifier of a MAC service access point.

NOTE—In this standard, the concatenation of the chassis identifier and the port identifier is used by LLDP as an MSAP identifier, to identify the port associated with an IEEE 802® LAN station.

management entity: The protocol entity that implements a particular network management protocol and that provides access support to a MIB associated with the protocol and implemented on a host chassis.

Management Information Base (MIB): The instantiation of all MIB modules in a managed entity (e.g., system or device).

Management Information Base module (MIB module): The specification or schema for a data base that can be populated with the information required to support a network management information system.

network: An interconnected group of systems, each comprising one or more IEEE 802® LAN stations.

[7] The *IEEE Standards Dictionary: Glossary of Terms & Definitions* is available at http://shop.ieee.org/.

[8] Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

Network Management System (NMS): A management system that is capable of utilizing the information in a MIB.

object identifier (OID): An identifier used to name an object. Structurally, an OID consists of a node in a hierarchically-assigned namespace, formally defined in ISO/IEC 8824-1, Abstract Syntax Notation 1 (ASN.1). OIDs are used in this standard to identify MIB modules and the objects they contain.

physical network topology: The identification of systems, of IEEE 802® LAN stations that compose each system, and of the IEEE 802 LAN stations that attach to the same IEEE 802 LAN.

port: The entity in a chassis/system to support an MSAP. A port incorporates one and only one MSAP and identifies the collection of manageable entities that provide the MAC Service at the MSAP**.**

port identifier: An administratively assigned name that identifies the particular port within the context of a system, where the identification is convenient, local to the system, and persistent for the system's use and management (whereas the MAC address that globally identifies the MSAP can not be).

system: A managed collection of hardware and software components incorporating one or more chassis, stations and ports.

station only: A non-forwarding IEEE 802® LAN station such as a user workstation, network file server, or print server.

type, length, value (TLV): A short, variable length encoding of an information element consisting of sequential type, length, and value fields where the type field identifies the type of information, the length field indicates the length of the information field in octets, and the value field contains the information, itself.

3.2 Numerical representation

Decimal, hexadecimal, and binary numbers are used within this document. For clarity, decimal numbers are generally used to represent counts, hexadecimal numbers are used to represent addresses, and binary numbers are used to describe bit patterns within binary fields.

Decimal numbers are represented in their usual 0, 1, 2, … format. Hexadecimal numbers are represented by a string of one or more hexadecimal (0–9, A–F) digits followed by the subscript 16, except in C-code contexts, where they are written as `0x123EF2` etc. Binary numbers are represented by a string of one or more binary (0,1) digits, followed by the subscript 2. Thus the decimal number "26" may also be represented as "$1A_{16}$" or "11010_2".

MAC addresses, Ethertype values, and OUI/EUI values are represented as strings of 8-bit hexadecimal numbers separated by hyphens and without a subscript, as for example "01-80-C2-00-00-15" or "AA-55-11", using the hexadecimal representation defined in IEEE Std 802.

4. Acronyms and abbreviations

BSSID	basic service set identification
DA	Destination Address
DS	Distribution System
EUI	Extended Unique Identifier
FCS	Frame Check Sequence
ID	Identifier
IETF	Internet Engineering Task Force
KaY	MAC Security Key Agreement Entity
LLC	logical link control (sublayer)
LLDP	Link Layer Discovery Protocol
LLDPDU	LLDP data unit
LSAP	link service access point
MAC	media access control (sublayer)
MAU	medium attachment unit
MDI	media dependent interface
MIB	Management Information Base (module)
MSAP	MAC service access point
MSDU	MAC service data unit
NMS	Network Management System
OID	object identifier
OUI	organizationally unique identifier
PD	Powered Device
PHY	physical (sublayer)
PMD	physical media dependent (sublayer)
PSE	Power Sourcing Equipment
PVID	port VLAN ID

PPVID	port and protocol VLAN ID
PTOPO	the name of the IETF physical topology MIB
RFC	Request for comments
SA	Source Address
SecY	MAC Security Entity
SNAP	Subnetwork Access Protocol
SNMP	Simple Network Management Protocol
STP	Spanning Tree Protocol
TPMR	Two-port MAC relay
TLV	type, length, value
TTL	time to live (value)
UCS	Universal Character Set
UTF-8	8-bit UCS/Unicode Transformation Format
VID	VLAN ID

5. Conformance

This clause specifies the mandatory and optional capabilities provided by conformant implementations of this standard.

5.1 Terminology

For consistency with IEEE and existing IEEE 802.1™ standards terminology, requirements placed upon conformant implementations of this standard are expressed using the following terminology:

a) *shall* is used for mandatory requirements.
b) *may* is used to describe implementation or administrative choices (“may” means “is permitted to”, and hence, “may” and “may not” mean precisely the same thing).
c) *should* is used for recommended choices (the behaviors described by “should” and “should not” are both permissible but not equally desirable choices).

The PICS proforma (see Annex A) reflects the occurrences of the words *shall*, *may*, and *should* within the standard.

The standard avoids needless repetition and apparent duplication of its formal requirements by using is, is not, are, and are not for definitions and the logical consequences of conformant behavior. Behavior that is permitted but is neither always required nor directly controlled by an implementor or administrator, or whose conformance requirement is detailed elsewhere, is described by can. Behavior that never occurs in a conformant implementation or system of conformant implementations is described by can not. The word *allow* is used as a replacement for the phrase “Support the ability for,” and the word *capability* means “is able to, or can be configured to.”

5.2 Protocol Implementation Conformance Statement (PICS)

The supplier of an implementation that is claimed to conform to this standard shall complete a copy of the PICS proforma provided in Annex A and shall provide the information necessary to identify both the supplier and the implementation.

5.3 Required capabilities

A system for which conformance to this standard is claimed shall, for all ports for which support is claimed, include the following capabilities:

a) If port access is controlled by IEEE Std 802.1X,[9] LLDP exchanges shall be supported through the controlled port, as specified in Clause 6.
b) The destination and source addressing shall conform to 7.1 and 7.2.
c) Ethertype encapsulation shall conform to 7.3.
d) LLDPDU recognition and reception shall conform to the operation of the receive state machine as defined in 9.2.9.
e) LLDPDU encapsulation shall conform to the specifications in 8.2.
f) The basic TLV format capability shall be implemented as defined in 8.4.
g) The basic management set of TLVs shall be implemented as defined in 8.5.
h) The Organizationally Specific TLV format capability shall be implemented as defined in 8.6.

[9] Information on references can be found in Clause 2.

i) The protocol shall conform to the specifications for all Clause 9 subclauses indicated in Table 9-1 for the particular operating mode (transmit only, receive only, or transmit and receive) being implemented.

j) If receipt of LLDPDUs is supported, for every set of TLVs (the basic management set and any organizationally specific sets) supported, support shall be implemented for receipt of every TLV defined in the set.

k) If transmission of LLDPDUs is supported, for every set of TLVs (the basic management set and any organizationally specific sets) supported, support shall be implemented for transmission of every TLV defined in the set.

l) If transmission of LLDPDUs is supported, for every set of TLVs (the basic management set and any organizationally specific sets) supported, a capability shall be implemented for users to determine which optional TLVs are transmitted in any particular LLDPDU.

m) If SNMP is supported, then
   1) The system shall conform to the LLDP management specifications in Clause 11 and shall implement the sections of version 2 of the basic LLDP MIB indicated in Table 11-1 for the operating mode being implemented.
   2) The system shall support at least one of the transport mappings defined by IETF RFC 3417 or IETF RFC 4789.

n) If SNMP is not supported, the system shall provide storage and retrieval capability equivalent to the functionality specified in 10.1 for the operating mode being implemented.

5.4 Optional capabilities

A system for which conformance to this standard is claimed may, for each port for which support is claimed, support the following capabilities:

a) Implement the entire IEEE 802.1 Organizationally Specific TLV extension set and the associated IEEE 802.1 version 2 MIB extension capability defined in Annex .

b) Implement the entire IEEE 802.3 Organizationally Specific TLV extension set and the associated IEEE 802.3 version 2 MIB extension capability defined in Annex .

c) If port access is controlled by IEEE Std 802.1X, LLDP exchanges may be supported through the uncontrolled port, as specified in Clause 6.

6. Principles of operation

LLDP is a link layer protocol that allows an IEEE 802 LAN station to advertise the capabilities and current status of the system associated with an MSAP. The MSAP provides the MAC service to an LLC Entity, and that LLC Entity provides an LSAP to an LLDP agent that transmits and receives information to and from the LLDP agents of other stations attached to the same LAN. The information distributed and received in each LLDPDU is stored in one or more Management Information Bases (MIBs). Figure 6-1 illustrates the LLDP agent and its relationship to its LLC Entity and MSAP, and to additional MIBs designed by the IETF, IEEE 802, and others.

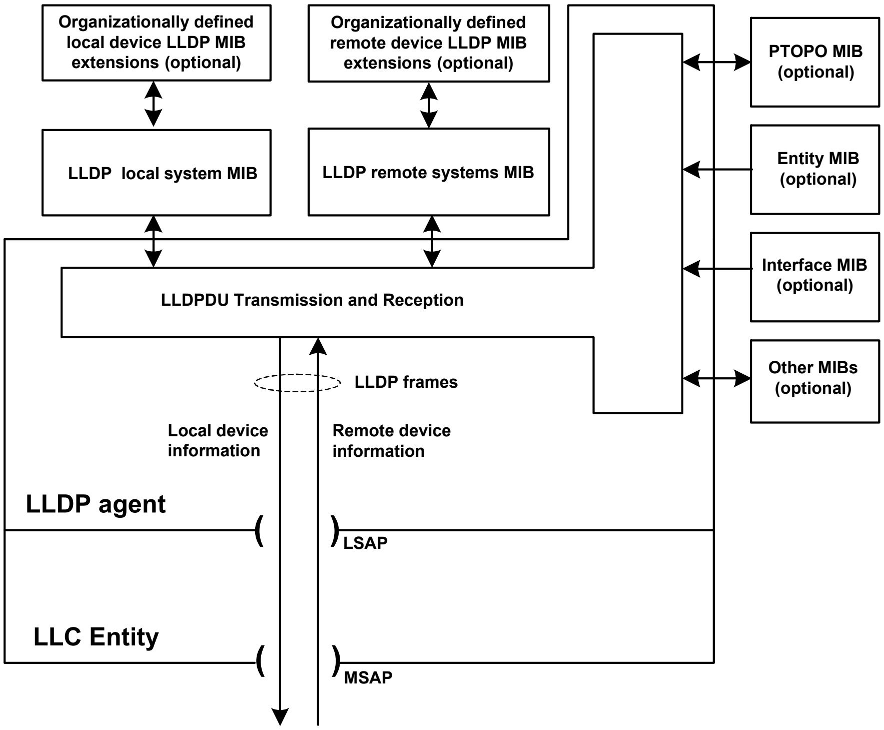

Organizationally defined local device LLDP MIB extensions (optional)
Organizationally defined remote device LLDP MIB extensions (optional)
PTOPO MIB (optional)
LLDP local system MIB
LLDP remote systems MIB
Entity MIB (optional)
Interface MIB (optional)
LLDPDU Transmission and Reception
LLDP frames
Other MIBs (optional)
Local device information
Remote device information
LLDP agent
LSAP
LLC Entity
MSAP

Figure 6-1—LLDP agent and its relationship to its LLC entity

This clause describes general principles of LLDP operation. The following clauses specify transmission, reception, and addressing of LLPDUs (Clause 7); LLDPDU formats (Clause 8); operation of each LLDP agent in detail including state machines (Clause 9); management of LLDP (Clause 10); and the MIB module used for LLDP management (Clause 11).

NOTE 1—For the purposes of this standard, the terms “LLC” and “LLC entity” include the service provided by the operation of entities that support protocol discrimination using an Ethertype; i.e., protocol discrimination based on the Type interpretation of the Length/Type field as specified in IEEE Std 802.3, or the use of the SNAP encapsulation of Ethertypes as described in IEEE Std 802. Hence, “LSAP” in the above description can refer to the use of IEEE Std 802.2 LLC addresses, or an Ethertype, as a means of higher layer protocol identification.

NOTE 2—LLC Entity also provides distinct LSAPs to other higher layer protocol entities (such as those responsible for the Spanning Tree Protocol and IP). In a bridge, the LLC Entity associated with each Bridge Port is directly connected to the attached LAN, as discussed in IEEE Std 802.1D-2004, 7.12.7 and in IEEE Std 802.1Q-2005, 8.13.9, so the operation of LLDP is unaffected by the spanning tree Port State.

6.1 Transmission and reception

The information fields in each LLDP frame are contained in a Link Layer Discovery Protocol Data Unit (LLDPDU) as a sequence of variable length information elements, that each include type, length, and value fields (known as TLVs), where

a) Type identifies what kind of information is being sent.
b) Length indicates the length of the information string in octets.
c) Value is the actual information that needs to be sent (for example, a binary bit map or an alphanumeric string that can contain one or more fields).

Each LLDPDU contains the following four mandatory TLVs (see Table 8-1), and can contain optional TLVs as selected by network management:

d) A Chassis ID TLV.
e) A Port ID TLV.
f) A Time To Live TLV.
g) Zero or more optional TLVs, as allowed by the maximum size of the LLDPDU.
h) An End Of LLDPDU TLV.

The chassis ID and the port ID values are concatenated to form a logical MSAP identifier that is used by the recipient to identify the sending LLDP agent/port. Both the chassis ID and port ID values can be defined in a number of convenient forms. Once selected, however, the chassis ID/port ID value combination remains the same as long as the particular port remains operable.

A non-zero value in the time to live (TTL) field of the Time To Live TLV tells the receiving LLDP agent how long all information pertaining to this LLDPDU's MSAP identifier is valid so that all the associated information can later be automatically discarded by the receiving LLDP agent if the sender fails to update it in a timely manner. A zero value indicates that any information pertaining to this LLDPDU's MSAP identifier is to be discarded immediately.

NOTE—A TTL value of zero can be used, for example, to signal that the sending port has initiated a port shutdown procedure.

The End Of LLDPDU TLV marks the end of the LLDPDU.

The format for the LLDPDU is defined in 8.2. The TLV categories and the basic TLV format are defined in 8.3 and 8.4. The specific format and field contents for the Chassis ID TLV are defined in 8.5.2; for the Port ID TLV, in 8.5.3; for the Time To Live TLV in 8.5.4; and for the End Of LLDPDU TLV, in 8.5.1.

6.2 LLDP operational modes

LLDP is a one way protocol. An LLDP agent can transmit information about the capabilities and current status of the system associated with its MSAP identifier. The LLDP agent can also receive information about the capabilities and current status of the system associated with a remote MSAP identifier. LLDP does not itself contain a mechanism for soliciting specific information from other LLDP agents, nor does it provide a specific means of confirming the receipt of information.

NOTE—The LLDP protocol is designed to advertise information useful for discovering pertinent information about a remote port and to populate topology MIBs. It is not intended to act as a configuration protocol for remote systems, nor as a mechanism to signal control information between ports. During the operation of LLDP, it may be possible to discover configuration inconsistencies between systems on the same IEEE 802 LAN. LLDP does not provide a mechanism to resolve those inconsistencies. Rather, it provides a means to report discovered information to higher layer management entities.

LLDP allows the transmitter and the receiver to be separately enabled, making it possible to configure an implementation so the local LLDP agent can either transmit only or receive only, or so the local LLDP agent can transmit and receive LLDP information.

6.3 LLDP information categories

The following three sets of TLVs are currently defined by this standard and can be used to describe the system and/or to assist in the detection of configuration inconsistencies associated with the MSAP identifier:

a) Basic management TLV set (this set is required in all LLDP implementations).
   1) Port Description TLV.
   2) System Name TLV.
   3) System Description TLV.
   4) System Capabilities TLV (indicates both the system's capabilities and its current primary network function, such as end station, bridge, router).
   5) Management Address TLV.

b) IEEE 802.1 Organizationally Specific TLV set (this set is optional for all LLDP implementations).
   1) Port VLAN ID TLV.
   2) Port And Protocol VLAN ID TLV.
   3) VLAN Name TLV.
   4) Protocol Identity TLV.
   5) VID Usage Digest TLV.
   6) Management VID TLV.
   7) Link Aggregation TLV.

c) IEEE 802.3 Organizationally Specific TLV set (this set is optional for all LLDP implementations).
   1) MAC/PHY Configuration/Status TLV (indicates the auto-negotiation capability and the duplex/speed status of IEEE 802.3 MAC/PHYs).
   2) Power Via MDI TLV (indicates the capabilities and current status of IEEE 802.3 PMDs that either require or are able to provide power over twisted-pair copper links).
   3) Link Aggregation TLV (indicates the current link aggregation status of IEEE 802.3 MACs).
   4) Maximum Frame Size TLV (indicates the maximum supported IEEE 802.3 frame size).

NOTE 1—Other organizations can define their own organizationally specific TLV sets for use in LLDP.

Table 8-1 includes a list of the currently defined optional TLVs in the basic management set and provides subclause references for their specific definitions.

Organizationally Specific TLVs can be defined by either the professional organizations or the individual vendors that are involved with the particular functionality being implemented within a system. The basic format and procedures for defining Organizationally Specific TLVs are provided in 8.6.

Annex contains definitions of Organizationally Specific TLVs associated with IEEE Std 802.1. Annex contains definitions of Organizationally Specific TLVs associated with IEEE Std 802.3. Annex contains an informative discussion of how several Organizationally Specific TLVs could be used to detect potential problems in communications networks.

NOTE 2—The IEEE 802.3 Organizationally Specific TLV set will, in due course, be incorporated into the IEEE 802.3 standard, at which point, the version defined in IEEE Std 802.3 will become the definitive version. Once that has happened, the IEEE 802.3 material will be removed from this standard.

6.4 TLV selection

Information for constructing the various TLVs to be sent is stored in the LLDP local system MIB. The selection of which particular TLVs to send is under control of network management. Information received from remote LLDP agents is stored in the LLDP remote systems MIB.

6.5 Transmission principles

Transmission can be initiated either by the expiration of a transmit countdown timing counter or by a change in the value of one or more of the information elements (managed objects) associated with the local system. When a transmit cycle is initiated, the LLDP management entity extracts the managed objects from the LLDP local system MIB and formats this information into TLVs. The TLVs are inserted into an LLDPDU that is passed to the LLDP transmit module. The LLDP transmit module prepends addressing parameters to the LLDPDU as defined in 8.2, 8.3, and 8.4. The LLDPDU and TLV formats are defined in Clause 8. The LLDP transmit state machine is described in 9.2.1 and 9.2.8.

NOTE 1—Because a transmission cycle can be initiated whenever a change occurs within the LLDP local system MIB, it is possible that a series of successive changes over a short period of time could trigger a number of LLDP frames to be sent, each reporting only a single change. LLDP utilizes a transmission delay timer that can be set by network management to ensure that there is a defined maximum number of LLDPDU transmissions in a given time period.

NOTE 2—Under normal circumstances, the information in the receiving LLDP agent's remote systems MIB is refreshed periodically to avoid being discarded due to ageing. To prevent the receiving LLDP agent's remote systems MIB information being aged out because a refresh frame has been lost in transmission, the sending LLDP agent typically sets the TTL value so that several refresh cycles can occur before the received MIB information ages out.

LLDP can disclose information about a device and network that could be considered sensitive in certain environments. Implementers are encouraged to provide controls that take into account the link protection characteristics when including information in an LLDP message. Different information can be included if an LLDP message is being sent on the uncontrolled port, the controlled port, or a MACsec protected connectivity association.

6.6 Reception principles

The LLDP receive module uses the services of the LLC entity to recognize that the incoming MA_UNITDATA.indication contains the correct combination of destination address and MSDU header values to identify it as resulting from a received LLDPDU. The LLDPDU recognition procedures are defined in 7.4 and 9.2.7.7.

6.6.1 LLDPDU and TLV error handling

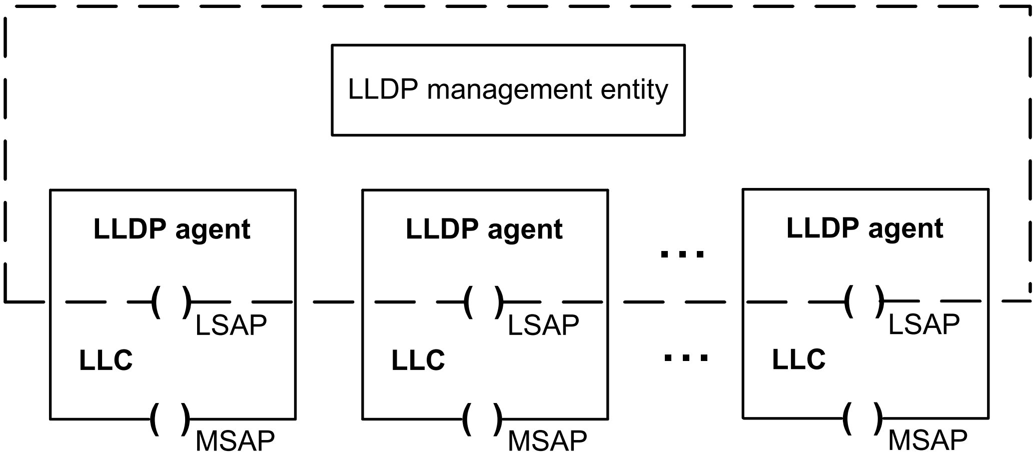
The LLDPDU is checked to ensure that it contains the correct sequence of mandatory TLVs and then each optional TLV is validated in succession. LLDPDUs and TLVs that contain detectable errors are discarded. TLVs that are not recognized, but that also contain no basic format errors, are assumed to be valid and are stored for possible later retrieval by network management (see 9.2.7.7.1 and 9.2.7.4).

6.6.2 LLDP remote systems MIB update

The LLDP remote systems MIB is updated after all TLVs have been validated. LLDP remote system MIB update procedures are defined in 9.2.7.7.4, 9.2.7.7.5, and 9.2.7.4. The LLDP receive state machine is described in 9.2.1 and 9.2.9.

6.7 Systems with multiple LLDP Agents

Each LLDP agent advertises a single set of information in the various TLVs it encodes in each transmitted LLPDU, and is associated with the MSAP that supports the LLC entity that the agent uses to transmit and receive. Each LLDP agent uses its LSAP directly, without the use of any additional multiplexing or addressing above the LSAP to support the use of that LSAP by multiple agents; and each LLC entity provides service to one and only one protocol entity at each of its LSAPs that it supports, using the service provided by a single MSAP. It follows that each LLDP agent makes use of a unique MSAP, and that the agent can be uniquely identified by that MSAP's identifier as specified above (7.2). A single LLDP management entity can support the operation of multiple LLDP agents within the same system. Figure 6-2 illustrates the relationship between the LLDP agents, LLC Entities, MSAPs, and the LLDP management entity.



LLDP - Link Layer Discovery Protocol
LSAP - Link service access point
MSAP - MAC service access point

Figure 6-2—Relationship between LLDP agents, LLC Entities, MSAPs, and the LLDP management entity

A given system can require the use of multiple LLDP agents because it naturally comprises multiple MSAPs, or because it needs to be able to transmit different information (different sets of TLVs) to different sets of peers. These sets of peers can be determined by the way that the MAC service is supported within the system (see 6.1.8 of IEEE Std 802.1Q-2005 for a description of the connectionless connectivity that characterizes an IEEE 802 LAN). A MAC Bridge (see IEEE Std 802.1D, IEEE Std 802.1Q), for example, attaches to multiple LANs, each providing the MAC service at a distinct MSAP. A different example is a station that uses port-based network access control (IEEE Std 802.1X) to provide both a Controlled Port and an Uncontrolled Port, i.e., two distinct MSAPs with potentially different connectivity, for transmission and reception to and from a single LAN. Similarly, different destination addresses can be associated with different sets of potential recipients. Table 7-1 identifies group MAC addresses that can be used for LLDPDU transmission, and 7.1 describes the different transmission scopes associated with each address. LLDP can also be used in conjunction with individual MAC addresses, and with other group MAC addresses. Distinct LLDP agents, and hence separate and distinct protocol state machines, local and remote MIB tables, and MSAPs are maintained for each LLDPDU destination address, even if the use of two or more MSAPs can result in transmission and reception on the same LAN.

NOTE—For a given MAC address that is used as a destination address in received LLDPDUs, there is the possibility for a station to receive LLDPDUs from multiple senders. All LLDPDUs that carry that destination MAC address are received by a single LLDP agent, via a single MSAP; however, as the LLPDU carries information that identifies the source of the LLDPDU, information carried in LLPDUs from different senders is able to be recorded independently in the remote systems MIB.

Figure 6-3 illustrates the use of LLDP in a MAC Bridge, with an LLDP agent for each of the two ports shown. Figure 6-4 shows the use of LLDP in an end system with port-based network access control (IEEE Std 802.1X) supported by MACsec (IEEE Std 802.1AE); an LLDP agent is supported by the Controlled Port and an additional LLDP agent may be supported by the Uncontrolled Port. Figure 6-5 shows LLDP in a MAC Bridge that uses port-based network access control on both ports.

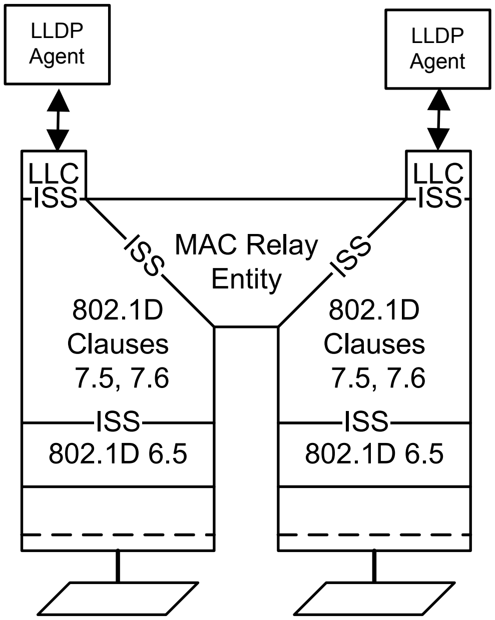


Figure 6-3—LLDP in a MAC Bridge

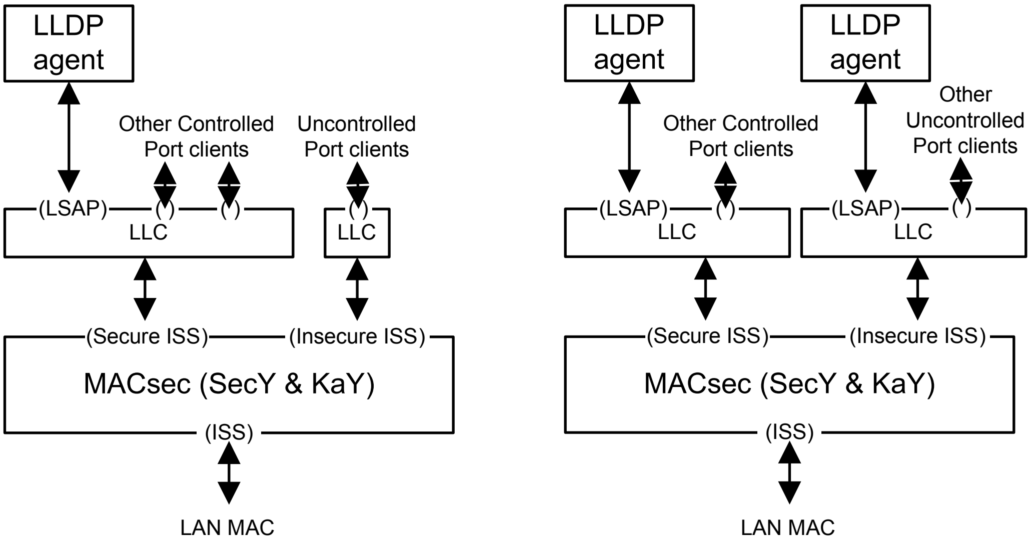


Figure 6-4—LLDP in an end system with port-based network access control

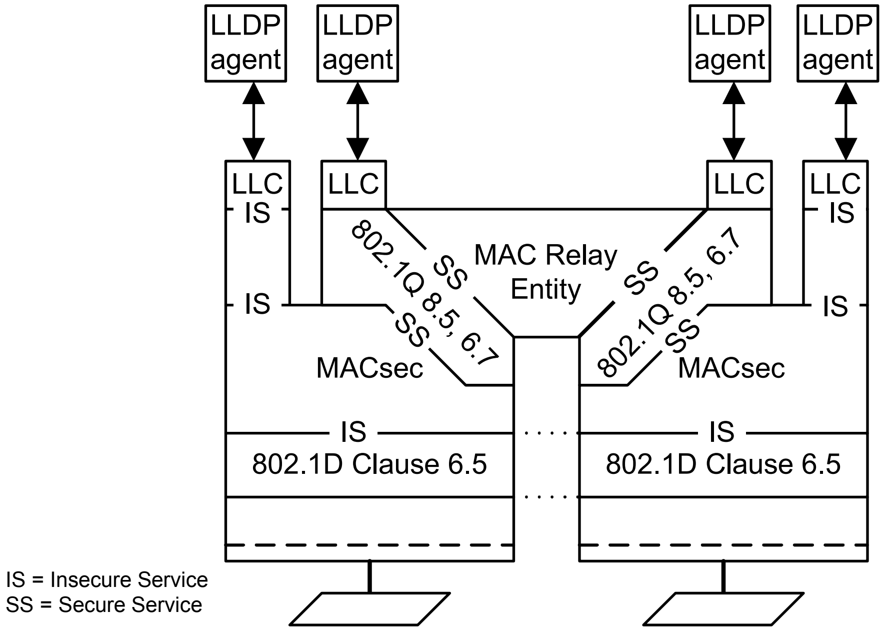


Figure 6-5—LLDP in a MAC Bridge that uses port-based network access control on both ports

LLDP frames sent on an unprotected link may be modified by an attacker. If an implementation is going to take action based upon a received LLDP attribute, it is advisable to take into account whether the message was received on a protected link, and allow for the system to be configured such that only information received in protected messages is acted upon.

The group addresses identified in Table 7-1 are taken from the set specified as reserved addresses by bridging standards. Frames (including those conveying LLDPDUs) that use these destination addresses are filtered or not by the various types of bridge components, as specified by Table 8-1 through Table 8-3 of IEEE Std 802.1Q-2005. The choice of a particular address thus allows a given agent to limit the propagation of LLDPDUs to an individual LAN, or to allow them a wider scope. Figure 6-6 illustrates the various scopes achievable with the three destination group MAC addresses identified in Table 7-1, their use is specified further in 7.1.

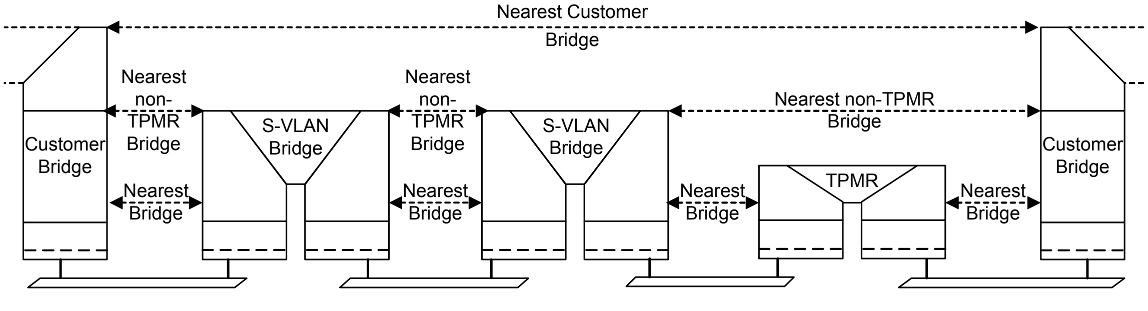


Figure 6-6—Scope of group MAC addresses

More than one LLDP agent, each using a different address scope, can be instantiated for a given system port by adding a simple shim that provides the necessary distinct MSAPs by multiplexing and demultiplexing between those MSAPs and a common MSAP for the port, as illustrated in Figure 6-7.

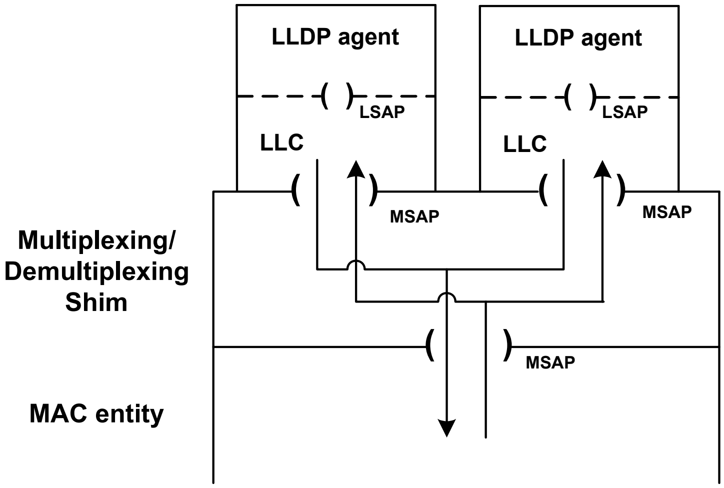


Figure 6-7—Multiplexing and demultiplexing using shims

7. LLDPDU transmission, reception, and addressing

This standard is intended to be compatible with all IEEE 802 MACs.

LLDP uses the service provided by the LLDP/LSAP and LLC to transmit and receive LLDPDUs. Each LLDPDU is transmitted as a single MAC service request by an LLC entity that uses a single instance of the MAC Service provided at an MSAP. Each incoming LLDP frame is received at the MSAP by the LLC entity as a MAC service indication.

NOTE—For the purposes of this standard, the terms "LLC" and "LLC entity" include the service provided by the operation of entities that support protocol discrimination using an Ethertype, i.e., protocol discrimination based on the Ethertype field specified in IEEE Std 802a.

The parameters of each service request and service indication comprise

a) Destination address
b) Source address
c) Ethertype
d) LLDPDU

The LLDP Ethertype, used to identify the LLDP protocol, is prepended to the LLDPDU as shown in Figure 7-1 to form the MSDU of the corresponding MAC service request.

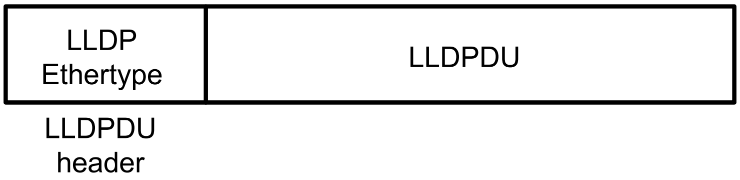


Figure 7-1—MSDU format

The values of the parameters used by LLDP, and their encoding by the LLC entity that supports the LLDP LSAP, are specified in the following subclauses.

7.1 Destination address

A set of standard group MAC addresses that can be used by LLDP is specified in Table 7-1. These addresses are in the range of IEEE Std 802.1D reserved addresses (see Table 7-10 in IEEE Std 802.1D-2004), the C-VLAN component reserved addresses (see Table 8-1 in IEEE Std 802.1Q-2005) and the S-VLAN component reserved addresses (see Table 8-2 in IEEE Std 802.1Q-2005). The choice of address used determines the scope of propagation of LLDPDUs within a bridged LAN, as follows:

a) The ***nearest bridge*** group MAC address is an address that no conformant Two-Port MAC Relay (TPMR) component, S-VLAN component, C-VLAN component, or IEEE 802.1D Bridge can forward. LLDPDUs transmitted using this destination address can therefore travel no further than those stations that can be reached via a single individual LAN from the originating station. LLDPDUs received on this address therefore represent information about stations that are attached to the same individual LAN segment as the recipient station.

NOTE 1—This address was selected in order to make it possible to transmit an LLDP frame containing information specific to a single individual LAN, and for that information not to be propagated further than the extent of that individual LAN, to avoid the meaning of that information being misinterpreted. For example, a TLV containing the auto-negotiation status of an IEEE 802.3 LAN would be open to misinterpretation if it were to be propagated via a Bridge onto a second IEEE 802.3 LAN, and would be meaningless if propagated onto a LAN based on a different MAC technology. This is the "LLDP_Multicast address" that was used in IEEE Std 802.1AB-2005. This address was erroneously omitted from the table of S-VLAN component Reserved addresses added to IEEE Std 802.1Q by IEEE Std 802.1ad-2005, but has been added to that table by IEEE P802.1aj/D 4.0/July 16, 2009 [B2].[10]

b) The ***nearest non-TPMR bridge*** group MAC address is an address that no conformant C-VLAN component, S-VLAN component, or IEEE 802.1D Bridge can forward. However, this address is relayed by TPMR components. Therefore, LLDPDUs received on this address represent information about stations that are not separated from the recipient station by any intervening C-VLAN component, S-VLAN component, or IEEE 802.1D Bridge. There may, however, be one or more TPMR components in the path between the originating and receiving stations.

NOTE 2—This address was selected in order to make it possible to communicate information between adjacent bridges and for that communication to be transparent to the presence or absence of TPMRs in the transmission path. This address is primarily intended for use within provider bridged networks.

c) The ***nearest Customer Bridge*** group MAC address is an address that no conformant C-VLAN component or IEEE 802.1D Bridge forwards. However, this address is relayed by TPMR components and S-VLAN components. Therefore, LLDPDUs received on this address represent information about stations that are not separated from the recipient station by any intervening C-VLAN components (e.g., a C-VLAN Bridge or Provider Edge Bridge). There may, however, be TPMR components and/or S-VLAN components in the path between the originating and receiving stations.

NOTE 3—This address was selected in order to make it possible to communicate information between adjacent Customer Bridges and for that communication to be transparent to the presence or absence of TPMRs or S-VLAN components in the communication path. The scope of this address is the same as that of a customer-to-customer MACSec connection.

Table 7-1—Group MAC addresses used by LLDP

Name	Value	Purpose
Nearest bridge	01-80-C2-00-00-0E	Propagation constrained to a single physical link; stopped by all types of bridge
Nearest non-TPMR bridge	01-80-C2-00-00-03	Propagation constrained by all bridges other than TPMRs; intended for use within provider bridged networks
Nearest Customer Bridge	01-80-C2-00-00-00	Propagation constrained by customer bridges; this gives the same coverage as a customer-customer MACSec connection

NOTE 4—The LSAP or Ethertype field is necessary to distinguish between different protocols conveyed in frames with the same group or individual destination address. Prior to revision of this standard to allow multiple address scopes, the destination address 01-80-C2-00-00-00 was only explicitly specified for Spanning Tree Protocol BPDUs. It is therefore possible that some implementations recognize only a frame's destination address before applying priority handling resources intended to guard against BPDU loss. Since LLDP rate limits LLDPDU transmission, the additional consumption of these resources by LLDPDUs is unlikely to pose a problem for robust implementations.

[10] Numbers preceded by P are IEEE authorized standards projects that were not approved by the IEEE-SA Standards Board at the time this publication went to press. For information about obtaining drafts, contact the IEEE.

It is assumed in the foregoing definitions of the scope of these group MAC addresses that an end station attached to an individual LAN is a potential recipient of any of these addresses, and therefore such end stations fall within the scope of these addresses as well as the identified bridge components.

In addition to determining the scope of transmission, the support of more than one destination MAC address allows different sets of TLVs to be supported over the different transmission scopes.

In addition to the prescribed support for standard group MAC addresses shown in Table 7-1, implementations of LLDP may support the following destination addresses for LLDPDUs:

d) Any group MAC address.
e) Any individual MAC address.

Support for the use of each of these destination addresses, for both transmission and reception of LLDPDUs, is either mandatory, recommended, permitted, or not permitted, according to the type of system in which LLDP is implemented, as shown in Table 7-2.

Table 7-2—Support for MAC addresses in different systems

Address	C-VLAN Bridge	S-VLAN Bridge	TPMR Bridge	End station
Nearest bridge	Mandatory	Mandatory	Mandatory	Mandatory
Nearest non-TPMR bridge	Mandatory	Mandatory	Not permitted	Recommended
Nearest Customer Bridge	Mandatory	Not permitted	Not permitted	Recommended
Any other group MAC address	Permitted	Permitted	Permitted	Permitted
Any individual MAC address	Permitted	Permitted	Permitted	Permitted

NOTE 5 —Where the implementation supports the use of individual MAC addresses, there is a need for some means whereby the sender can ascertain what address to use, and what scope is associated with that address; how this is achieved is outside the scope of this standard.

NOTE 6—The option of using an individual MAC addresses supports the use of LLDP in IEEE Std 802.11 and other wireless LANs, where it is desirable to target specific TLV content at specific logical Ports. In particular, the use of an individual MAC address allows an access point to direct LLDP frames at an individual station with which it is associated.

NOTE 7—If an individual MAC address is used as the destination address by a given LLDP Agent, then that agent would not also receive LLDPDUs on that address; it makes no sense for an LLDP Agent to send LLDP frames to an individual MAC address that it also receives LLDP frames on. Similarly, if an Agent is able to receive LLDPDUs sent to a given individual MAC address, it would not also transmit LLDPDUs to that address. Therefore, Agents associated with individual MAC addresses are either transmitters or receivers of LLDPDUs for a given address, but not both.

NOTE 8—The destination MAC address used by a given LLDP agent defines only the scope of transmission and the intended recipient(s) of the LLDPDUs; it plays no part in protocol identification. In particular, the group MAC addresses identified in Table 7-1 are not used exclusively by LLDP; other protocols that require to use a similar transmission scope are free to use the same addresses.

7.2 Source address

The source address shall be the individual MAC address of the sending station or port.

7.3 Ethertype use and encoding

The Ethertype used to identify the LLDP protocol shall be the LLDP Ethertype specified in Table 7-3.

Table 7-3—LLDP Ethertype

Name	Value
LLDP Ethertype	88-CC

Where the LLC entity uses an MSAP that is supported by a specific media access control method (for example, IEEE Std 802.3) or a media access control independent entity (for example, IEEE Std 802.1AE) that directly supports encoding of Ethertypes, the LLC entity shall encode the LLDP Ethertype as the two octet LLDPDU header in the MSDU of the corresponding MAC service request.

Where the LLC entity uses an MSAP that is supported by a specific media access control method that does not directly support Ethertype encoding (for example IEEE Std 802.5™ [B3] or IEEE Std 802.11™ [B4]), the LLDP Ethertype shall be encoded in the octets of LLDPDU header according to the procedures specified in IEEE Std 802 for Subnetwork Access Protocols (SNAP).

NOTE 1—IEEE Std 802.11 does not natively support Ethertypes, as was erroneously stated in the 2005 publication of this standard. IEEE Std 802.11 is defined in terms of the use of IEEE Std 802.2 LLC as the native method of addressing for LLC; therefore, Ethertypes are supported only via SNAP encapsulation.

NOTE 2—The SNAP discriminator comprises the octets AA-AA-03-00-00-00 prepended to the LLDP Ethertype.

NOTE 3—Annex provides example LLDP transmission frame formats for both direct-encoded and SNAP-encoded LLDP Ethertype encoding methods.

7.4 LLDPDU reception

The LLDPDU shall be delivered to the LLDP receive module if, and only if

a) The destination MAC address is equal to the MAC address associated with the corresponding LLDP Agent; and

NOTE—The destination MAC address can be one of the addresses in Table 7-1, or any other valid MAC address—see 7.1.

b) The Ethertype is equal to the value shown in Table 7-3.

8. LLDPDU and TLV formats

8.1 LLDPDU bit and octet ordering conventions

All LLDPDUs shall contain an integral number of octets. The octets in an LLDPDU are numbered starting from 1 and increasing in the order they are put into the LLDPDU. The bits in an octet are numbered from 1 to 8, where bit 1 is the low-order bit.

When consecutive bits within an octet are used to represent a binary number, the highest bit number has the most significant value. When consecutive octets are used to represent a binary number, the lower octet number has the most significant value. All TLVs respect these bit and octet ordering conventions.

When the encoding of a field or a number of fields is represented using a diagram

a) Octets are shown with the lowest numbered octet nearest the left of the page, the octet numbering increasing from left to right.
b) Within an octet, bits are shown with bit 8 to the left and bit 1 to the right.

8.2 LLDPDU format

The LLDPDU shall contain the following ordered sequence of three mandatory TLVs followed by zero or more optional TLVs plus an End Of LLDPDU TLV, as shown in Figure 8-1:

a) Three mandatory TLVs shall be included at the beginning of each LLDPDU and shall be in the order shown.
   1) Chassis ID TLV
   2) Port ID TLV
   3) Time To Live TLV
b) Optional TLVs as selected by network management (may be inserted in any order).

NOTE 1—”Optional” in the sense that they are not required for LLDP operation; however, their presence could be required by other system elements that use LLDP.

c) The End Of LLDPDU TLV shall be the last TLV in the LLDPDU.

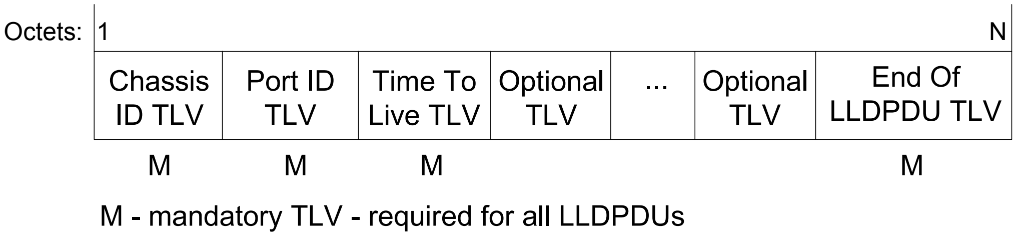


Figure 8-1—LLDPDU format

The maximum length of the LLDPDU shall be the maximum information field length allowed by the particular transmission rate and protocol. In IEEE 802.3 MACs, for example, the maximum LLDPDU length is the maximum data field length for the basic, untagged MAC frame (1500 octets).

NOTE 2—There is no defined minimum length of an LLDPDU, other than that implied by the requirement that conformant implementations support the mandatory TLVs specified in Table 8-1.

8.3 TLV categories

The TLVs are grouped into two general categories as follows:

a) A set of TLVs that are considered to be basic to the management of network stations and that are a required capability of all LLDP implementations. Each TLV in this category is identified by a unique TLV type value that indicates the particular kind of information contained in the TLV.
b) Organizationally specific extension sets of TLVs that are defined by standards groups such as IEEE 802.1 and IEEE 802.3 and others to enhance management of network stations that are operating with particular media and/or protocols.
   1) TLVs in this category are identified by a common TLV type value that indicates the TLV as belonging to the set of Organizationally Specific TLVs.
   2) Each organization is identified by its organizationally unique identifier (OUI).
   3) Organizationally Specific TLV subtype values indicate the kind of information contained in the TLV.

The basic TLV format and general field definition rules are defined in 8.4. Specific definitions and usage requirements for all basic management set TLVs are defined in 8.5. Usage rules/requirements that pertain to each individual basic TLV are contained in the definition for that particular TLV.

The basic format and the field definition/general usage rules/restrictions for Organizationally Specific TLVs are defined in 8.6. Specific definitions for IEEE 802.1 and IEEE 802.3 extension sets are contained in Annex and Annex .

Usage rules/requirements that pertain to each individual basic TLV are contained in the definition for that particular TLV.

8.4 Basic TLV format

Figure 8-2 shows the basic TLV format.

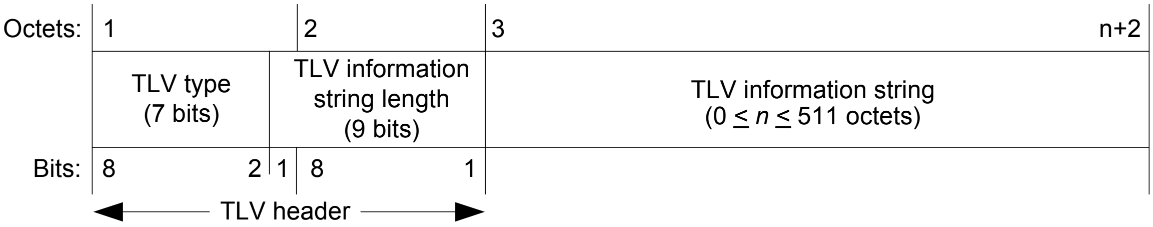


Figure 8-2—Basic TLV format

The TLV type field occupies the seven most significant bits of the first octet of the TLV format. The least significant bit in the first octet of the TLV format is the most significant bit of the TLV information string length field.

8.4.1 TLV type

The TLV type field is seven bits long and identifies the specific TLV. Two classes of TLVs are defined:

a) Mandatory TLVs that shall be included in all LLDPDUs.
b) Optional TLVs that may be included in LLDPDUs.

Table 8-1 lists the currently defined TLVs, their identifying TLV type values, and whether they are mandatory or optional for inclusion in any particular LLDPDU.

Table 8-1—TLV type values

TLV type [a]	TLV name	Usage in LLDPDU	Reference
0	End Of LLDPDU	Mandatory	8.5.1
1	Chassis ID	Mandatory	8.5.2
2	Port ID	Mandatory	8.5.3
3	Time To Live	Mandatory	8.5.4
4	Port Description	Optional	8.5.5
5	System Name	Optional	8.5.6
6	System Description	Optional	8.5.7
7	System Capabilities	Optional	8.5.8
8	Management Address	Optional	8.5.9
9–126	Reserved for future standardization	—	—
127	Organizationally Specific TLVs	Optional	Annex Annex

[a] TLVs with type values 0–8 are members of the basic management set.

8.4.2 TLV information string length

The TLV information string length field shall contain the length of the information string, in octets.

8.4.3 TLV information string

The information string

a) May be fixed or variable length.
b) May include one or more information fields with associated subtype identifiers and field length designators as in, for example, the Management Address TLV (see 8.5.9).
c) May contain either binary or alpha-numeric information that is instance specific for the particular TLV type and/or subtype.
    1) Bit 1 in binary bit maps shall be the least significant bit in the field.
    2) The first octet of an alpha-numeric field shall be the most significant octet.
    3) Alpha-numeric information shall be encoded in UTF-8 [IETF RFC 3629].

8.5 Basic management TLV set formats and definitions

8.5.1 End Of LLDPDU TLV

The End Of LLDPDU TLV is a 2-octet, all-zero TLV that is used to mark the end of the TLV sequence in LLDPDUs. The format for this TLV is shown in Figure 8-3.

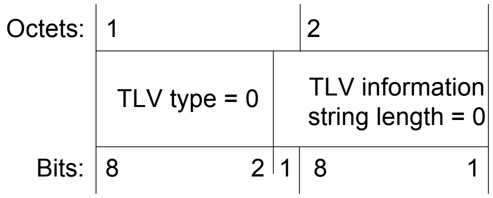


Figure 8-3—End Of LLDPDU TLV format

NOTE—Some IEEE 802 MACs require the data field in a frame to contain a minimum number of octets. For example, the IEEE 802.3 MAC adds pad octets to complete a minimum length data field if the user's data is less than the minimum required length. Since pad octets are unspecified, an End Of LLDPDU TLV is necessary to prevent non-zero pad octets from being interpreted by the receiving LLDP agent as another TLV.

8.5.2 Chassis ID TLV

The Chassis ID TLV is a mandatory TLV that identifies the chassis containing the IEEE 802 LAN station associated with the transmitting LLDP agent. There are several ways in which a chassis may be identified and a chassis ID subtype is used to indicate the type of component being referenced by the chassis ID field. Each LLDPDU shall contain one, and only one, Chassis ID TLV and the chassis ID field value shall remain constant for all LLDPDUs while the MAC status parameter for the Port remains operational.

The Chassis ID TLV shall be the first TLV in the LLDPDU. Its format is shown in Figure 8-4.

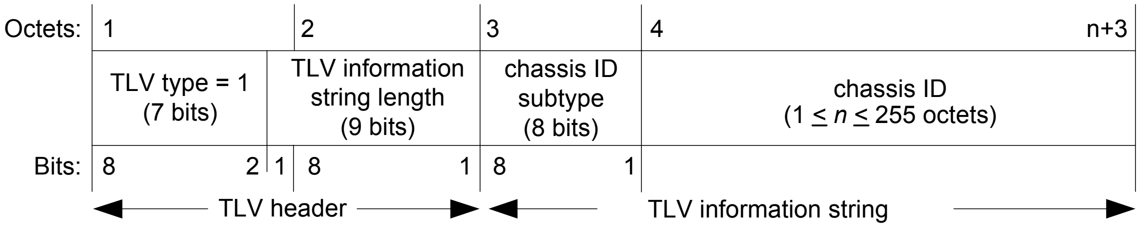


Figure 8-4—Chassis ID TLV format

8.5.2.1 TLV information string length

The TLV information string length field shall indicate the exact length, in octets, of the (chassis ID subtype + chassis ID) fields.

8.5.2.2 chassis ID subtype

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 defined chassis ID subtypes and their preferred use order are listed in Table 8-2.

Table 8-2—chassis ID subtype enumeration

ID subtype	ID basis	Reference
0	Reserved	—
1	Chassis component	EntPhysicalAlias when entPhysClass has a value of ‘chassis(3)’ (IETF RFC 4133)
2	Interface alias	IfAlias (IETF RFC 2863)
3	Port component	EntPhysicalAlias when entPhysicalClass has a value ‘port(10)’ or ‘backplane(4)’ (IETF RFC 4133)
4	MAC address	MAC address (IEEE Std 802)
5	Network address	networkAddress [a]
6	Interface name	ifName (IETF RFC 2863)
7	Locally assigned	local[b]
8–255	Reserved	—

[a] networkAddress is an octet string that identifies a particular network address family and an associated network address that are encoded in network octet order. An IP address, for example, would be encoded with the first octet containing the IANA Address Family Numbers enumeration value for the specific address type and octets 2 through *n* containing the address value (for example, the encoding for C0-00-02-0A would indicate the IPv4 address 192.0.2.10).

[b] local is an alpha-numeric string and is locally assigned.

8.5.2.3 chassis ID

The chassis ID field shall contain an octet string indicating the specific identifier for the particular chassis in this system. Because chassis ID and port ID values are concatenated to form the local MSAP identifier, the value chosen from Table 8-2 for the chassis ID shall be non-null.

8.5.2.4 Chassis ID TLV usage rules

An LLDPDU shall contain exactly one Chassis ID TLV.

8.5.3 Port ID TLV

The Port ID TLV is a mandatory TLV that identifies the port component of the MSAP identifier associated with the transmitting LLDP agent. As with the chassis, there are several ways in which a port may be identified. A port ID subtype is used to indicate how the port is being referenced in the port ID field. Each LLDPDU shall contain one, and only one, Port ID TLV. The port ID value shall remain constant for all LLDPDUs while the transmitting port remains operational.

The chosen port shall be identified in an unambiguous manner (for example, backplane number, management entity, MAC address, etc.).

The Port ID TLV shall be the second TLV in the LLDPDU. Its format is shown in Figure 8-5.

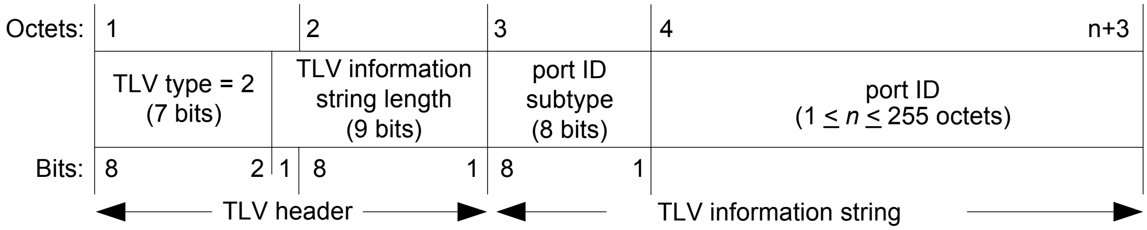


Figure 8-5—Port ID TLV format

8.5.3.1 TLV information string length

The TLV information string length field shall indicate the length, in octets, of the (port ID subtype + port ID) fields.

8.5.3.2 port ID subtype

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 defined port ID subtypes and their preferred use order are listed in Table 8-3.

Table 8-3—port ID subtype enumeration

ID subtype	ID basis	References
0	Reserved	—
1	Interface alias	ifAlias (IETF RFC 2863)
2	Port component	entPhysicalAlias when entPhysicalClass has a value ‘port(10)’ or ‘backplane(4)’ (IETF RFC 4133)
3	MAC address	MAC address (IEEE Std 802)
4	Network address	networkAddress [a]
5	Interface name	ifName (IETF RFC 2863)
6	Agent circuit ID	agent circuit ID (IETF RFC 3046)
7	Locally assigned	local [b]
8–255	Reserved	—

[a] networkAddress is an octet string that identifies a particular network address family and an associated network address that are encoded in network octet order. An IP address, for example, would be encoded with the first octet containing the IANA Address Family Numbers enumeration value for the specific address type and octets 2 through *n* containing the address value (for example, the encoding for C0-00-02-0A would indicate the IP version 4 address 192.0.2.10).

[b] local is an alpha-numeric string and is locally assigned.

8.5.3.3 port ID

The port ID field is an alpha-numeric string that contains the specific identifier for the port from which this LLDPDU was transmitted. Because chassis ID and port ID values are concatenated to form the local MSAP identifier, the value chosen from Table 8-3 for the port ID shall be non-null.

NOTE—The port ID can contain alphanumeric data or binary data, depending upon the value of the port ID subtype.

8.5.3.4 Port ID TLV usage rules

An LLDPDU shall contain exactly one Port ID TLV.

8.5.4 Time To Live TLV

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.

a) When the TTL field is non-zero the receiving LLDP agent is notified to completely replace all information associated with this MSAP identifier with the information in the received LLDPDU.

b) When the TTL field is set to zero, the receiving LLDP agent is notified to delete all system information associated with the LLDP agent/port. This TLV may be used, for example, to signal that the sending port has initiated a port shutdown procedure.

The Time To Live TLV is mandatory and shall be the third TLV in the LLDPDU. Its format is shown in Figure 8-6.

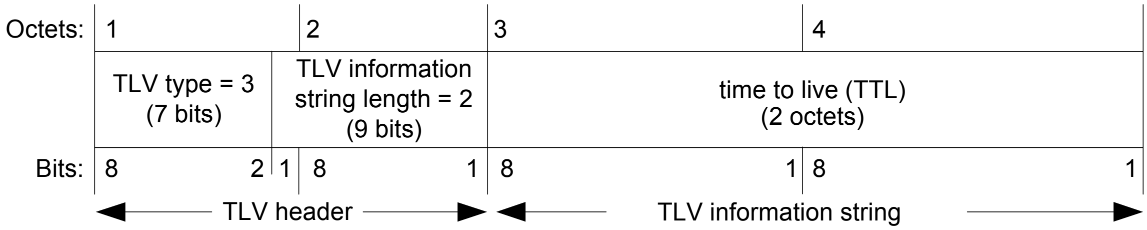


Figure 8-6—Time To Live TLV format

8.5.4.1 time to live (TTL)

The TTL field shall contain an integer value in the range 0 ≥ *t* ≥ 65535 seconds and is set to the computed value of txTTL at the time the LLDPDU is constructed (see 9.2.5.22).

8.5.4.2 Time To Live TLV usage rules

An LLDPDU shall contain exactly one Time To Live TLV.

8.5.5 Port Description TLV

The Port Description TLV allows network management to advertise the IEEE 802 LAN station's port description. The format for this TLV is shown in Figure 8-7.

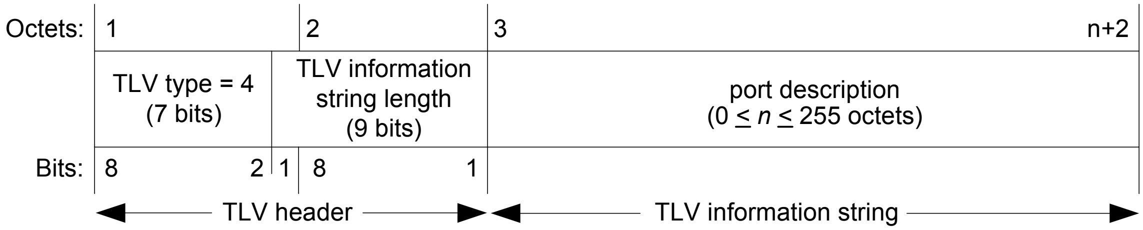


Figure 8-7—Port Description TLV format

8.5.5.1 TLV information string length

The TLV information string length field shall contain the exact length, in octets, of the port description field.

8.5.5.2 port description

The port description field shall contain an alpha-numeric string that indicates the port's description. If RFC 2863 is implemented, the ifDescr object should be used for this field.

8.5.5.3 Port Description TLV usage rules

An LLDPDU should not contain more than one Port Description TLV.

8.5.6 System Name TLV

The System Name TLV allows network management to advertise the system's assigned name. The format for this TLV is shown in Figure 8-8.

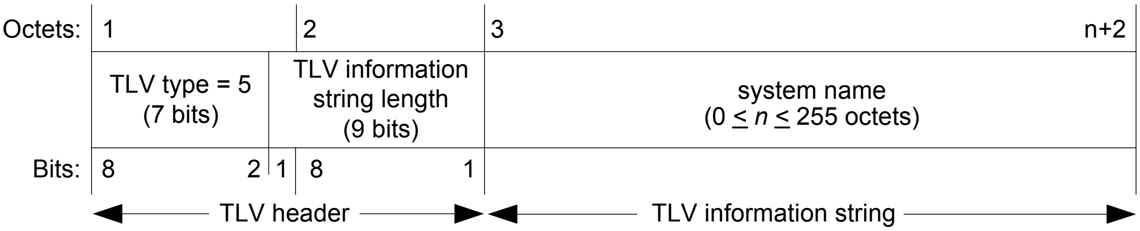

Octets: 1
2
3
n+2
TLV type = 5 (7 bits)
TLV information string length (9 bits)
system name ($0 \leq n \leq 255$ octets)
Bits: 8
2
1
8
1
TLV header
TLV information string

Figure 8-8—System Name TLV format

8.5.6.1 TLV information string length

The TLV information string length field shall contain the exact length, in octets, of the system name.

8.5.6.2 system name

The system name field shall contain an alpha-numeric string that indicates the system's administratively assigned name. The system name should be the system's fully qualified domain name. If implementations support IETF RFC 3418, the sysName object should be used for this field.

8.5.6.3 System Name TLV usage rules

An LLDPDU shall not contain more than one System Name TLV.

8.5.7 System Description TLV

The System Description TLV allows network management to advertise the system's description. The format for this TLV is shown in Figure 8-9.

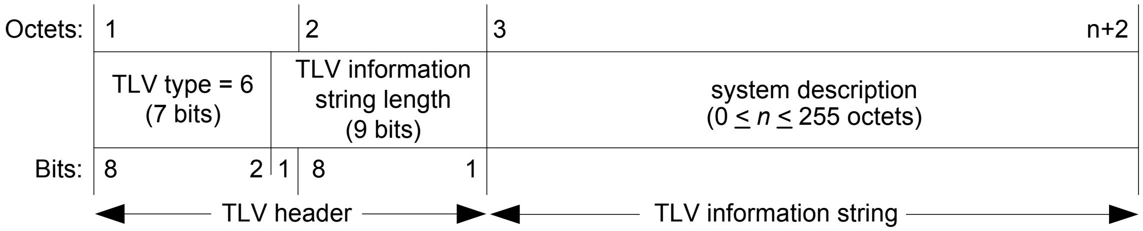


Figure 8-9—System Description TLV format

8.5.7.1 TLV information string length

The TLV information string length field shall indicate the exact length, in octets, of the system description.

8.5.7.2 system description

The system description field shall contain an alpha-numeric string that is the textual description of the network entity. The system description should include the full name and version identification of the system's hardware type, software operating system, and networking software. If implementations support IETF RFC 3418, the sysDescr object should be used for this field.

8.5.7.3 System Description TLV usage rules

An LLDPDU shall not contain more than one System Description TLV.

8.5.8 System Capabilities TLV

The System Capabilities TLV is an optional TLV that identifies the primary function(s) of the system and whether or not these primary functions are enabled. Figure 8-10 shows the format of this TLV.

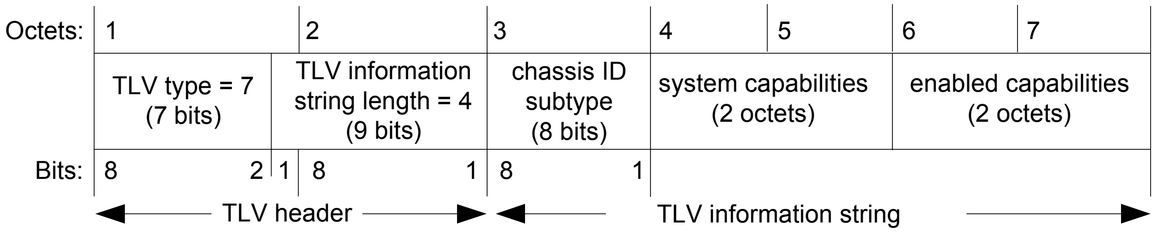

Octets: 1
2
3
4
5
6
7
TLV type = 7 (7 bits)
TLV information string length = 4 (9 bits)
chassis ID subtype (8 bits)
system capabilities (2 octets)
enabled capabilities (2 octets)
Bits: 8
2
1
8
1
8
1
TLV header
TLV information string

Figure 8-10—System Capabilities TLV format

8.5.8.1 system capabilities

The system capabilities field shall contain a bit-map of the capabilities that define the primary function(s) of the system. The bit positions for each function and the associated MIB or standard that are likely, but not guaranteed, to be supported are listed in Table 8-4. A binary one in the associated bit indicates the existence of that capability. Individual systems may indicate more than one implemented functional capability (for example, both a bridge and router capability).

Table 8-4—System capabilities

Bit	Capability	Reference
1	Other	—
2	Repeater	IETF RFC 2108
3	MAC Bridge	IEEE Std 802.1D
4	WLAN Access Point	IEEE Std 802.11 MIB
5	Router	IETF RFC 1812
6	Telephone	IETF RFC 4293
7	DOCSIS cable device	IETF RFC 4639 and IETF RFC 4546
8	Station Only [a]	IETF RFC 4293
9	C-VLAN Component of a VLAN Bridge	IEEE Std 802.1Q
10	S-VLAN Component of a VLAN Bridge	IEEE Std 802.1Q
11	Two-port MAC Relay (TPMR)	IEEE Std 802.1Q
12–16	reserved	—

[a] The Station Only capability is intended for devices that implement only an end station capability, and for which none of the other capabilities in the table apply. Bit 8 should therefore not be set in conjunction with any other bits.

8.5.8.2 enabled capabilities

The enabled capabilities field shall contain a bit map of the primary functions listed in Table 8-4. A binary one in a bit position indicates that the function associated with that bit is currently enabled.

8.5.8.3 System Capabilities TLV usage rules

An LLDPDU shall not contain more than one System Capabilities TLV.

If the system capabilities field does not indicate the existence of a capability that the enabled capabilities field indicates is enabled, the TLV is interpreted as containing an error and shall be discarded.

8.5.9 Management Address TLV

The Management Address TLV identifies an address associated with the local LLDP agent that may be used to reach higher layer entities to assist discovery by network management. The TLV also provides room for the inclusion of both the system interface number and an object identifier (OID) that are associated with this management address, if either or both are known. Figure 8-11 shows the Management Address TLV format.

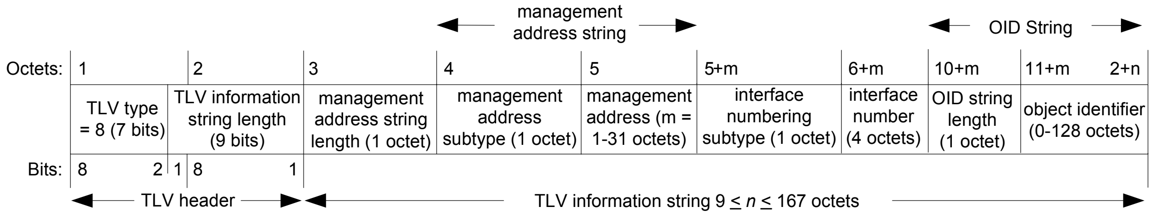

management address string
OID String
Octets:
1
2
3
4
5
5+m
6+m
10+m
11+m
2+n
TLV type = 8 (7 bits)
TLV information string length (9 bits)
management address string length (1 octet)
management address subtype (1 octet)
management address (m = 1-31 octets)
interface numbering subtype (1 octet)
interface number (4 octets)
OID string length (1 octet)
object identifier (0-128 octets)
Bits:
8
2
1
8
1
TLV header
TLV information string 9 ≤ n ≤ 167 octets

Figure 8-11—Management Address TLV format

8.5.9.1 TLV information string length

The TLV information string length field shall contain the length, in octets, of all the fields in the TLV information string.

8.5.9.2 management address string length

The management address string length field shall contain the length, in octets, of the (management address subtype + management address) fields.

8.5.9.3 management address subtype

The management address subtype field shall contain an integer value indicating the type of address that is listed in the management address field. Enumeration for this field is contained in the ianaAddressFamilyNumbers module of the IETF RFC 3232 on-line database that is accessible through a web page (currently, http://www.iana.org). The management address subtype is contained in the first octet of the management address string.

NOTE—As a consequence of the limitation on the size of the management address field (a maximum of 31 octets), some options for the management address subtype (such as long DNS names) may be impractical.

8.5.9.4 management address

The management address field shall contain an octet string indicating the particular management address associated with this TLV.

a) The returned address should be the most appropriate for management use, typically a layer 3 address such as the IPv4 address, 192.0.2.10 (see also Table 8-2, footnote a).
b) If no management address is available, the return address should be the MAC address for the station or port. The ianaAddressFamilyNumber for a MAC address is all802 (value 6).

8.5.9.5 interface numbering subtype

The interface numbering subtype field shall contain an integer value indicating the numbering method used for defining the interface number. The following three values are currently defined:

1) Unknown
2) ifIndex
3) system port number

8.5.9.6 interface number

The interface number field shall contain the assigned number within the system that identifies the specific interface associated with this management address. If the value of the interface subtype is unknown, this field shall be set to zero.

8.5.9.7 object identifier (OID) string length

The object identifier string length field shall contain the length, in octets, of the OID. A value of zero in this field indicates that the OID field is not provided.

8.5.9.8 object identifier

The object identifier field contains an OID that identifies the type of hardware component or protocol entity associated with the indicated management address. The OID shall be the value portion of the ASN.1 encoding of the object identifier, encoded according to ASN.1 basic encoding rules [ISO/IEC 8824-1]. If no OID is available, this field shall not be provided.

NOTE—The interface number and OID are included in this TLV to assist NMS discovery by indicating Enterprise Specific or other starting points for the search, such as the Interface or Entity MIB.

8.5.9.9 Management Address TLV usage rules

Management Address TLVs are subject to the following:

a) At least one Management Address TLV should be included in every LLDPDU.
b) Since there are typically a number of different addresses associated with a MSAP identifier, an individual LLDPDU may contain more than one Management Address TLV.
c) When Management Address TLV(s) are included in an LLDPDU, the included address(es) should be the address(es) offering the best management capability.
d) If more than one Management Address TLV is included in an LLDPDU, each management address shall be different from the management address in any other management address TLV in the LLDPDU.
e) If an OID is included in the TLV, it shall be reachable by the management address.
f) If the network system is a VLAN bridge that implements the port and protocol based VLAN classification, every Management Address TLV that reports an address that is accessible on a port and protocol VLAN through the particular port should be accompanied by a port and protocol VLAN TLV that indicates the VLAN identifier (VID) associated with the management address reported by this TLV (see E.3.2).
g) In a properly formed Management Address TLV, the TLV information string length is equal to:
(management address string length) + (OID string length) + 7.

   If the TLV information string length in a received Management Address TLV is incorrect, then it is ignored and processing of that LLDPDU is terminated.

8.6 Organizationally Specific TLVs

This TLV category is provided to allow different organizations, such as IEEE 802.1, IEEE 802.3, IETF, as well as individual software and equipment vendors, to define TLVs that advertise information to remote entities attached to the same media, subject to the following restrictions:

a) Information transmitted in an Organizationally Specific TLV is intended to be a one way advertisement.

b) Information transmitted in an Organizationally Specific TLV shall be independent from information in a TLV received from a remote port.
c) Information transmitted in one Organizationally Specific TLV shall not be concatenated with information transmitted in another TLV on the same media in order to provide a means for sending messages that are larger than would fit within a single TLV.
d) Information received in an Organizationally Specific TLV shall not be explicitly forwarded to other ports in the system.
e) Organizationally Specific TLVs shall conform to 8.4 and 8.6.1.

Each set of Organizationally Specific TLVs shall include associated LLDP MIB extensions and the associated TLV selection management variables and MIB/TLV cross reference tables (for example, see E.8 and F.5). Systems that implement LLDP and that also support standard protocols for which Organizationally Specific TLV extension sets have been defined shall support all TLVs and the LLDP MIB extensions defined for that particular TLV set.

Annex and Annex contain currently defined Organizationally Specific TLVs for IEEE 802.1 and IEEE 802.3, along with their associated LLDP MIB extensions and LLDP MIB/TLV cross reference tables. Organizations wishing to define TLVs for their use should use these annexes as examples. Future TLV definitions for IEEE 802 working groups should be included in annexes to this standard.

8.6.1 Basic Organizationally Specific TLV format

The basic format for Organizationally Specific TLVs is shown in Figure 8-12.

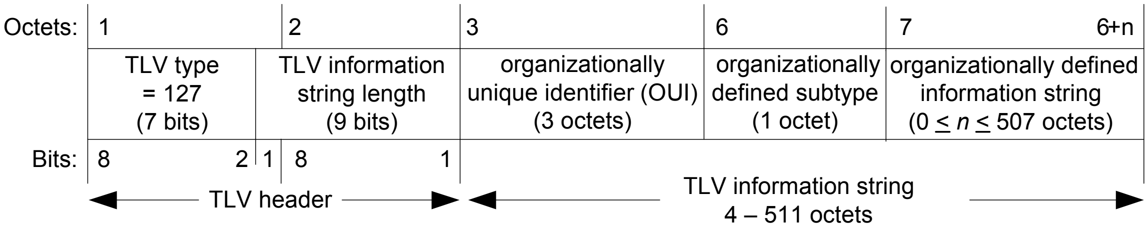

Octets: 1
2
3
6
7
6+n
TLV type = 127 (7 bits)
TLV information string length (9 bits)
organizationally unique identifier (OUI) (3 octets)
organizationally defined subtype (1 octet)
organizationally defined information string (0 ≤ n ≤ 507 octets)
Bits: 8
2
1
8
1
TLV header
TLV information string 4 – 511 octets

Figure 8-12—Basic format for Organizationally Specific TLVs

The following subclauses indicate how the individual fields shall be defined.

8.6.1.1 TLV type

The same Organizationally Specific TLV type value, 127, shall be used for all organizationally defined TLVs.

8.6.1.2 TLV information string length

The TLV information string length field shall contain the length of the information string, in octets.

8.6.1.3 organizationally unique identifier (OUI)

The organizationally unique identifier field shall contain the organization’s OUI as defined in Clause 9 of IEEE Std 802.

8.6.1.4 organizationally defined subtype

The organizationally defined subtype field shall contain a unique subtype value assigned by the defining organization.

NOTE—Defining organizations are responsible for maintaining listings of organizationally defined subtypes in order to assure uniqueness.

8.6.1.5 organizationally defined information string

The actual format of the organizationally defined information string field is organizationally specific and can

a) Contain either binary or alpha-numeric information that is instance specific for the particular TLV type and/or subtype. Alpha-numeric information should be encoded in UTF-8 (IETF RFC 3629).

b) Include one or more information fields with their associated field-type identifiers and field length designators similar to those in the Management Address TLV (see 8.5.9).

8.6.2 Organizationally Specific TLV usage rules

Organizations defining their own Organizationally Specific TLVs should include a subclause that defines any specific usage rules and/or specific conditions that affects how the receiving LLDP agent shall treat the TLV.

The Organizationally Specific TLV usage rules should include the following:

a) The number of Organizationally Specific TLVs that may be contained in an LLDPDU and any additional information field subtypes that would identify differences between two TLVs with the same OUI and organizationally defined subtype [for example, see E.3.3 a)].

b) Any error conditions that are specific to the particular Organizationally Specific TLV and the action that is taken for each defined error condition [see E.3.3 b) and c)].

9. LLDP agent operation

This clause describes the operation of the protocol from the point of view of a single LLDP agent (see Clause 6); i.e., it describes the operation of the protocol for the transmission and reception of LLDPDUs on a single Port, using a MAC address (see Clause 7) as the destination address. Where the use of more than one MAC address is supported on a given Port, a separate instance of the LLDP agent is responsible for the operation of the protocol for each MAC address that is supported.

9.1 Overview

Each LLDP agent is responsible for causing the following tasks to be performed:

a) Maintaining current information in the LLDP local system MIB.
b) Extracting and formatting LLDP local system MIB information for transmission to the remote port LLDP agent(s) at regular intervals or whenever there is a change in the system condition or status.
c) Recognizing and processing received LLDP frames.
d) Maintaining current values in the LLDP remote system MIB.
e) Using the procedure somethingChangedLocal() and the procedure somethingChangedRemote() to notify the PTOPO MIB manager and MIB managers of other optional MIBs whenever a value or status change has occurred in one or more objects in the LLDP local system LLDP remote systems MIB.

NOTE—A consequence of the support of multiple MAC addresses on a Port is that there are multiple copies of the LLDP local system MIB and remote system MIB, one copy for each address supported.

LLDP allows implementations that support three different operating modes: transmit only, receive only, or both transmit and receive. An LLDP agent shall conform to the specifications of each of the state machines indicated in Table 9-1 for the operating mode that it supports.

Table 9-1—Subclause/operating mode applicability

Subclause number	Subclause title	Transmit only	Receive only	Transmit and receive
9.2.9	Receive state machine	—	Mandatory	Mandatory
9.2.8	Transmit state machine	Mandatory	—	Mandatory
9.2.10	Transmit timer state machine	Mandatory	—	Mandatory

9.1.1 Frame transmission

LLDPDU transmission is performed by the transmit state machine, and the timing of transmissions is controlled by the transmit timer state machine. Transmissions occur as a result of a number of different local events, as follows:

a) A regular background transmission occurs as a result of a transmission timer expiring. This ensures that the receiving system does not time out the information received, as a result of the “time to live” associated with the last received LLDPDU expiring.
b) If a *new neighbor* is recognized (i.e., an LLDPDU is received by the receive state machine from a hitherto unknown remote agent), then four LLDPDU transmissions are performed at shorter time intervals to ensure that the new neighbor is quickly updated with current information about its own neighbors. This rapid transmission behavior is suppressed if the remote systems MIB is not able to

accommodate the new neighbor information without removing current information relating to an older neighbor, in order to prevent excessive PDU transmissions resulting from "churn" effects.

c) If a condition (status or value) change occurs in one or more objects in the LLDP local system MIB, then an LLDPDU is transmitted immediately, in order to communicate the local changes as quickly as possible to any neighboring systems. The transmit timer state machine operates a simple credit-based transmission strategy that allows a number of LLDPDUs to be transmitted in quick succession (the maximum number being determined by the maximum credit value), thus allowing rapid updating of information in situations where the local state is changing quickly. However, once the LLDP Agent's transmission credit is exhausted, the rate of transmission is cut to a maximum of one transmission per second.
d) The overall timing of regular transmissions is governed by a system "tick" that operates on a nominal timebase of 1 s. However, in shared media LANs, in order to avoid bunching of transmissions, the intervals between ticks include a random jitter component so that, while the average time interval between ticks is 1 s, the interval between adjacent pairs of ticks can vary (see 9.2.2).

In order to minimize synchronization effects, it is recommended that transmission intervals for different LLDP agents on the same multi-port implementation are staggered.

9.1.2 LLDPDU types

The following two types of LLDPDUs are defined:

a) Normal LLDPDUs that provide management information about the local station to that station's neighbors.
b) A special shutdown advisory LLDPDU indicating that any information about the local station that is maintained in a remote LLDP agent's remote systems MIB is now invalid and is to be discarded.

9.1.2.1 Normal LLDPDUs

The LLDP local system MIB contains the information needed for constructing individual TLVs and includes a capability that allows network managers to select the optional TLVs to be included in the LLDPDU (see 10.2.2).

When the transmit state machine (9.2.8) determines that a normal LLDPDU is to be transmitted, the LLDP MIB manager extracts the selected information from the LLDP local system MIB and constructs an LLDPDU as defined in 9.1, containing the following:

a) The mandatory TLVs as specified in 8.2:
   1) Chassis ID TLV (see 8.5.2).
   2) Port ID TLV (see 8.5.3).
   3) Time To Live TLV, with the TTL value set equal to txTTL (see 8.5.4).
b) Additional optional TLVs, from the basic management set or from one or more organizationally specific sets, as allowed by LLDPDU length restrictions and as selected in the LLDP local system MIB by network management (see Table 8-1, Table E.1, and Table F.1).
c) An End Of LLDPDU TLV.

Optional TLVs from the basic management set, such as the Management Address TLV, with different TLV type and subtype combinations as well as optional TLVs with different OUI and organizationally defined subtype combinations from one or more organizationally specific sets can be included within the same LLDPDU.

9.1.2.2 Shutdown LLDPDUs

A special procedure exists for the case in which a LLDP agent knows an associated port is about to become non-operational (for example, the adminStatus for the port is transitioning to ‘disabled’). In the event a port, currently configured with LLDP frame transmission enabled, either becomes disabled for LLDP activity, or the interface is administratively disabled, the transmit state machine attempts to send a final LLDP shutdown LLDPDU with:

a) The Chassis ID TLV.
b) The Port ID TLV.
c) The Time To Live TLV with the TTL field set to zero.
d) An End Of LLDPDU TLV.

The shutdown LLDPDU does not include any optional TLVs and, if possible, should be transmitted before the interface is disabled.

NOTE—There is an inherent race condition between an interface knowing it is going down and its ability to send “one more frame.” If possible, the actual transition of the port to disabled is delayed until after this frame is transmitted. In the event where adminStatus is transitioning to the disabled state and the LLDP agent is shutting down, this shutdown procedure should be executed for all local ports.

9.1.3 Frame reception

LLDP frame reception consists of three phases: frame recognition, frame validation, and LLDP remote systems MIB updating. All error checking is done during frame validation.

Frame recognition is performed at the LLDP/LSAP (see Figure 6-2), where the destination address and Ethertype values determine whether the frame is an LLDP frame destined for this LLDP agent or not. Frames that are recognized as LLDP frames are then validated to determine whether they are properly constructed and contain the correct set of mandatory TLVs; frames that pass the validation criteria are used to update the contents of entries in the LLDP remote systems MIB for the originating LSAP identifier and destination MAC address. If the frame is a normal LLDPDU and an entry does not exist in the LLDP remote systems MIB for the originating LSAP identifier and destination MAC address, then a new entry in the MIB is created, assuming that sufficient space exists to do so. If the frame is a normal LLDPDU and an entry already exists in the remote systems MIB for the originating LSAP identifier and destination MAC address, then the new information contained in the LLDPDU is used to replace the whole of the existing entry in the MIB; i.e., if there are information elements in the existing entry for which there are corresponding elements in the received LLDPDU, then those elements are updated using the information received; any other information elements in the existing entry in the MIB are deleted.

One of the parameters received in an incoming LLDPDU is the TTL value; this determines how long the information associated with that LSAP identifier and destination MAC address is to be stored in the LLDP remote systems MIB before being aged out and deleted. The ageing out of old data ensures that the MIB is purged of data that was originated by systems that are no longer neighbors as a result of topology changes, system failure, or system inactivation.

If the received frame is a shutdown LLDPDU and an entry exists in the LLDP remote systems MIB for the originating LSAP identifier and destination MAC address, then that entry is deleted from the MIB.

9.1.4 Too many neighbors

The amount of space needed in the LLDP remote systems MIB to accommodate the creation of several new MIB structures is beyond the scope of this standard. It may not always be possible to accommodate another new neighbor in implementations with limited memory. There are several possibilities for handling this case, including but not limited to the following examples:

a) Ignore and not process the new neighbor's information.
b) Delete the information from the oldest neighbor(s) until there is sufficient memory available to store the new neighbor's information.
c) Randomly delete neighbors until there is sufficient memory available to store the new neighbor's information.

The method of handling the case where a new entry in the remote systems MIB can not be created is beyond the scope of this standard, however it is necessary for the implementation to keep track of this case by properly updating the variable tooManyNeighbors and the tooManyNeighborsTimer (9.2.5.15, 9.2.2). The variable tooManyNeighbors identifies when there is insufficient space in the LLDP remote systems MIB to store information from all active neighbors. The tooManyNeighborsTimer indicates the minimum time that this condition exists.

Further detail on the handling of the too many neighbors condition can be found in 9.2.7.7.5.

9.1.5 LLDP remote systems rxInfoTTL timer expiration

If the rxInfoTTL timer (9.2.2.1) associated with an MSAP identifier expires, all information associated with that MSAP identifier is deleted and the procedure somethingChangedRemote() notifies the managers of the PTOPO MIB and other optional MIB modules (see Figure 11-1) that something has changed in the LLDP remote systems MIB associated with that MSAP identifier.

9.1.6 LLDP local port/connection failure

If the local port or the connection to the remote system fails unexpectedly before a shutdown frame is received, the LLDP management entity does not delete objects in the LLDP remote systems MIB pertaining to information received from any MSAP identifier through that local port until the port is re-initialized or the associated rxInfoTTL timer (9.2.2.1) expires.

9.2 State machines

The operation of the protocol is represented by the following three state machines and associated timers to indicate when local system managed object values are to be transmitted to refresh the values in remote LLDP agent's LLDP remote systems MIB and when values in the local LLDP agent's remote systems MIB have become invalid:

a) Transmit state machine (9.2.8).
b) Receive state machine (9.2.9).
c) Transmit timer state machine (9.2.10).

9.2.1 Notational conventions used in state diagrams

State diagrams are used to represent the operation of a function as a group of connected, mutually exclusive states. Only one state of a function can be active at any given time.

Each state is represented in the state diagram as a rectangular box, divided into two parts by a horizontal line. The upper part contains the state identifier, written in uppercase letters. The lower part contains any procedures that are executed on entry to the state.

All permissible transitions between states are represented by arrows, the arrowhead denoting the direction of the possible transition. Labels attached to arrows denote the condition(s) that shall be met in order for the transition to take place. A transition that is global in nature (i.e., a transition that occurs from any of the possible states if the condition attached to the arrow is met) is denoted by an open arrow; i.e., no specific state is identified as the origin of the transition.

On entry to a state, the procedures defined for the state (if any) are executed exactly once, in the order that they appear on the page. Each action is deemed to be atomic; i.e., execution of a procedure completes before the next sequential procedure starts to execute. No procedures execute outside of a state block. On completion of all of the procedures within a state, all exit conditions for the state (including all conditions associated with global transitions) are evaluated continuously until such a time as one of the conditions is met. All exit conditions are regarded as Boolean expressions that evaluate to TRUE or FALSE; if a condition evaluates to TRUE, then the condition is met. When the condition associated with a global transition is met, it supersedes all other exit conditions, including UCT. The label UCT denotes an unconditional transition (i.e., UCT always evaluates to TRUE). The label ELSE denotes a transition that occurs if none of the other conditions for transitions from the state are met (i.e., ELSE evaluates to TRUE if all other possible exit conditions from the state evaluate to FALSE).

A variable that is set to a particular value in a state block retains this value until a subsequent state block executes a procedure that modifies the value, or until the value is modified by an external event or timer tick.

Where it is necessary to segment a state machine description across more than one diagram, a transition between two states that appear on different diagrams is represented by an exit arrow drawn with dashed lines, plus a reference to the diagram that contains the destination state. Similarly, dashed arrows and a dashed state box are used on the destination diagram to show the transition to the destination state. In a state machine that has been segmented in this way, any global transitions that can cause entry to states defined in one of the diagrams are deemed to be potential exit conditions for all of the states of the state machine, regardless of which diagram the state boxes appear in.

Should a conflict exist between the interpretation of a state diagram and either the corresponding global transition tables or the textual description associated with the state machine, the state diagram takes precedence.

The interpretation of the special symbols and operators used in the state diagrams is defined in Table 9-2; these symbols and operators are derived from the notation of the “C” programming language, ANSI X3.159.

9.2.2 Timers

A set of timers is used by the LLDP state machines; these operate as countdown timers (i.e., they expire when their value reaches zero). These timers

a) Have a resolution of one second.
b) Have an integer value n, where $0 < n < 65535$ seconds.
c) Are started by loading an initial integer value.
d) Are decremented once per timer tick as long as $n > 0$.
e) Represent the remaining time in the period.

For Ports connected to point-to-point LANs, the interval between timer ticks is 1 s. For Ports connected to shared media LANs, the interval between any pair of timer ticks is 0.8 s, plus a “jitter” component that is a random value between 0.0 s and 0.4 s. Hence, the average interval between timer ticks is 1 s; however, the interval between any pair of ticks varies randomly. When a timer tick occurs, all instances of the variable txTick (9.2.5.21) for the Port are set TRUE.

Table 9-2—State machine symbols

Symbol	Interpretation
( )	Used to force the precedence of operators in Boolean expressions and to delimit the argument(s) of actions within state boxes.
;	Used as a terminating delimiter for actions within state boxes. Where a state box contains multiple actions, the order of execution follows the normal English language conventions for reading text.
=	Assignment action. The value of the expression to the right of the operator is assigned to the variable to the left of the operator. Where this operator is used to define multiple assignments, e.g., a = b = X the action causes the value of the expression following the right-most assignment operator to be assigned to all of the variables that appear to the left of the right-most assignment operator.
!	Logical NOT operator.
&&	Logical AND operator.
||	Logical OR operator.
if...then...	Conditional action. If the Boolean expression following the **if** evaluates to TRUE, then the action following the **then** is executed.
{statement 1, ... statement N}	Compound statement. Braces are used to group statements that are executed together as if they were a single statement.
!=	Inequality. Evaluates to TRUE if the expression to the left of the operator is not equal in value to the expression to the right.
==	Equality. Evaluates to TRUE if the expression to the left of the operator is equal in value to the expression to the right.
<	Less than. Evaluates to TRUE if the value of the expression to the left of the operator is less than the value of the expression to the right.
>	Greater than. Evaluates to TRUE if the value of the expression to the left of the operator is greater than the value of the expression to the right.
>=	Greater than or equal to. Evaluates to TRUE if the value of the expression to the left of the operator is either greater than or equal to the value of the expression to the right.
+	Arithmetic addition operator.
–	Arithmetic subtraction operator.

NOTE—The random component of the tick time used in shared media LANs is intended to minimize the possibility of systems connected to the same LAN becoming synchronized in their transmission timings.

9.2.2.1 rxInfoTTL

An instance of this timer exists for each entry in the LLDP remote systems MIB that has been created by this instance of the receive state machine for a given MSAP identifier. The timer value indicates the number of seconds remaining until the information in all the objects in the LLDP remote systems MIB associated with the MSAP identifier is no longer valid and needs to be deleted.

9.2.2.2 tooManyNeighborsTimer

This timer indicates the number of seconds remaining during which it is known that an LLDP neighbor exists that may not be stored in the remote systems MIB.

9.2.2.3 txTTR

An instance of this timer exists for each Agent. The txTTR timer is used to determine the next LLDPDU transmission is due; it is initialized by the transmit timer state machine, with the value msgTxInterval (9.2.5.7) if txFast (9.2.5.18) is equal to zero, or with the value msgFastTx (9.2.5.5) if txFast is greater than zero.

9.2.2.4 txShutdownWhile

An instance of this timer exists for each Agent. The txShutdownWhile timer indicates the number of seconds remaining until LLDP re-initialization can occur.

9.2.3 Per-System variables

An instance of each of these variables exists per system; they are available for use by all of the state machines of all of the LLDP agents in the system.

9.2.3.1 BEGIN

This Boolean variable is controlled by the system initialization process. A value of TRUE causes all state machines to continuously execute their initial state. A value of FALSE allows all state machines to perform transitions out of their initial state, in accordance with the relevant state machine definitions.

9.2.4 Per-Port variables

An instance of each of these variables exists per Port; they are available to all of the state machines associated with a Port.

9.2.4.1 portEnabled

This variable is externally controlled. Its value reflects the operational state of the MAC service supporting the port. Its value is TRUE if the MAC service supporting the Port is in an operable condition; otherwise, it is FALSE.

9.2.5 Per-Agent variables

An instance of each of these variables exists per LLDP agent; they are available to all of the state machines associated with an LLDP agent.

9.2.5.1 adminStatus

This variable indicates whether or not the LLDP agent is enabled. The defined values for this variable are as follows:

a) enabledRxTx: The LLDP agent is enabled for reception and transmission of LLDPDUs. This is the recommended default value.
b) enabledTxOnly: The LLDP agent is enabled for transmission of LLDPDUs only.
c) enabledRxOnly: The LLDP agent is enabled for reception of LLDPDUs only.
d) disabled: The LLDP agent is disabled for both reception and transmission.

9.2.5.2 badFrame

This variable indicates that an incoming LLDPDU was unable to be validated because the LLDPDU failed validation and was discarded.

9.2.5.3 localChange

This variable is set TRUE by the somethingChangedLocal() procedure (see 9.2.7.8) when there is a change in the value of the LLDP local system MIB associated with this LLDP agent. The variable is set FALSE by the operation of the transmit timer state machine (see 9.2.10).

9.2.5.4 MAC address

The MAC address associated with this instance of the Agent, i.e., the destination MAC address that is used when the Agent transmits LLDPDUs, and the destination MAC address that, when present in a received LLDPDU, causes the PDU to be passed to this agent instance for processing.

9.2.5.5 msgFastTx

This variable defines the time interval in timer ticks between transmissions during fast transmission periods (i.e., txFast is non-zero). The recommended default value of msgFastTx is 1; this value can be changed by management to any value in the range 1 through 3600.

9.2.5.6 msgTxHold

This variable is used, as a multiplier of msgTxInterval, to determine the value of txTTL that is carried in LLDP frames transmitted by the LLDP agent. The recommended default value of msgTxHold is 4; this value can be changed by management to any value in the range 1 through 100.

9.2.5.7 msgTxInterval

This variable defines the time interval in timer ticks between transmissions during normal transmission periods (i.e., txFast is zero). The recommended default value for msgTxInterval is 30 s; this value can be changed by management to any value in the range 1 through 3600.

9.2.5.8 newNeighbor

This variable is set TRUE by the rxProcessFrame() procedure (see 9.2.7.7) when information is received from a new neighbor. It is set FALSE by the Transmit timer state machine (9.2.10).

NOTE—The newNeighbor variable is used to force a more rapid regular transmission rate when a new neighbor appears, to ensure that the new neighbor also receives new information from the receiving system.

9.2.5.9 rcvFrame

This variable indicates that an LLDP frame has been recognized by the LLDP LSAP function and is ready to be processed by the LLDP receive state machine. If both of the following conditions are TRUE, the variable rcvFrame is set to TRUE and the frame is made available to the receive state machine for validation and processing:

a) The destination address value is the MAC address associated with this specific LLDP Agent.
b) The Ethertype value carried by the frame is the LLDP Ethertype defined in Table 7-3.

NOTE—The model that is assumed for reception is that incoming LLDPDUs are presented to all LLDP agents associated with the reception Port, and if the destination MAC address is not one that is associated with a given Agent, that LLDPDU is ignored by that agent. In practice, at most one agent processes any received LLDPDU, as there is only one agent associated with any given destination MAC address on a given reception Port.

9.2.5.10 reinitDelay

This parameter indicates the amount of delay from when adminStatus becomes ‘disabled’ until re-initialization is attempted. The recommended default value for reinitDelay is 2 s.

9.2.5.11 remoteChanges

A Boolean indication of whether the status/value of one or more selected objects in the LLDP remote systems MIB has changed or that all objects associated with a particular MSAP identifier have been deleted. This variable takes the value *(rxInfoAge OR (rxChanges && (rxTTL !=0)))*

9.2.5.12 rxChanges

This variable indicates that the incoming LLDPDU has been received with different TLV values from those currently in the LLDP remote systems MIB associated with the LLDPDU’s MSAP identifier.

9.2.5.13 rxInfoAge

This variable is set TRUE when a timer expiry event occurs for the rxInfoTTL timing counter associated with a particular MSAP identifier in the LLDP remote systems MIB (i.e., the counter transitions from non-zero to zero). It is set FALSE by the operation of the Receive state machine.

9.2.5.14 rxTTL

This variable indicates the time to live value associated with all TLVs received in the current frame.

9.2.5.15 tooManyNeighbors

This Boolean variable indicates that there is insufficient space in the LLDP remote systems MIB to store information from all connected active remote ports (see 9.2.7.7.5).

9.2.5.16 txCredit

The number of consecutive LLDPDUs that can be transmitted at any time. This variable is incremented by the txAddCredit() procedure, up to the maximum value specified by the txCreditMax variable (see 9.2.5.17), and is decremented whenever an LLDPDU is transmitted by the transmit state machine.

9.2.5.17 txCreditMax

The maximum value of txCredit. The recommended default value is 5; this value can be changed by management to any value in the range 1 through 10.

9.2.5.18 txFast

This variable is used as a down counter to count the number of transmissions to be made during a fast transmission period. Fast transmission periods are initiated when a new neighbor is detected, and cause LLDPDU transmissions to take place at shorter time intervals than during normal (steady state) operation of the protocol. The fast transmission period ensures that more than one LLDPDU is transmitted when a new neighbor is detected. The first transmission is immediate; the subsequent transmissions occur at intervals determined by msgFastTx. The number of transmissions is determined by the value of txFastInit (see 9.2.5.19).

9.2.5.19 txFastInit

This variable is used as the initial value for the txFast variable (see 9.2.5.18). This value determines the number of LLDPDUs that are transmitted during a fast transmission period. The recommended default value of txFastInit is 4; this value can be changed by management to any value in the range 1 through 8.

9.2.5.20 txNow

This variable is used to signal to the transmit state machine that a transmission is required. It is set TRUE by the transmit timer state machine, and set FALSE by the transmit state machine when the transmission has been initiated.

9.2.5.21 txTick

This variable is set TRUE by the system timer tick at one second intervals (see 9.2.2). It is set FALSE by the operation of the transmit timer state machine.

9.2.5.22 txTTL

This variable indicates the time remaining before information in the outgoing LLDPDU is no longer valid. The TTL field in the Time To Live TLV is set to txTTL during LLDPDU construction (see 9.1.2). The value of txTTL depends on the following:

a) During normal operation, txTTL is set to whichever is the smaller of the values represented by Equation (1) and Equation (2):

$$(\text{msgTxInterval} \times \text{msgTxHold}) + 1 \tag{1}$$

$$65535 \tag{2}$$

where msgTxInterval is defined in 9.2.5.7 and msgTxHold is defined in 9.2.5.6.

b) If adminStatus is transitioning to ‘disabled’ or portEnabled is transitioning to FALSE, txTTL shall be set to zero.

9.2.6 Per-Agent statistical counters

An instance of each of these statistical counters exists per LLDP agent; they are used to count significant events in the transmit and receive state machines and are made available to the management functions described in Clause 10 and Clause 11. All counters are maintained as unsigned integer values, four octets in length, and are initialized to zero only on system initialization (i.e., when the BEGIN system variable is set TRUE).

9.2.6.1 statsAgeoutsTotal

This counter provides a count of the times that a neighbor’s information has been deleted from the LLDP remote systems MIB because the rxInfoTTL timer associated with the neighbor’s MSAP has expired.

9.2.6.2 statsFramesDiscardedTotal

This counter provides a count of all LLDPDUs received and then discarded for any of the following reasons:

a) One or more of the three mandatory TLVs at the beginning of the LLDPDU is missing, out of order, or contains an out of range information string length.
b) There is insufficient space in the remote systems MIB to store the LLDPDU.

9.2.6.3 statsFramesInErrorsTotal

This counter provides a count of all LLDPDUs received with one or more detectable errors.

9.2.6.4 statsFramesInTotal

This counter provides a count of all LLDP frames received.

9.2.6.5 statsFramesOutTotal

This counter provides a count of all LLDP frames transmitted by this instance of the transmit state machine. The counter shall be maintained as an unsigned integer value, four octets in length.

9.2.6.6 statsTLVsDiscardedTotal

This counter provides a count of all TLVs received and then discarded for any reason.

9.2.6.7 statsTLVsUnrecognizedTotal

This counter provides a count of all TLVs received on the port that are not recognized by the LLDP local agent.

9.2.6.8 lldpduLengthErrors

A count of the number of LLPDU length restriction errors detected by the mibConstrInfoLLDPDU() procedure (9.2.7.2).

9.2.7 State machine procedures

9.2.7.1 dec (variable-name)

If the state machine variable *variable-name* has a non-zero value, this procedure decrements the value of the variable by 1.

9.2.7.2 mibConstrInfoLLDPDU()

The mibConstrInfoLLDPDU() procedure constructs an information LLDPDU, structured according to the specification in 8.2, the associated basic TLV formats defined in 8.4, plus any optional Organizationally Specific TLVs as specified in 8.6 and their associated individual organizationally defined formats (as, for example, in Annex and Annex). The information LLDPDU contains the following:

a) The set of mandatory TLVs as specified in 8.2, with the value of txTTL set in accordance with the definition in 9.2.5.22.
b) Additional optional TLVs, from the basic management set or from one or more organizationally specific sets, as allowed by LLDPDU length restrictions and as selected in the LLDP local system MIB by network management (see Table 8-1, Table E.1, and Table F.1).
c) An End Of LLDPDU TLV.

If the set of TLVs that is selected in the LLDP local system MIB by network management would result in an LLDPDU that violates LLDPDU length restrictions, then the variable lldpduLengthErrors (9.2.7.2) is incremented by 1, and an LLDPDU is sent containing the mandatory TLVs plus as many of the optional TLVs in the set as will fit in the remaining LLPDU length.

9.2.7.3 mibConstrShutdownLLDPDU()

The mibConstrShutdownLLDPDU() procedure constructs a shutdown LLDPDU according to the LLDPDU and the associated TLV formats specified in 8.2 and 8.5. The shutdown LLDPDU contains only the following items:

a) The Chassis ID and Port ID TLVs.
b) The Time To Live TLV with the TTL field set to zero.
c) An End Of LLDPDU TLV.

9.2.7.4 mibDeleteObjects()

The mibDeleteObjects() procedure deletes all information in the LLDP remote systems MIB associated with a given MSAP identifier if an LLDPDU is received with an rxTTL value of zero (see 9.2.7.7.1) or the timing counter rxInfoTTL expires (see 9.2.2.1).

9.2.7.5 mibUpdateObjects()

The mibUpdateObjects() procedure updates the MIB objects corresponding to the TLVs contained in the received LLDPDU for the LLDP remote system if MIB space is available, as follows:

a) Compare the MSAP identifier in the current LLDPDU with the MSAP identifiers in the LLDP remote systems MIB:
    1) If a match is found, replace all current information associated with the MSAP identifier in the LLDP remote systems MIB with the information in the current LLDPDU.
    2) If no match is found, create a new MIB structure to receive information associated with the new MSAP identifier, and set these MIB objects to the values indicated in their respective TLVs.
b) Set the timing counter rxInfoTTL associated with the MSAP identifier to rxTTL.

If an incoming TLV is not recognized by the receiving LLDP agent, the TLV is stored in the LLDP remote systems MIB as follows:

c) If the TLV type value is in the range of the reserved TLV types in Table 8-1, the TLV can be from a later version of the basic management set and is stored according to the basic TLV format shown in Figure 8-2. These TLVs are indexed by their TLV type.
d) If the TLV type value is 127, the TLV is an Organizationally Specific TLV and is stored according to the basic format for Organizationally Specific TLVs shown in Figure 8-12. These TLVs are indexed by their OUI and organizationally defined TLV subtype.

9.2.7.6 rxInitializeLLDP()

The rxInitializeLLDP() procedure initializes the LLDP receive module. After the variable portEnabled is equal to TRUE, the LLDP receive module is initialized or re-initialized for frame reception. During this process, the local LLDP agent performs the following tasks:

a) The variable tooManyNeighbors is set to FALSE.
b) All information in the remote systems MIB associated with this LLDP agent is deleted.

9.2.7.7 rxProcessFrame()

The rxProcessFrame() procedure:

a) Validates the TLVs contained in the LLDPDU as defined in 9.2.7.7.1 through 9.2.7.7.3.
b) Determines whether or not a MIB update may be required as defined in 9.2.7.7.4.
c) If sufficient space is not available, determines whether to discard the incoming LLDPDU from a new neighbor or to delete information from an existing neighbor that is already in the LLDP remote systems MIB, as defined in 9.2.7.7.5. The tooManyNeighborsTimer and the tooManyNeighbors flag variable are both set during this process.

NOTE—The flag variable tooManyNeighbors is automatically reset when the tooManyNeighborsTimer expires.

9.2.7.7.1 LLDPDU validation

The receive module processes each incoming LLDPDU as it is received. The statsFramesInTotal counter for the port is incremented and the LLDPDU is checked to verify the presence of the three mandatory TLVs at the beginning of the LLDPDU as defined in 8.2.

a) The first TLV is extracted:
   1) If the extracted TLV type value does not equal 1, the TLV is not a Chassis ID TLV:
      i) The LLDPDU is discarded.
      ii) The statsFramesDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
      iii) The variable badFrame is set to TRUE.
      iv) The procedure rxProcessFrame**()** is terminated.
   2) If the extracted TLV type value equals 1, and the chassis ID TLV information string length is not within the range $2 \leq n \leq 256$:
      i) The LLDPDU is discarded.
      ii) The statsFramesDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
      iii) The variable badFrame is set to TRUE.
      iv) The procedure rxProcessFrame() is terminated.
   3) If the extracted TLV type value equals 1, and the chassis ID TLV information string length is within the range $2 \leq n \leq 256$, the chassis ID value is extracted to become the first part of the MSAP identifier.
b) The second TLV is extracted:
   1) If the extracted TLV type value does not equal 2, the TLV is not a Port ID TLV:
      i) The LLDPDU is discarded.
      ii) The statsFramesDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
      iii) The variable badFrame is set to TRUE.
      iv) The procedure rxProcessFrame() is terminated.
   2) If the extracted TLV type value equals 2, and the port ID TLV information string length is not within the range $2 \leq n \leq 256$:
      i) The LLDPDU is discarded.
      ii) The statsFramesDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
      iii) The variable badFrame is set to TRUE.
      iv) The procedure rxProcessFrame() is terminated.
   3) If the extracted TLV type value equals 2, and the port ID TLV information string length is within the range $2 \leq n \leq 256$, the port ID value is extracted and appended to the chassis ID value to complete construction of the MSAP identifier.

c) The third TLV is extracted:
   1) If the extracted TLV type value does not equal 3, the TLV is not a Time To Live TLV.
      i) The LLDPDU is discarded.
      ii) The statsFramesDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
      iii) The variable badFrame is set to TRUE.
      iv) The procedure rxProcessFrame() is terminated.
   2) If the extracted TLV type value equals 3, and the Time To Live TLV information string length is less than 2:
      i) The LLDPDU is discarded.
      ii) The statsFramesDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
      iii) The variable badFrame is set to TRUE.
      iv) The procedure rxProcessFrame() is terminated.
   3) If the extracted TLV type value equals 3, and the Time To Live TLV information string length is greater than or equal to 2, the first two octets of the TLV information string is extracted and rxTTL is set to this value:
      i) If rxTTL equals zero, a shutdown frame has been received. The MSAP identifier and rxTTL are passed up to the LLDP MIB manager, and further LLDPDU validation is terminated.
      ii) If rxTTL is non-zero, LLDPDU validation continues and the remaining TLVs are validated.

Each of the remaining TLV information elements are decoded in succession as required by their particular TLV format definitions:

d) If the TLV type value equals 0, the TLV is the End Of LLDPDU TLV. The MSAP identifier, rxTTL, and all validated TLVs are passed to the LLDP management entity for LLDP remote systems MIB updating.
e) If (0 < TLV_type_value ≤ 8) the TLV is a member of the basic management set and is validated according to the general rules for all TLVs defined in 9.2.7.7.2 as well as any specific rules defined for the particular TLVs defined in 8.5.
f) If TLV_type_value is in the range of reserved TLV types in Table 8-1, the TLV is unrecognized and may be a basic TLV from a later LLDP version. The statsTLVsUnrecognizedTotal counter is incremented, and the TLV is assumed to be validated.
g) If the TLV type value is 127, the TLV is an Organizationally Specific TLV:
   1) If the TLV's OUI and organizationally defined subtype are recognized, the TLV is validated according to the general rules for all TLVs defined in 9.2.7.7.2 as well as the general rules for Organizationally Specific TLVs defined in 9.2.7.7.3 plus any specific rules defined for the particular TLV (see Annex for IEEE 802.1 TLVs and Annex for IEEE 802.3 TLVs).
   2) If the TLV's OUI and/or organizationally defined subtype are not recognized, the statsTLVsUnrecognizedTotal counter is incremented, and the TLV is assumed to be validated.
h) If the end of the LLDPDU has been reached, the MSAP identifier, rxTTL, and all validated TLVs are passed to the LLDP management entity for LLDP remote systems MIB updating.

9.2.7.7.2 General validation rules for all TLVs

The value in the TLV information string length field is the value used to validate the TLV and to indicate the location of the next TLV in the LLDPDU.

All TLVs are subject to the general validation rules listed in this subclause as well as any specific usage rules defined for the particular TLV (for example, see systems capabilities TLV usage rules in 8.5.8.3):

a) If the LLDPDU contains more than one Chassis ID TLV, Port ID TLV, or Time To Live TLV:
   1) The LLDPDU is discarded.
   2) The statsFramesDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
   3) The variable badFrame is set to TRUE.
   4) The procedure rxProcessFrame() is terminated.
b) If the TLV information string length value is not exactly equal to the sum of the lengths of all fields contained in the TLV information string:
   1) The LLDPDU is discarded.
   2) The statsFramesDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
   3) The variable badFrame is set to TRUE.
   4) The procedure rxProcessFrame() is terminated.
c) If any TLV contains an error condition specified for that particular TLV (for example, see E.3.3):
   1) The TLV is discarded.
   2) The statsTLVsDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
   3) The location of the next TLV is based on the TLV information string length value of the current TLV.
d) With the exception of the TTL TLV for which specific rules apply (see 9.2.7.7.1), if the length of any field of a TLV is outside the length range specified for that particular TLV (for example, the TLV information string length is greater than the maximum permitted length for the TLV information string as specified for that TLV):
   1) The TLV is discarded.
   2) The statsTLVsDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
   3) The location of the next TLV is based on the TLV information string length value of the current TLV.
e) If any TLV extends past the physical end of the frame:
   1) The TLV is discarded.
   2) The statsTLVsDiscardedTotal and statsFramesInErrorsTotal counters are both incremented.
f) Any information following an End Of LLDPDU TLV is ignored.

NOTE—Usage rules for individual TLVs allow some TLVs to appear more than once in an LLDPDU. Duplicate TLVs result in any one of the values being placed in the MIB, can cause the discard stats to increment, and can cause the change marker for the MIB entry to change if any of the TLV copies change the value even if the value finally recorded is unchanged. The only thing guaranteed is that the MIB value is set to one (unspecified) of the TLV values, and if that value is different to what was previously in the MIB then the change marker is set.

9.2.7.7.3 General validation rules for all Organizationally Specific TLVs

If an Organizationally Specific TLV is not recognized by the receiving LLDP agent, the content of the TLV can be ignored but the TLV is stored in the LLDP remote systems MIB for possible retrieval by network management using the basic Organizationally Specific TLV format (see 8.6) and the StatsTLVsUnrecognizedTotal counter is incremented. If more than one unrecognized Organizationally Specific TLV is received with the same OUI and organizationally defined subtype, but with identifiable differences in the organizationally defined information strings, all copies are assigned a temporary identification index and stored.

9.2.7.7.4 TLV/MIB object value comparison

The LLDP MIB manager is responsible for updating and maintaining the LLDP remote systems MIB with information received by LLDP agents. It uses the rxChanges variable to signal when any change has occurred in the LLDP remote systems MIB due to new or different information in the TLVs from an incoming LLDPDU.

The TLV/MIB object value comparison function is associated with the following actions:

Compare the MSAP identifier in the current LLDPDU with the MSAP identifiers in the LLDP remote systems MIB:

a) If a match is found, but no difference exists between the information in the TLVs just received and the information in the LLDP remote systems MIB, set the control variable rxChanges to FALSE, set the timing counter rxInfoTTL associated with the MSAP identifier to rxTTL, and wait for the next LLDPDU.
b) If a match is not found, or if a match is found and any differences exist between the information in the TLVs just received and the information in the LLDP remote systems MIB, check to determine if sufficient space exists in the LLDP remote systems MIB to accommodate the current LLDPDU:
    1) If sufficient space exists, set the control variable rxChanges to TRUE and set the flag variable tooManyNeighbors to FALSE.
    2) If sufficient space does not exist, perform the “Too many neighbors” process defined in 9.2.7.7.5.

9.2.7.7.5 Too many neighbors

When there is insufficient space in the LLDP remote systems MIB to store information from a new neighbor something needs to be discarded. Either the received LLDPDU is discarded or existing information within the current remote systems MIB is discarded in order to make space for the new information received in the LLDPDU:

a) Set the flag variable tooManyNeighbors to TRUE.
b) If the information selected to be discarded is the information in the current LLDPDU:
    1) Set the tooManyNeighborsTimer as specified in Equation (3).

$$\text{tooManyNeighborsTimer} = \max(\text{tooManyNeighborsTimer}, \text{rxTTL}) \tag{3}$$

    where rxTTL is the TTL value in the current LLDPDU
    2) Discard the current LLDPDU and increment the statsFramesDiscardedTotal counter.
    3) Wait for the next LLDPDU.
c) If the information selected to be discarded is currently in the LLDP remote systems MIB:
    1) Delete all information associated with the selected neighbor’s MSAP identifier from the LLDP remote systems MIB.
    2) Set the tooManyNeighborsTimer as specified in Equation (4).

$$\text{tooManyNeighborsTimer} = \max(\text{tooManyNeighborsTimer}, \text{rxInfoTTL}) \tag{4}$$

    where rxInfoTTL = the selected neighbor’s TTL value
    3) If sufficient space exists to store the information received in the current LLDPDU in the LLDP remote systems MIB, set control variable rxChanges to TRUE.
    4) If sufficient space still does not exist to store the information received in the current LLDPDU in the LLDP remote systems MIB, perform steps 1–3 again.

The variable tooManyNeighbors is automatically set to FALSE whenever the tooManyNeighborsTimer expires.

NOTE—The tooManyNeighborsTimer is not precise, as it is only cleared (and the tooManyNeighbors variable set FALSE) by timer expiration, and not by the removal of the too many neighbors condition.

9.2.7.8 somethingChangedLocal()

This procedure is called to indicate that the status/value of one or more of the selected objects in the LLDP local system MIB has changed, and that there is therefore a need to transmit new information. It is used to notify the managers of the PTOPO and other optional MIBs that something has changed in the LLDP local systems MIB.

This procedure also sets the value of the variable localChange (see 9.2.5.3) to signal the need for the LLDP agent(s) to transmit the new information, and copies the value of the variable txFastInit (see 9.2.5.19) to the variable txFast (see 9.2.5.18) to ensure that the new values will be seen by the neighbors on the port.

It is assumed that the system provides the ability for any processes that need to receive such indications to register with this procedure so that appropriate signals can be received by those processes when the procedure is called.

9.2.7.9 somethingChangedRemote()

This procedure is called after all the information associated with the particular MSAP identifier has been updated in the LLDP remote systems MIB. The procedure call serves as an indication to the managers of the PTOPO and other optional MIBs that one or more of the following conditions is true:

a) That the status/value of one or more objects in the LLDP remote systems MIB associated with the particular MSAP identifier has changed.
b) That an incoming LLDPDU contained an MSAP identifier requiring creation of a new MIB structure in the LLDP remote systems MIB to receive the information in that LLDPDU.
c) That information in the LLDP remote systems MIB associated with the MSAP identifier has been deleted.

It is assumed that the system provides the ability for any processes that need to receive such indications to register with this procedure so that appropriate signals can be received by those processes when the procedure is called.

9.2.7.10 txAddCredit()

This procedure increments the value of the txCredit variable (9.2.5.16) by one if the current value of the txCredit variable is less than the value of txCreditMax (9.2.5.17).

9.2.7.11 txFrame()

The txFrame() procedure makes use of the services of LLC to transmit the LLDPDU constructed by either the mibConstrInfoLLDPDU() or mibConstrShutdownLLDPDU() procedures (9.2.7.2, 9.2.7.3). The destination MAC address used is the MAC address associated with the instance of the LLDP Agent (see 7.1 and 9.2.5.4). The source MAC address used is the individual MAC address of the transmitting port. The Ethertype used is the LLDP Ethertype identified in Table 7-3.

After the frame has been transmitted, the statsFramesOutTotal counter (9.2.6.5) is incremented.

9.2.7.12 txInitializeLLDP()

The txInitializeLLDP() procedure initializes the LLDP transmit module. It performs the following tasks:

a) If applicable, either the non-volatile configuration for the LLDP local system MIB are retrieved or the appropriate default values are assigned to all LLDP configuration variables.

b) The internal (implementation specific) data structures are initialized with appropriate local physical topology information.
c) System default values are set for the following timing parameters:
   1) reinitDelay (9.2.5.10)
   2) msgTxHold (9.2.5.6)
   3) msgTxInterval (9.2.5.7)
   4) msgFastTx (9.2.5.5)

NOTE—It is recommended to introduce a degree of stagger into starting the LLDP local agent initialization in multi-port implementations so that the timing of LLDP frame transmission cycles can be distributed among system ports, and distributed among supported MAC addresses on each port. The method of accomplishing the stagger is an implementation issue and is beyond the scope of this standard.

9.2.8 Transmit state machine

The transmit state machine for an individual port and destination MAC address (see 7.1) shall implement the function specified by the state diagram contained in Figure 9-1 and the attendant definitions contained in 9.2.3 through 9.2.6.8.

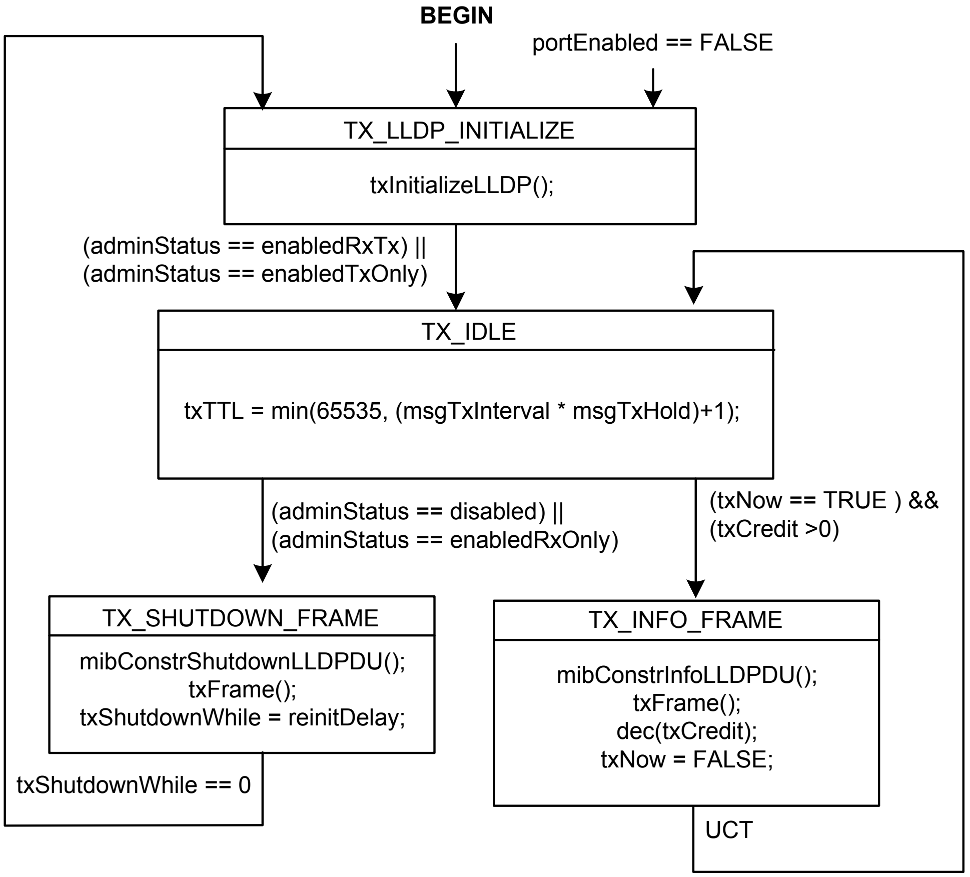

BEGIN
portEnabled == FALSE
TX_LLDP_INITIALIZE
txInitializeLLDP();
(adminStatus == enabledRxTx) ||
(adminStatus == enabledTxOnly)
TX_IDLE
txTTL = min(65535, (msgTxInterval * msgTxHold)+1);
(adminStatus == disabled) ||
(adminStatus == enabledRxOnly)
(txNow == TRUE) &&
(txCredit >0)
TX_SHUTDOWN_FRAME
mibConstrShutdownLLDPDU();
txFrame();
txShutdownWhile = reinitDelay;
TX_INFO_FRAME
mibConstrInfoLLDPDU();
txFrame();
dec(txCredit);
txNow = FALSE;
txShutdownWhile == 0
UCT

Figure 9-1—Transmit state machine

9.2.9 Receive state machine

The receive state machine for an individual port and destination MAC address (see 7.1) shall implement the function specified by the state diagram contained in Figure 9-2 and the attendant definitions contained in 9.2.2 through 9.2.6.8.

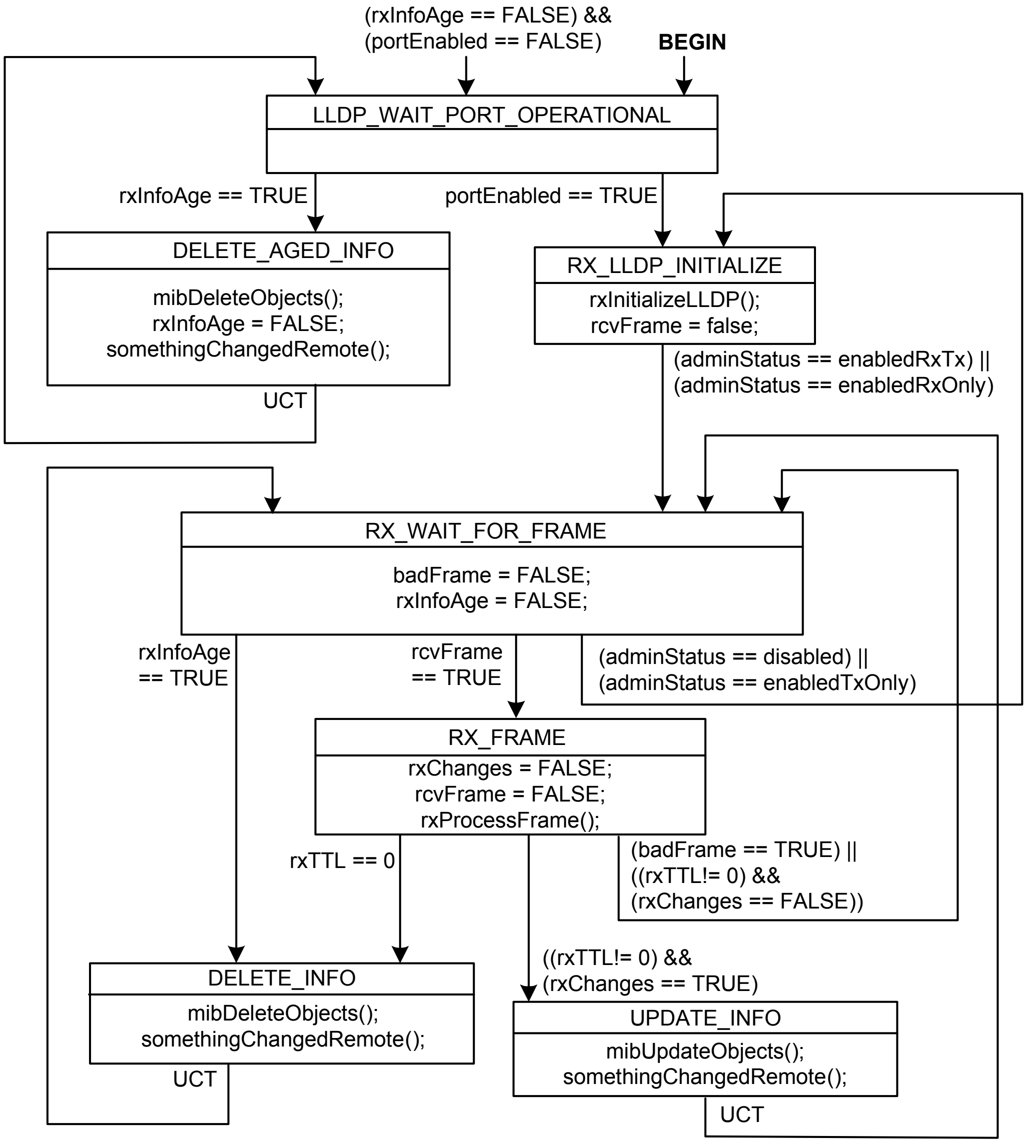


Figure 9-2—Receive state machine

9.2.10 Transmit timer state machine

The transmit timer state machine for an individual port and destination MAC address (see 7.1) shall implement the function specified by the state diagram contained in Figure 9-3 and the attendant definitions contained in 9.2.3 through 9.2.6.8.

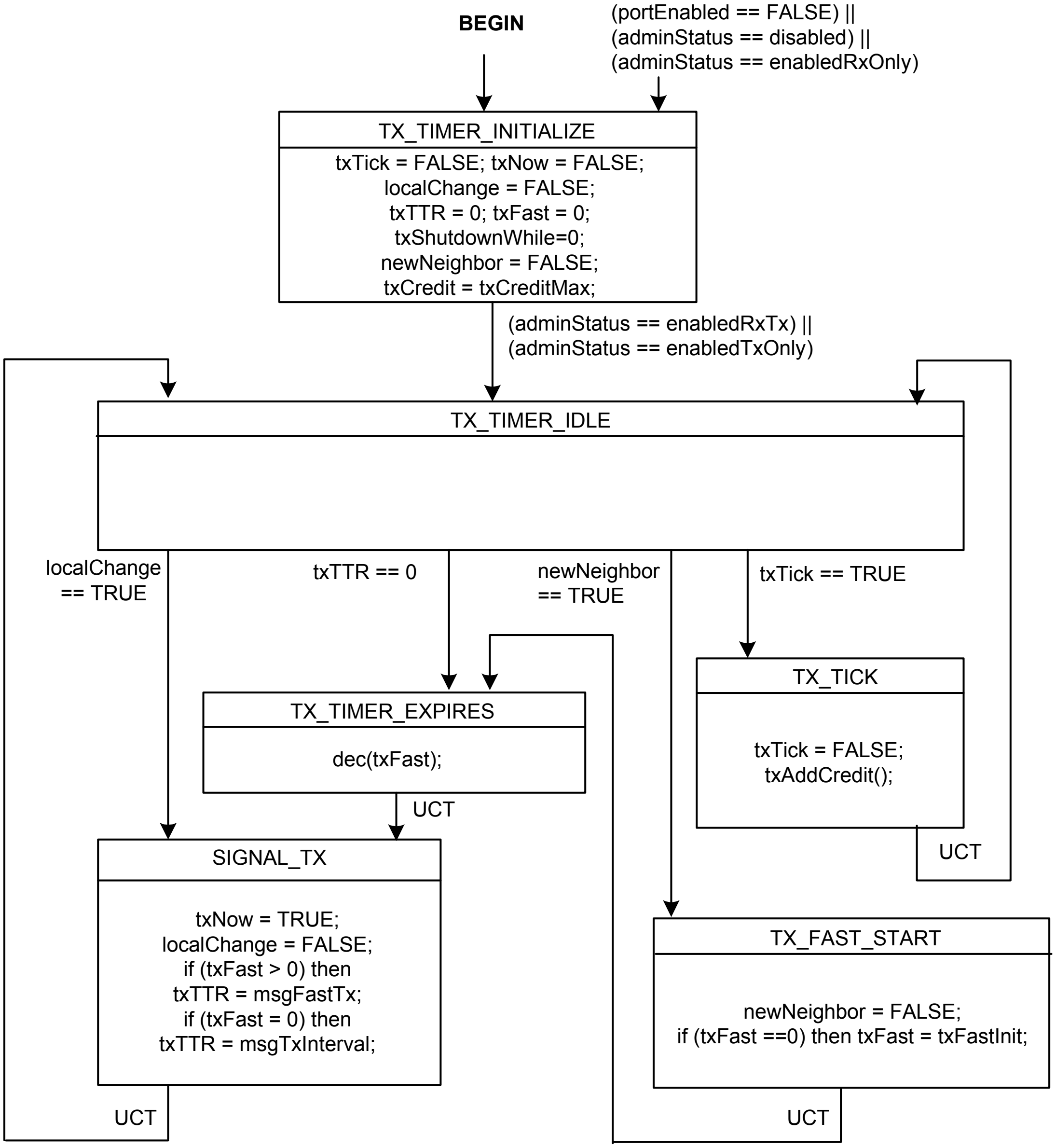


Figure 9-3—Transmit timer state machine

10. LLDP management

This clause defines the set of managed objects and their functionality that allow administrative configuration and monitoring of LLDP operation.

10.1 Data storage and retrieval

LLDP agents need to have a place to store both information about the local system and information they have received about remote systems. Data storage and retrieval capability to support the functionality defined in Clause 7, Clause 8, Clause 9, and Clause 10 shall be provided. No particular implementation is implied.

10.2 The LLDP management entity’s responsibilities

The LLDP management entity has the following responsibilities:

a) Starting the transmit and receive state machines.
b) Providing a means for the network manager to select TLVs to be included in outgoing LLDPDUs.
c) Extracting the necessary information from the LLDP local system MIB and constructing the individual TLVs selected for insertion into the LLDPDU.
d) Prepending appropriate addressing and LLDP Ethertype to the LLDPDU before submitting the MA_UNITDATA.request for frame transmission.
e) Updating the LLDP remote systems MIB and monitoring for MIB object adds, deletions and value changes.
f) Maintaining operational statistics.

10.2.1 Protocol initialization management

Protocol initialization consists of:

a) Retrieving non-volatile configuration values for the LLDP local system MIB.
b) Assigning default or management assigned values to LLDP configuration variables.
c) Loading physical topology information into their associated LLDP local system MIB objects.

10.2.2 TLV selection management

TLV selection management consists of providing the network manager with the means to select which specific TLVs are enabled for inclusion in an LLDPDU. The following LLDP variables cross reference to LLDP local systems configuration MIB tables indicating which specific TLVs are enabled for the particular port(s) on the system. The specific port(s) through which each TLV is enabled for transmission may be set (or reset) by the network manager.

a) **mibBasicTLVsTxEnable:** This variable lists the single-instance-use basic management TLVs, each with a bit map indicating the system ports through which the referenced TLV is enabled for transmission.
b) **mibMgmtAddrInstanceTxEnable:** This variable lists the different management addresses (by subtype) that are defined for the system, each with a bit map indicating the system ports through which the particular management address/subtype TLV is enabled for transmission.

NOTE—Implementers of new TLVs should be aware that provision needs to be made to allow similar network management selection of new TLVs and that doing so requires linkage to the LLDP MIB, regardless of whether or not the TLV is part of the basic management set or part of an Organizationally Specific TLV set.

10.2.3 Transmission management

Transmission management consists of the following:

a) Determining when a new transmission cycle is required, as signaled by the somethingChangedLocal() procedure (see 9.2.7.8).
b) Extracting the appropriate LLDP local system MIB information for the three mandatory TLVs and inserting them at the beginning of the LLDPDU in proper format order.
c) Extracting the appropriate LLDP local system MIB information for the selected optional TLVs and inserting them into the LLDPDU.
d) Appending an End Of LLDPDU TLV after the last optional TLV in the LLDPDU.
e) Maintaining length control during LLDPDU construction to ensure that the TLVs do not exceed the maximum length allowed for the LLDPDU.
f) Submitting the frame for transmission.

10.2.4 Reception management

Reception management consists of the following:

a) Receiving and parsing the incoming LLDPDUs.
b) Validating, and checking the types of the first three TLVs to ensure that they are the required type and in LLDPDU format order.
c) Validating optional TLVs and extracting information values.
d) Checking whether or not the current LLDPDU represents a new MSAP identifier.
e) Monitoring whether or not there is sufficient space available in the LLDP remote systems MIB for all active neighbors.
f) Arbitrating which information is to be discarded in cases where insufficient space is available in the LLDP remote systems MIB for all active neighbors.
g) Checking whether or not the received information represents a status or value change to the existing MIB object.
h) Updating remote systems MIB objects as necessary.

10.2.5 Performance management

Performance management consists of the following:

a) Monitoring the LLDP local system MIB update activities for status or value changes to selected MIB objects and:
    1) Calling the somethingChangedLocal() procedure (see 9.2.7.8) whenever a status/value change occurs.
    2) Initiating a new transmit cycle if txCredit > 0.
b) Monitoring the txTTR timer for countdown expiration and initiating a new transmit cycle if txCredit > 0.
c) Monitoring the rxInfoTTL timer for countdown expiration and:
    1) Deleting the associated objects from the LLDP remote systems MIB whenever the timing counter expires.
    2) Performing the procedure somethingChangedRemote() associated with the MSAP identifier.
d) Monitoring rxTTL in the incoming LLDPDUs for shutdown indication and:
    1) Deleting the associated objects from the LLDP remote systems MIB whenever rxTTL = 0.
    2) Performing the procedure somethingChangedRemote() associated with the MSAP identifier.

e) Monitoring the "tooManyNeighbors" variable to determine whether an existing neighbor's information needs to be deleted and:
   1) Deleting the objects associated with a selected MSAP identifier from the LLDP remote systems MIB whenever existing information is selected to be deleted.
   2) Performing the procedure somethingChangedRemote() associated with the MSAP identifier.

f) Monitoring the tooManyNeighborsTimer to determine when there is not sufficient space available to accommodate information from all active neighbors and setting the variable tooManyNeighbors associated with the port to FALSE when the tooManyNeighborsTimer expires.

g) Notifying the managers of the PTOPO MIB and other optional MIB modules (see Figure 11-1) whenever the procedures somethingChangedLocal() or somethingChangedRemote() are performed.

h) Maintaining operational statistics regarding the LLDP frames sent and received.

10.3 Managed objects

Managed objects model the semantics of management operations. Operations upon a managed object supply information concerning, or facilitate control over, the process or entity associated with that managed object.

Management of LLDP is described in terms of the managed resources that are associated with individual TLVs and that support frame transmission and reception.

10.4 Data types

This subclause specifies the semantics of operations independent of their encoding in management protocol. The data types of the parameters of operations are defined for that specification.

The following data types are used:

a) Boolean.
b) Enumerated, for a collection of named values.
c) Unsigned, for all parameters specified as "number of" some quantity.
d) MAC address.
e) Time interval, an Unsigned value representing a positive integral number of seconds for all time out parameters.
f) Counter, for all parameters specified as a "count" of some quantity (all counters increment and wrap with a modulus of 2 to the power 32).

10.5 LLDP variables

LLDP managed objects fall into the following categories:

a) Status/control variables necessary for operation of the protocol.
b) Variables that accumulate operational statistics.
c) Variables that are required by the particular TLVs.

10.5.1 LLDP operational status and control

a) Global parameters and variables:
   1) **adminStatus:** The authority that controls whether or not a local LLDP agent is enabled for transmit and receive, transmit only, or receive only; or is disabled (9.2.5.1).

b) Transmit state machine parameters and variables:

1) **msgTxHold:** A multiplier on msgTxInterval used to compute the TTL value of txTTL (9.2.5.6, 9.2.5.22).
2) **msgTxInterval:** The interval between successive transmit cycles in normal transmission mode (9.2.5.7).
3) **reinitDelay:** The delay after adminStatus becomes 'disabled' before re-initialization is attempted (9.2.5.10).
4) **txCreditMax:** The maximum value of transmission credit (9.2.5.17).
5) **txFastInit:** The interval between successive LLDPDU transmissions in fast transmission mode (9.2.5.19).

c) Receive state machine parameters and variables:
   1) **remoteChanges:** An indication that the status/value of one or more selected objects in the LLDP remote systems MIB has changed or that all objects associated with a particular MSAP identifier have been deleted (9.2.5.11).
   2) **tooManyNeighbors:** An indication that there is insufficient space in the LLDP remote systems MIB to store information from all active neighbors (9.2.5.15).

10.5.2 LLDP operational statistics counters

The following counters provide operational statistics on a per port basis:

a) Transmission counters:
   1) **statsFramesOutTotal**: A count of all LLDP frames transmitted through the port (9.2.6.5).
   2) **statsLengthErrorsTotal:** A count of all LLDP length errors detected when constructing LLPDU frames for transmission through the port (9.2.7.2).
b) Reception counters:
   1) **statsAgeoutsTotal:** A count of the times that a neighbor's information is deleted from the LLDP remote systems MIB because of rxInfoTTL timer expiration (9.2.6.1).
   2) **statsFramesDiscardedTotal:** A count of all LLDPDUs received and then discarded (9.2.6.2).
   3) **statsFramesInErrorsTotal:** A count of all LLDPDUs received at the port with one or more detectable errors 9.2.6.3).
   4) **statsFramesInTotal:** A count of all LLDP frames received at the port (9.2.6.4).
   5) **statsTlvsDiscardedTotal:** A count of all TLVs received at the port and discarded for any reason. (9.2.6.6)
   6) **statsTLVsUnrecognizedTotal:** This counter provides a count of all TLVs not recognized by the receiving LLDP local agent (9.2.6.7).

10.5.3 TLV required variables

Variables in this category are defined by the requirements of the particular TLVs. They are maintained with reference to the local system in the LLDP local system MIB; and with reference to the remote system, in the LLDP remote systems MIB. TLV variables are outputs from the local LLDP agent and inputs to the remote LLDP agent.

Variables that pertain to basic set TLVs are listed below. Variables pertaining to Organizationally Specific TLVs are listed in Annex for IEEE 802.1 defined extensions and in Annex for IEEE 802.3 defined extensions.

10.5.3.1 Chassis ID TLV objects

a) **chassis ID subtype:** The type of identifier used for the chassis (see 8.5.2.2).
b) **chassis ID:** The identification assigned to the chassis containing the port (see 8.5.2.3).

10.5.3.2 Port ID TLV objects

a) **port ID subtype:** The type of identifier used for the port (see 8.5.3.2).

b) **port ID:** The identification assigned to the port (see 8.5.3.3).

10.5.3.3 Port description TLV object

a) **port description:** The port's description (see 8.5.5.2).

10.5.3.4 System name TLV object

a) **system name:** The system's assigned name (see 8.5.6.2).

10.5.3.5 System description TLV object

a) **system description:** The system's description (see 8.5.7.2).

10.5.3.6 System capabilities TLV objects

a) **system capabilities:** The primary capabilities of the system (see 8.5.8.1).

b) **enabled capabilities:** The system's enabled capabilities (see 8.5.8.2).

10.5.3.7 Management address TLV objects

a) **management address length:** The length of the management address (see 8.5.9.2).

b) **management address subtype:** The management address type (see 8.5.9.3).

c) **management address:** The management address (see 8.5.9.4).

d) **interface numbering subtype:** The interface type (see 8.5.9.5).

e) **interface number:** The interface number (see 8.5.9.6).

f) **OID length:** The object identifier length (see 8.5.9.7).

g) **OID:** The object identifier (see 8.5.9.8).

11. LLDP MIB definitions

This clause defines the LLDP basic MIB for use with SNMP in TCP/IP based internets. In particular, it defines objects for managing the operation of LLDP based on the specifications of Clause 7, Clause 8, Clause 9, and Clause 10.

11.1 Internet Standard Management Framework

LLDP MIBs are designed to operate in a manner consistent with the principles of the Internet Standard Management Framework, which describes the separation of a data modeling language (for example, SMIv2) from content-specific data models (for example the LLDP remote systems MIB), and from messages and protocol operations used to manipulate the data (for example SNMPv3).

For a detailed overview of the documents that describe the current Internet Standard Management Framework, please refer to section 7 of IETF RFC 3410 (2002).

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This clause specifies a MIB module that is compliant to the SMIv2, which is described in IETF STD 58, IETF RFC 2578, IETF RFC 2579, and IETF RFC 2580.

11.2 Structure of the LLDP MIB

The LLDP MIB consists of two types of MIB modules, the mandatory basic MIB defined in this clause and from zero to *n* optional organizationally specific MIB extensions such as the IEEE 802.1 MIB in Annex F and the IEEE 802.3 MIB in Annex G.

Each MIB module is divided into two major sections as shown in Figure 11-1 to allow selective MIB support for the particular operating mode (transmit only, receive only, or both transmit and receive) being implemented.

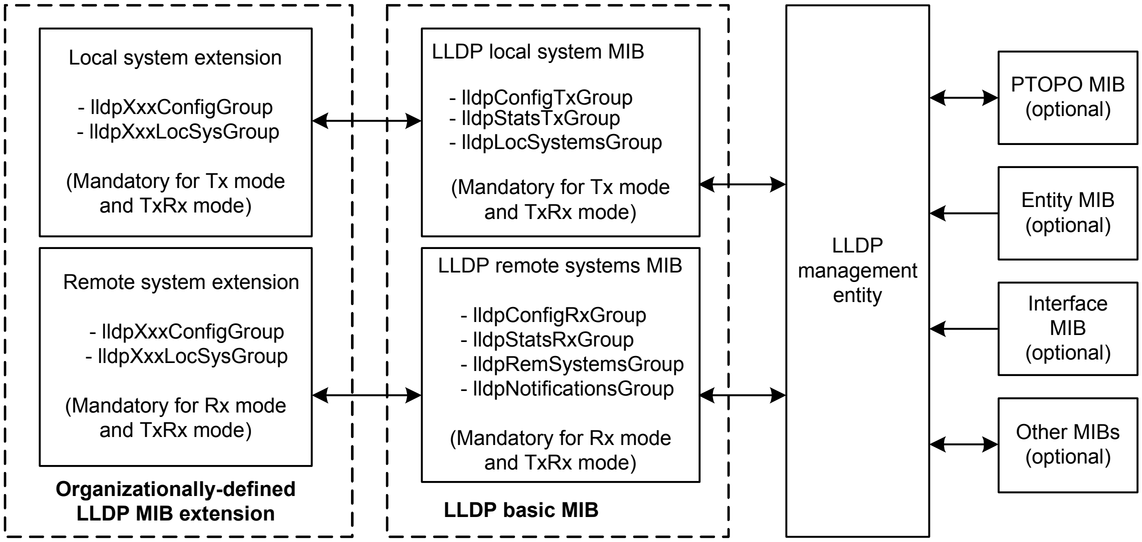


Figure 11-1—LLDP MIB block diagram

Table 11-1 summarizes the particular object groups that are required for each operating mode.The basic MIB shall comply with the MIB conformance section for the particular operating mode (Rx, Tx, or TxRx mode) being supported.

Table 11-1—MIB object groups and operating mode applicability

MIB group	Rx mode	Tx mode	TxRx mode
lldpV2ConfigGroup			
lldpV2ConfigRxGroup	M[*]	—	M
lldpV2ConfigTxGroup	—	M	M
lldpV2StatsRxGroup	M	—	M
lldpV2StatsTxGroup	—	M	M
lldpV2LocSysGroup	—	M	M
lldpV2RemSysGroup	M	—	M
lldpV2NotificationsGroup	M	—	M
ifGeneralInformationGroup	M	M	M

[*] M=Mandatory

Table 11-2 shows the structure of the MIB and the relationship of the MIB objects to the LLDP operational status/control variables, LLDP statistics variables, and TLV variables.

Table 11-2—LLDP MIB structure and object cross reference

MIB table	MIB object	LLDP reference
LLDP Configuration group		
	lldpV2MessageTxInterval	msgTxInterval, 9.2.5.7
	lldpV2MessageTxHoldMultiplier	msgTxHold, 9.2.5.6
	lldpV2ReinitDelay	reinitDelay, 9.2.5.10
	lldpV2NotificationInterval	msgTxInterval, 9.2.5.7
	lldpV2TxCreditMax	txCreditMax, 9.2.5.17
	lldpV2MessageFastTx	msgFastTx, 9.2.5.5
	lldpV2TxFastInit	txFastInit, 9.2.5.19
lldpV2PortConfigTable		
	lldpV2PortConfigIfIndex	(Table index)
	lldpV2PortConfigDestAddressIndex	(Table index)
	lldpV2PortConfigAdminStatus	adminStatus, 9.2.5.1
	lldpV2PortConfigNotificationEnable	—
	lldpV2PortConfigTLVsTxEnable	9.1.2.1

Table 11-2—LLDP MIB structure and object cross reference *(continued)*

MIB table	MIB object	LLDP reference
lldpV2DestAddressTable		
	lldpV2AddressTableIndex	(Table index)
	lldpV2DestMacAddress	(Table index)
lldpV2ManAddrConfigTxPortsTable		
	lldpV2ManAddrConfigIfIndex	(Table index)
	lldpV2ManAddrConfigDestAddressIndex	(Table index)
	lldpV2ManAddrConfigLocManAddrSubtype	8.5.9.3 (Table index)
	lldpV2ManAddrConfigLocManAddr	8.5.9.4 (Table index)
	lldpV2ManAddrConfigTxEnable	9.1.2.1
	lldpV2ManAddrConfigRowStatus	—
LLDP Statistics group		
	lldpV2StatsRemTablesLastChangeTime	—
	lldpV2StatsRemTablesInserts	—
	lldpV2StatsRemTablesDeletes	—
	lldpV2StatsRemTablesDrops	—
	lldpV2StatsRemTablesAgeouts	—
lldpV2StatsTxPortTable		
	lldpV2StatsTxIfIndex	(Table index)
	lldpV2StatsTxDestMACAddress	(Table index)
	lldpV2StatsTxPortFramesTotal	statsFramesOutTotal, 9.2.6.5
	lldpV2StatsTxLLDPDULengthErrors	lldpduLengthErrors, 9.2.6.8
lldpV2StatsRxPortTable		
	lldpV2StatsRxDestIfIndex	(Table index)
	lldpV2StatsRxDestMACAddress	(Table index)
	lldpV2StatsRxPortFramesDiscardedTotal	statsFramesDiscardedTotal, 9.2.6.2
	lldpV2StatsRxPortFramesErrors	statsFramesInErrorsTotal, 9.2.6.3
	lldpV2StatsRxPortFramesTotal	statsFramesInTotal, 9.2.6.4
	lldpV2StatsRxPortTLVsDiscardedTotal	statsTLVsDiscardedTotal, 9.2.6.6
	lldpV2StatsRxPortTLVsUnrecognizedTotal	statsTLVsUnrecognizedTotal, 9.2.6.7
	lldpV2StatsRxPortAgeoutsTotal	statsAgeoutsTotal, 9.2.6.1
Local System Data group		

Table 11-2—LLDP MIB structure and object cross reference *(continued)*

MIB table	MIB object	LLDP reference
	lldpV2LocChassisIdSubtype	chassis ID subtype, 8.5.2.2
	lldpV2LocChassisId	chassis ID, 8.5.2.3
	lldpV2LocSysName	system name, 8.5.6.2
	lldpV2LocSysDesc	system description, 8.5.7.2
	lldpV2LocSysCapSupported	system capabilities, 8.5.8.1
	lldpV2LocSysCapEnabled	enabled capabilities, 8.5.8.2
lldpV2LocPortTable		
	lldpV2LocPortIfIndex	(Table index)
	lldpV2LocPortIdSubtype	port ID subtype, 8.5.3.2
	lldpV2LocPortId	port ID, 8.5.3.3
	lldpV2LocPortDesc	port description, 8.5.5.2
lldpV2LocManAddrTable		
	lldpV2LocManAddrSubtype	management address subtype, 8.5.9.3 (Table index)
	lldpV2LocManAddr	management address, 8.5.9.4 (Table index)
	lldpV2LocManAddrLen	management address string length, 8.5.9.2
	lldpV2LocManAddrIfSubtype	interface numbering subtype, 8.5.9.5
	lldpV2LocManAddrIfId	interface number, 8.5.9.6
	lldpV2LocManAddrOID	object identifier, 8.5.9.8
Remote Systems Data group		
lldpV2RemTable		

Table 11-2—LLDP MIB structure and object cross reference *(continued)*

MIB table	MIB object	LLDP reference
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2RemChassisIdSubtype	chassis ID subtype, 8.5.2.2
	lldpV2RemChassisId	chassis ID, 8.5.2.3
	lldpV2RemPortIdSubtype	port ID sybtype, 8.5.3.2
	lldpV2RemPortId	port ID, 8.5.3.3
	lldpV2RemPortDesc	port description, 8.5.5.2
	lldpV2RemSysName	system name, 8.5.6.2
	lldpV2RemSysDesc	system description, 8.5.7.2
	lldpV2RemSysCapSupported	system capabilities, 8.5.8.1
	lldpV2RemSysCapEnabled	enabled capabilities, 8.5.8.2
	lldpV2RemRemoteChanges	remoteChanges, 9.2.5.11
	lldpV2RemTooManyNeighbors	tooManyNeighbors, 9.2.5.15
lldpV2RemManAddrTable		(Table index)
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2RemManAddrSubtype	management address subtype, 8.5.9.3 (Table index)
	lldpV2RemManAddr	management address, 8.5.9.4 (Table index)
	lldpV2RemManAddrIfSubtype	interface numbering subtype, 8.5.9.5
	lldpV2RemManAddrIfId	interface number, 8.5.9.6
	lldpV2RemManAddrOID	object identifier, 8.5.9.8
lldpV2RemUnknownTLVTable		

Table 11-2—LLDP MIB structure and object cross reference *(continued)*

MIB table	MIB object	LLDP reference
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2RemUnknownTLVType	LLDPDU validation, 9.2.7.7.1 (Table index)
	lldpV2RemUnknownTLVInfo	LLDPDU validation, 9.2.7.7.1
lldpV2RemOrgDefInfoTable		
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2RemOrgDefInfoOUI	organizationally unique identifier, 8.6.1.3 (Table index)
	lldpV2RemOrgDefInfoSubtype	organizationally defined subtype, 8.6.1.4 (Table index)
	lldpV2RemOrgDefInfoIndex	(Table index)
	lldpV2RemOrgDefInfo	organizationally defined information, 8.6.1.5
LLDP MIB Notifications		
	lldpV2RemTablesChange	

11.3 Relationship to other MIBs

This clause, Annex E , and Annex F include specifications for an LLDP Textual Conventions MIB module, an LLDP MIB module, and for IEEE 802.1 and IEEE 802.3 extension MIB modules that are compliant with the SMIv2 as defined in IETF STD 58, RFC 2578 [B11]; IETF STD 58, RFC 2579 [B12]; and IETF STD 58, RFC 2580 [B13].

LLDP is designed to operate in conjunction with MIB modules defined by the IETF, IEEE 802, and others. The following subclauses discuss the relationship between LLDP and IETF MIB modules. LLDP agents automatically notify the managers of these MIB modules whenever there is a value or status change in an LLDP MIB object.

LLDP managed objects for the local system are stored in the LLDP local system MIB. Information received from a remote LLDP agent is stored in the local LLDP agent’s LLDP remote system MIB.

NOTE—In this standard, managed objects for an LLDP MIB module are defined as they would be for an SNMP MIB. However, it is not required for LLDP implementations to support SNMP to store and retrieve system data. LLDP agents need to have a place to store both information about the local system and information they have received about remote systems. No particular implementation is implied.

11.3.1 Relationship to LLDP Version 1 MIB

The version 1 MIB module that was published in the initial 2005 publication of this standard has been superseded by the version 2 MIB module specified in 11.5.1, and support of the version 2 module is a requirement for conformance to the required or optional capabilities (Clause 5) in this revision of the standard. The version 2 MIB module reflects changes in indexation of the MIB objects that support the use of LLDP with multiple destination MAC addresses, as discussed in Clause 6.

In addition to the changes in indexation, the version 2 MIB module also supports changes to the management of the LLDP protocol that have resulted from changes to the LLDP protocol state machines. As these protocol changes affect only the timing and frequency of transmission of LLDPDUs, and not the content of the LLDPDUs, version 1 and version 2 implementations can successfully co-exist and interoperate.

From the perspective of a version 2 implementation, a version 1 neighbor behaves as a version 2 neighbor that is only using a single destination MAC address (the 01-80-C2-00-00-0E address specified for use in the IEEE 802.1AB-2005 version of the standard). From the perspective of a version 1 implementation, a version 2 neighbor that uses the 01-80-C2-00-00-0E destination MAC address behaves as a version 1 neighbor.

11.3.2 IETF Physical Topology MIB

The IETF Physical Topology (PTOPO) MIB (IETF RFC 2922 [B14]) allows a LLDP agent to expose learned physical topology information, using an IETF MIB. LLDP is intended to support the PTOPO MIB.

NOTE—The LLDP MIB module is a logical superset of the IETF PTOPO MIB, and therefore, from a functional point of view, if the LLDP MIB module is implemented, it is likely not to be necessary to implement the PTOPO MIB defined in IETF RFC 2922 [B14]. However, for backward compatibility, this standard also supports the use of the PTOPO MIB.

11.3.3 IETF Entity MIB

The Entity MIB (IETF RFC 4133) allows the physical component inventory and hierarchy to be identified. Chassis IDs passed in the LLDPDU can identify entPhysicalTable entries. SNMP agents that implement the LLDP MIB should implement the entPhysicalAlias object from the Entity MIB version 2 or higher.

11.3.4 IETF Interfaces MIB

The Interfaces MIB (IETF RFC 2863) provides a standard mechanism for managing network ports. Port IDs passed in the LLDPDU can identify ifTable (or entPhysicalTable) entries. SNMP agents that implement the LLDP MIB shall also implement the ifTable and ifXTable for the ports that are represented in the Interfaces MIB.

11.4 Security considerations for LLDP base MIB module

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write[9]. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

a) Setting the following objects to incorrect values can result in an excessive number of LLDP packets being sent by the LLDP agent:
    1) lldpV2MessageTxInterval

[9] In IETF MIB definitions, the MAX-ACCESS clause defines the type of access that is allowed for particular data elements in the MIB. An explanation of the MAX-ACCESS mappings is given in section 7.3 of IETF RFC 2578 [B11].

    2) lldpV2TxCreditMax
    3) lldpV2MessageFastTx
    4) lldpV2TxFastInit

b) Setting the object, lldpV2MessageTxHoldMultiplier, to incorrect values can cause the LLDP agent to transmit LLDPDUs with too-high TTL values, which affect the expiration time of objects grouped under lldpV2RemoteSystemsData identifier.

c) Setting the object, lldpV2ReinitDelay, to too low a value can cause the transmit state machine to attempt excessive re-initializations.

d) Setting incorrect bits in the object, lldpV2PortConfigTLVsTxEnable, can cause the LLDP agent to transmit LLDPDUs with an undesired optional TLV sequence.

e) Setting incorrect bits in the object, lldpV2ConfigManAddrPortsTxEnable, can cause the LLDP agent to advertise management addresses that were not meant to be disclosed and/or to omit addresses that were desired.

f) Setting the following objects to incorrect values can result in improper operation of the MIB notification process:
    1) llldpV2NotificationInterval
    2) lldpV2PortConfigNotificationEnable

g) Setting the object, lldpV2PortConfigAdminStatus, to the incorrect value can result in enabling a non-desired operational mode.

The following readable objects in this MIB module may be considered to be sensitive or vulnerable in some network environments:

h) Objects that are associated with the transmit mode
    1) lldpV2LocChassisIdSubtype
    2) lldpV2LocChassisId
    3) lldpV2LocPortIdSubtype
    4) lldpV2LocPortId
    5) lldpV2LocPortDesc
    6) lldpV2LocSysName
    7) lldpV2LocSysDesc
    8) lldpV2LocSysCapSupported
    9) lldpV2LocSysCapEnabled
    10) lldpV2LocManAddrLen
    11) lldpV2LocManAddrIfSubtype
    12) lldpV2LocManAddrIfId
    13) lldpV2LocManAddrOID

i) Objects that are associated with the receive mode
    1) lldpV2NotificationInterval
    2) lldpV2PortConfigNotificationEnable
    3) lldpV2RemChassisIdSubtype
    4) lldpV2RemChassisId
    5) lldpV2RemPortIdSubtyp
    6) lldpV2RemPortId
    7) lldpV2RemPortDesc
    8) lldpV2RemSysName
    9) lldpV2RemSysDesc
    10) lldpV2RemSysCapSupported
    11) lldpV2RemSysCapEnabled
    12) lldpV2RemManAddrIfSubtype
    13) lldpV2RemManAddrIfId
    14) lldpV2RemManAddrOID
    15) lldpV2RemUnknownTLVInfo
    16) lldpV2RemOrgDefInfo

This concern applies both to objects that describe the configuration of the local host, as well as for objects that describe information from the remote hosts, acquired via LLDP and displayed by the objects in this MIB module. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

Implementers should consider the security features as provided by the SNMPv3 framework (see IETF RFC 3410, section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, implementers should not deploy SNMP versions prior to SNMPv3. Instead**,** implementers should deploy SNMPv3 to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

11.5 LLDP MIB modules [10,11]

Two MIB modules are defined—a textual conventions MIB (11.5.1) that contains the textual conventions used by the LLDP version 2 MIB and by the version 2 extension MIBs in Annex and Annex , and the LLDP version 2 MIB module itself (11.5.2).

11.5.1 Definitions for the LLDP-V2-TC MIB module

In the following MIB module, should any discrepancy between the DESCRIPTION text and the corresponding definition in Clause 9 and Clause 10 occur, the definition in Clause 9 and Clause 10 shall take precedence.

```
LLDP-V2-TC-MIB DEFINITIONS ::= BEGIN
IMPORTS
    MODULE-IDENTITY,
    Unsigned32,
    org
        FROM SNMPv2-SMI
    TEXTUAL-CONVENTION
        FROM SNMPv2-TC;

lldpV2TcMIB MODULE-IDENTITY
    LAST-UPDATED "200906080000Z" -- June 08, 2009
-- <<Editor's Note: Date will need updating before publication>>
    ORGANIZATION "IEEE 802.1 Working Group"
    CONTACT-INFO
            "WG-URL: http://grouper.ieee.org/groups/802/1/index.html
             WG-EMail: STDS-802-1-L@LISTSERV.IEEE.ORG

             Contact: Tony Jeffree
             Postal:  11a Poplar Grove
```

[10] *Copyright release for MIBs:* Users of this standard may freely reproduce the MIB contained in this subclause so that it can be used for its intended purpose.

[11] An ASCII version of this MIB module can be obtained by Web browser from the IEEE 802.1 Website at http://www.ieee802.org/1/pages/MIBS.html.

```
                    Sale
                    Cheshire M33 3AX
                    UK
             Tel:   +44-161-973-4278
             E-mail: tony@jeffree.co.uk"
    DESCRIPTION
            "Textual conventions used throughout the IEEE Std 802.1AB
            version 2 and later MIB modules.

            Unless otherwise indicated, the references in this
            MIB module are to IEEE 802.1AB-2009.

            The TCs in this MIB are taken from the original LLDP-MIB,
            LLDP-EXT-DOT1-MIB, and LLDP-EXT-DOT3-MIB published in
            IEEE Std 802-1D-2005, with the addition of TCs to support
            the management address table. They have been made available
            as a separate TC MIB module to facilitate referencing from
            other MIB modules.

            Copyright (C) IEEE (2009). This version of this MIB module
            is published as subclause 11.5.1 of IEEE Std 802.1AB-2009;
            see the standard itself for full legal notices."

    REVISION "200906080000Z" -- June 08, 2009


    DESCRIPTION
            "Published as part of IEEE Std 802.1AB-2009 revision."

   ::= { org ieee(111) standards-association-numbers-series-standards(2)
         lan-man-stds(802) ieee802dot1(1) 1 12 }

--
-- Definition of the root OID arc for IEEE 802.1 MIBs
--

ieee802dot1mibs OBJECT IDENTIFIER
    ::= { org ieee(111) standards-association-numbers-series-standards(2)
          lan-man-stds(802) ieee802dot1(1) 1 }

--
-- ***********************************************************
--
-- Textual Conventions
--
-- ***********************************************************

LldpV2ChassisIdSubtype ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
            "This TC describes the source of a chassis identifier.

            The enumeration 'chassisComponent(1)' represents a chassis
            identifier based on the value of entPhysicalAlias object
            (defined in IETF RFC 4133) for a chassis component (i.e.,
            an entPhysicalClass value of 'chassis(3)').

            The enumeration 'interfaceAlias(2)' represents a chassis
            identifier based on the value of ifAlias object (defined in
            IETF RFC 2863) for an interface on the containing chassis.

            The enumeration 'portComponent(3)' represents a chassis
            identifier based on the value of entPhysicalAlias object
            (defined in IETF RFC 4133) for a port or backplane
            component (i.e., entPhysicalClass value of 'port(10)' or
            'backplane(4)'), within the containing chassis.

            The enumeration 'macAddress(4)' represents a chassis
            identifier based on the value of a unicast source address
            (encoded in network byte order and IEEE 802.3 canonical bit
            order), of a port on the containing chassis as defined in
            IEEE Std 802.

            The enumeration 'networkAddress(5)' represents a chassis
            identifier based on a network address, associated with
            a particular chassis. The encoded address is actually
            composed of two fields. The first field is a single octet,
            representing the IANA AddressFamilyNumbers value for the
            specific address type, and the second field is the network
            address value.

            The enumeration 'interfaceName(6)' represents a chassis
            identifier based on the value of ifName object (defined in
            IETF RFC 2863) for an interface on the containing chassis.

            The enumeration 'local(7)' represents a chassis identifier
            based on a locally defined value."
    SYNTAX  INTEGER {
            chassisComponent(1),
            interfaceAlias(2),
            portComponent(3),
            macAddress(4),
            networkAddress(5),
            interfaceName(6),
            local(7)
    }

LldpV2ChassisId ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "1x:"
    STATUS      current
    DESCRIPTION
            "This TC describes the format of a chassis identifier string.
            Objects of this type are always used with an associated
            LldpChassisIdSubtype object, which identifies the format of
            the particular LldpChassisId object instance.

            If the associated LldpChassisIdSubtype object has a value of
            'chassisComponent(1)', then the octet string identifies
            a particular instance of the entPhysicalAlias object
            (defined in IETF RFC 4133) for a chassis component (i.e.,
            an entPhysicalClass value of 'chassis(3)').

            If the associated LldpChassisIdSubtype object has a value
            of 'interfaceAlias(2)', then the octet string identifies
            a particular instance of the ifAlias object (defined in
            IETF RFC 2863) for an interface on the containing chassis.
            If the particular ifAlias object does not contain any values,
            another chassis identifier type should be used.
            If the associated LldpChassisIdSubtype object has a value
            of 'portComponent(3)', then the octet string identifies a
            particular instance of the entPhysicalAlias object (defined
            in IETF RFC 4133) for a port or backplane component within
            the containing chassis.

            If the associated LldpChassisIdSubtype object has a value of
            'macAddress(4)', then this string identifies a particular
            unicast source address (encoded in network byte order and
            IEEE 802.3 canonical bit order), of a port on the containing
            chassis as defined in IEEE Std 802.

            If the associated LldpChassisIdSubtype object has a value of
            'networkAddress(5)', then this string identifies a particular
            network address, encoded in network byte order, associated
            with one or more ports on the containing chassis. The first
            octet contains the IANA Address Family Numbers enumeration
            value for the specific address type, and octets 2 through
            N contain the network address value in network byte order.

            If the associated LldpChassisIdSubtype object has a value
            of 'interfaceName(6)', then the octet string identifies
            a particular instance of the ifName object (defined in
            IETF RFC 2863) for an interface on the containing chassis.
            If the particular ifName object does not contain any values,
            another chassis identifier type should be used.

            If the associated LldpChassisIdSubtype object has a value of
            'local(7)', then this string identifies a locally assigned
            Chassis ID."
    SYNTAX      OCTET STRING (SIZE (1..255))

LldpV2PortIdSubtype ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
            "This TC describes the source of a particular type of port
            identifier used in the LLDP MIB.

            The enumeration 'interfaceAlias(1)' represents a port
            identifier based on the ifAlias MIB object, defined in IETF
            RFC 2863.

            The enumeration 'portComponent(2)' represents a port
            identifier based on the value of entPhysicalAlias (defined in
            IETF RFC 4133) for a port component (i.e., entPhysicalClass
            value of 'port(10)'), within the containing chassis.

            The enumeration 'macAddress(3)' represents a port identifier
            based on a unicast source address (encoded in network
            byte order and IEEE 802.3 canonical bit order), which has
            been detected by the agent and associated with a particular
            port (IEEE Std 802).

            The enumeration 'networkAddress(4)' represents a port
            identifier based on a network address, detected by the agent
            and associated with a particular port.

            The enumeration 'interfaceName(5)' represents a port
            identifier based on the ifName MIB object, defined in IETF
            RFC 2863.

            The enumeration 'agentCircuitId(6)' represents a port
            identifier based on the agent-local identifier of the circuit
            (defined in RFC 3046), detected by the agent and associated
            with a particular port.

            The enumeration 'local(7)' represents a port identifier
            based on a value locally assigned."

    SYNTAX  INTEGER {
            interfaceAlias(1),
            portComponent(2),
            macAddress(3),
            networkAddress(4),
            interfaceName(5),
            agentCircuitId(6),
            local(7)
    }

LldpV2PortId ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "1x:"
    STATUS      current
    DESCRIPTION
            "This TC describes the format of a port identifier string.
            Objects of this type are always used with an associated
            LldpPortIdSubtype object, which identifies the format of the
            particular LldpPortId object instance.

            If the associated LldpPortIdSubtype object has a value of
            'interfaceAlias(1)', then the octet string identifies a
            particular instance of the ifAlias object (defined in IETF
            RFC 2863). If the particular ifAlias object does not contain
            any values, another port identifier type should be used.

            If the associated LldpPortIdSubtype object has a value of
            'portComponent(2)', then the octet string identifies a
            particular instance of the entPhysicalAlias object (defined
            in IETF RFC 4133) for a port or backplane component.

            If the associated LldpPortIdSubtype object has a value of
            'macAddress(3)', then this string identifies a particular
            unicast source address (encoded in network byte order
            and IEEE 802.3 canonical bit order) associated with the port
            (IEEE Std 802).

            If the associated LldpPortIdSubtype object has a value of
            'networkAddress(4)', then this string identifies a network
            address associated with the port. The first octet contains
            the IANA AddressFamilyNumbers enumeration value for the
            specific address type, and octets 2 through N contain the
            networkAddress address value in network byte order.

            If the associated LldpPortIdSubtype object has a value of
            'interfaceName(5)', then the octet string identifies a
            particular instance of the ifName object (defined in IETF
            RFC 2863). If the particular ifName object does not contain
            any values, another port identifier type should be used.
            If the associated LldpPortIdSubtype object has a value of
            'agentCircuitId(6)', then this string identifies a agent-local
            identifier of the circuit (defined in RFC 3046).

            If the associated LldpPortIdSubtype object has a value of
            'local(7)', then this string identifies a locally
            assigned port ID."
    SYNTAX      OCTET STRING (SIZE (1..255))

LldpV2ManAddrIfSubtype ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
            "This TC defines an enumeration value that identifies
            the interface numbering method used for defining the
            interface number associated with a management address.
            An object with this syntax defines the format of an
            interface number object.

            The enumeration 'unknown(1)' represents the case where the
            interface is not known. In this case, the corresponding
            interface number is of zero length.

            The enumeration 'ifIndex(2)' represents interface identifier
            based on the ifIndex MIB object.

            The enumeration 'systemPortNumber(3)' represents interface
            identifier based on the system port numbering convention."
    REFERENCE
            "8.5.9.5"

    SYNTAX  INTEGER {
            unknown(1),
            ifIndex(2),
            systemPortNumber(3)
    }

LldpV2ManAddress ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "1x:"
    STATUS      current
    DESCRIPTION
            "The value of a management address associated with the LLDP
            agent that may be used to reach higher layer entities to
            assist discovery by network management.

            It should be noted that appropriate security credentials,
            such as SNMP engineId, may be required to access the LLDP
            agent using a management address. These necessary credentials
            should be known by the network management and the objects
            associated with the credentials are not included in the
            LLDP agent."
    SYNTAX      OCTET STRING (SIZE (1..31))

LldpV2SystemCapabilitiesMap ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
            "This TC describes the system capabilities.

            The bit 'other(0)' indicates that the system has capabilities
            other than those listed below.

            The bit 'repeater(1)' indicates that the system has repeater
            capability.

            The bit 'bridge(2)' indicates that the system has bridge
            capability.

            The bit 'wlanAccessPoint(3)' indicates that the system has
            WLAN access point capability.

            The bit 'router(4)' indicates that the system has router
            capability.

            The bit 'telephone(5)' indicates that the system has telephone
            capability.

            The bit 'docsisCableDevice(6)' indicates that the system has
            DOCSIS Cable Device capability (IETF RFC 4639 & 2670).

            The bit 'stationOnly(7)' indicates that the system has only
            station capability and nothing else.

            The bit 'cVLANComponent(8)' indicates that the system has
            C-VLAN component functionality.

            The bit 'sVLANComponent(8)' indicates that the system  has
            S-VLAN component functionality.

            The bit 'twoPortMACRelay(10)' indicates that the system has
            Two-port MAC Relay (TPMR) functionality."
    SYNTAX  BITS {
            other(0),
            repeater(1),
            bridge(2),
            wlanAccessPoint(3),
            router(4),
            telephone(5),
            docsisCableDevice(6),
            stationOnly(7),
            cVLANComponent(8),
            sVLANComponent(9),
            twoPortMACRelay(10)

    }


LldpV2DestAddressTableIndex ::= TEXTUAL-CONVENTION
    DISPLAY-HINT "d"
    STATUS    current
    DESCRIPTION
            "An index value, used as the index to the table of destination
            MAC addresses used both as the destination addresses on
            transmitted LLDPDUs and on received LLDPDUs. This index value
            is also used as a secondary index value in tables indexed
            by fields of type  ifIndex, in order to associate
            a destination address with each row of the table."
    SYNTAX  Unsigned32(1..4096)
```

```
LldpV2LinkAggStatusMap ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
            "This TC describes the link aggregation status.

            The bit 'aggCapable(0)' indicates the link is capable of being
            aggregated.

            The bit 'aggEnabled(1)' indicates the link is currently in
            aggregation."
    SYNTAX  BITS {
            aggCapable(0),
            aggEnabled(1)
    }

LldpV2PowerPortClass ::= TEXTUAL-CONVENTION
    STATUS      current
    DESCRIPTION
            "This TC describes the Power over Ethernet (PoE) port class."
    SYNTAX  INTEGER {
            pClassPSE(1),
            pClassPD(2)
    }

END
```

11.5.2 LLDP MIB module - version 2

In the following MIB module, should any discrepancy between the DESCRIPTION text and the corresponding definition in Clause 9 and Clause 10 occur, the definition in Clause 9 and Clause 10 shall take precedence.

```
LLDP-V2-MIB DEFINITIONS ::= BEGIN
IMPORTS
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Unsigned32,
    Counter32,
    NOTIFICATION-TYPE
        FROM SNMPv2-SMI
    TimeStamp,
    TruthValue,
    MacAddress,
    RowStatus
        FROM SNMPv2-TC
    SnmpAdminString
        FROM SNMP-FRAMEWORK-MIB
    MODULE-COMPLIANCE,
    OBJECT-GROUP,
    NOTIFICATION-GROUP
        FROM SNMPv2-CONF
    TimeFilter,
    ZeroBasedCounter32
        FROM RMON2-MIB
    AddressFamilyNumbers
        FROM IANA-ADDRESS-FAMILY-NUMBERS-MIB
    ifGeneralInformationGroup,
    InterfaceIndex
        FROM IF-MIB
    LldpV2ChassisIdSubtype,
    LldpV2ChassisId,
    LldpV2PortIdSubtype,
    LldpV2PortId,
    LldpV2ManAddrIfSubtype,
    LldpV2ManAddress,
    LldpV2SystemCapabilitiesMap,
    LldpV2DestAddressTableIndex,
    ieee802dot1mibs
        FROM LLDP-V2-TC-MIB;

lldpV2MIB MODULE-IDENTITY
    LAST-UPDATED "200906080000Z" -- June 08, 2009
    ORGANIZATION "IEEE 802.1 Working Group"
    CONTACT-INFO
            "WG-URL: http://grouper.ieee.org/groups/802/1/index.html
             WG-EMail: stds-802-1@ieee.org

            Contact: Tony Jeffree
            Postal:  11a Poplar Grove
                     Sale
                     Cheshire M33 3AX
                     UK
            Tel:     +44-161-973-4278
            E-mail:  tony@jeffree.co.uk"
    DESCRIPTION
            "Management Information Base module for LLDP configuration,
            statistics, local system data and remote systems data
            components.

            This MIB module supports the architecture described in
            Clause 6, where multiple LLDP agents can be associated with
            a single Port, each supporting transmission by means of a
            different MAC address.

            Unless otherwise indicated, the references in this
            MIB module are to IEEE 802.1AB-2009.

            Copyright (C) IEEE (2009). This version of this MIB module
            is published as subclause 11.5.2 of IEEE Std 802.1AB-2009;
            see the standard itself for full legal notices."

    REVISION "200906080000Z" -- June 08, 2009

    DESCRIPTION
            "Published as part of IEEE Std 802.1AB-2009 revision.
            This revision incorporated changes to the MIB to
            support the use of LLDP with multiple destination MAC
            addresses."

   ::= { ieee802dot1mibs 13 }

lldpV2Notifications           OBJECT IDENTIFIER ::= { lldpV2MIB 0 }
lldpV2Objects                 OBJECT IDENTIFIER ::= { lldpV2MIB 1 }
lldpV2Conformance             OBJECT IDENTIFIER ::= { lldpV2MIB 2 }

--
-- LLDP MIB Objects
--

lldpV2Configuration           OBJECT IDENTIFIER ::= { lldpV2Objects 1 }
lldpV2Statistics              OBJECT IDENTIFIER ::= { lldpV2Objects 2 }
lldpV2LocalSystemData         OBJECT IDENTIFIER ::= { lldpV2Objects 3 }
lldpV2RemoteSystemsData       OBJECT IDENTIFIER ::= { lldpV2Objects 4 }
lldpV2Extensions              OBJECT IDENTIFIER ::= { lldpV2Objects 5 }

--
-- ***********************************************************
--
--                  L L D P   C O N F I G
--
-- ***********************************************************
--

lldpV2MessageTxInterval OBJECT-TYPE
    SYNTAX      Unsigned32(5..32768)
    UNITS       "seconds"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
            "The interval at which LLDP frames are transmitted on
            behalf of this LLDP agent.

            The default value for lldpV2MessageTxInterval object is
            30 seconds.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    REFERENCE
            "9.2.5.7"
    DEFVAL     { 30 }
    ::= { lldpV2Configuration 1 }

lldpV2MessageTxHoldMultiplier OBJECT-TYPE
    SYNTAX      Unsigned32(2..10)
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
            "The time-to-live value expressed as a multiple of the
            lldpV2MessageTxInterval object. The actual time-to-live value
            used in LLDP frames, transmitted on behalf of this LLDP agent,
            can be expressed by the following formula: TTL = min(65535,
            (lldpV2MessageTxInterval * lldpV2MessageTxHoldMultiplier)) For
            example, if the value of lldpV2MessageTxInterval is '30', and
            the value of lldpV2MessageTxHoldMultiplier is '4', then the
            value '120' is encoded in the TTL field in the LLDP header.

            The default value for lldpV2MessageTxHoldMultiplier object is 4.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    REFERENCE
            "9.2.5.6"
    DEFVAL      { 4 }
    ::= { lldpV2Configuration 2 }

lldpV2ReinitDelay OBJECT-TYPE
    SYNTAX      Unsigned32(1..10)
    UNITS       "seconds"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
            "The lldpV2ReinitDelay indicates the delay (in units of
            seconds) from when lldpPortConfigAdminStatus object of a
            particular port becomes 'disabled' until re-initialization
            is attempted.

            The default value for lldpV2ReinitDelay is two seconds.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    REFERENCE
            "9.2.5.10"
    DEFVAL      { 2 }
    ::= { lldpV2Configuration 3 }

lldpV2NotificationInterval OBJECT-TYPE
    SYNTAX      Unsigned32(5..3600)
    UNITS       "seconds"
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
            "This object controls the interval between transmission of
            LLDP notifications during normal transmission periods.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    DEFVAL { 30 }
    ::= { lldpV2Configuration 4 }

lldpV2TxCreditMax OBJECT-TYPE
    SYNTAX Unsigned32(1..100)
    UNITS "PDUs"
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
            "The maximum number of consecutive LLDPDUs that can be
            transmitted at any time.

            The default value for lldpV2TxCreditMax object is 5 PDUs.
            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    REFERENCE
            "9.2.5.17"
    DEFVAL { 5 }
    ::= { lldpV2Configuration 5 }

lldpV2MessageFastTx OBJECT-TYPE
    SYNTAX Unsigned32(1..3600)
    UNITS "seconds"
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
                "The interval at which LLDP frames are transmitted on
                behalf of this LLDP agent during fast transmission period
                (e.g. when a new neighbor is detected).
                The default value for lldpV2MessageFastTx object is
                1 second.
                The value of this object is restored from non-volatile
                storage after a re-initialization of the management system."
    REFERENCE
            "9.2.5.5"
    DEFVAL { 1 }
    ::= { lldpV2Configuration 6 }

lldpV2TxFastInit OBJECT-TYPE
    SYNTAX Unsigned32(1..8)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
                "The initial value used to initialize the txFast variable
                which determines the number of transmissions that are
                made in fast transmission mode.
                The default value for lldpV2TxFastInit object is
                4.
                The value of this object is restored from non-volatile
                storage after a re-initialization of the management system."
    REFERENCE
            "9.2.5.19"
    DEFVAL { 4 }
    ::= { lldpV2Configuration 7 }
--
```

```
-- lldpV2PortConfigTable: LLDP configuration indexed on a per port,
-- per destination address basis. The  ifIndex, coupled with an index into
-- the lldpDestAddressTable, is used to index per port per
-- destination MAC address.
--

lldpV2PortConfigTable   OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2PortConfigEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The table that controls LLDP frame transmission on individual
            ports and using particular destination MAC addresses."
    ::= { lldpV2Configuration 8 }

lldpV2PortConfigEntry   OBJECT-TYPE
    SYNTAX      LldpV2PortConfigEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "LLDP configuration information for a particular port and
            destination MAC address.

            This configuration parameter controls the transmission and
            the reception of LLDP frames on those interface/address
            combinations whose rows are created in this table.

            Rows in this table can only be created for MAC addresses
            that can validly be used in association with the type of
            interface concerned, as defined by table 8-2.

            The contents of this table is persistent across
            re-initializations or re-boots."
     INDEX  { lldpV2PortConfigIfIndex,
              lldpV2PortConfigDestAddressIndex  }
    ::= { lldpV2PortConfigTable 1 }

LldpV2PortConfigEntry ::= SEQUENCE {
      lldpV2PortConfigIfIndex             InterfaceIndex,
      lldpV2PortConfigDestAddressIndex    LldpV2DestAddressTableIndex,
      lldpV2PortConfigAdminStatus         INTEGER,
      lldpV2PortConfigNotificationEnable  TruthValue,
      lldpV2PortConfigTLVsTxEnable        BITS }

lldpV2PortConfigIfIndex   OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The interface index value used to identify the port
            associated with this entry. Its value is an index into
            the interfaces MIB.

            The value of this object is used as an index to the
            lldpV2PortConfigTable."
    ::= { lldpV2PortConfigEntry 1 }

lldpV2PortConfigDestAddressIndex   OBJECT-TYPE
    SYNTAX      LldpV2DestAddressTableIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The index value used to identify the destination
            MAC address associated with this entry. Its value identifies
            the row in the lldpV2DestAddressTable where the MAC address
            can be found.

            The value of this object is used as an index to the
            lldpV2PortConfigTable."
    ::= { lldpV2PortConfigEntry 2 }

lldpV2PortConfigAdminStatus  OBJECT-TYPE
    SYNTAX INTEGER {
       txOnly(1),
       rxOnly(2),
       txAndRx(3),
       disabled(4)
    }
    MAX-ACCESS read-write
    STATUS     current
    DESCRIPTION
            "The administratively desired status of the local LLDP agent.

            If the associated lldpV2PortConfigAdminStatus object is
            set to a value of 'txOnly(1)', then LLDP agent transmits
            LLDPframes on this port and it does not store any
            information about the remote systems connected.

            If the associated lldpV2PortConfigAdminStatus object is
            set to a value of 'rxOnly(2)', then the LLDP agent
            receives, but it does not transmit LLDP frames on this port.

            If the associated lldpV2PortConfigAdminStatus object is set
            to a value of 'txAndRx(3)', then the LLDP agent transmits
            and receives LLDP frames on this port.

            If the associated lldpV2PortConfigAdminStatus object is set
            to a value of 'disabled(4)', then LLDP agent does not
            transmit or receive LLDP frames on this port. If there is
            remote systems information which is received on this port
            and stored in other tables, before the port's
            lldpV2PortConfigAdminStatus becomes disabled, then that
            information is deleted."
    REFERENCE
            "9.2.5.1"
    DEFVAL  { txAndRx }
   ::= { lldpV2PortConfigEntry 3 }

lldpV2PortConfigNotificationEnable OBJECT-TYPE
    SYNTAX     TruthValue
    MAX-ACCESS read-write
    STATUS     current
    DESCRIPTION
            "The lldpV2PortConfigNotificationEnable controls, on a per
            agent basis, whether or not notifications from the agent
            are enabled. The value true(1) means that notifications are
            enabled; the value false(2) means that they are not."
    DEFVAL  { false }
   ::= { lldpV2PortConfigEntry 4 }

lldpV2PortConfigTLVsTxEnable OBJECT-TYPE
    SYNTAX      BITS {
            portDesc(0),
            sysName(1),
            sysDesc(2),
            sysCap(3)
    }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
            "The lldpV2PortConfigTLVsTxEnable, defined as a bitmap,
            includes the basic set of LLDP TLVs whose transmission is
            allowed on the local LLDP agent by the network management.
            Each bit in the bitmap corresponds to a TLV type associated
            with a specific optional TLV.

            It should be noted that the organizationally-specific TLVs
            are excluded from the lldpV2PortConfigTLVsTxEnable bitmap.

            LLDP Organization Specific Information Extension MIBs should
            have similar configuration object to control transmission
            of their organizationally defined TLVs.

            The bit 'portDesc(0)' indicates that LLDP agent should
            transmit 'Port Description TLV'.

            The bit 'sysName(1)' indicates that LLDP agent should transmit
            'System Name TLV'.

            The bit 'sysDesc(2)' indicates that LLDP agent should transmit
            'System Description TLV'.

            The bit 'sysCap(3)' indicates that LLDP agent should transmit
            'System Capabilities TLV'.

            There is no bit reserved for the management address TLV type
            since transmission of management address TLVs are controlled
            by another object, lldpV2ConfigManAddrTable.

            The default value for lldpV2PortConfigTLVsTxEnable object is
            empty set, which means no enumerated values are set.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    REFERENCE
            "9.1.2.1"
    DEFVAL  { { } }
    ::= { lldpV2PortConfigEntry 5 }


--
-- lldpV2DestAddressTable: Destination MAC addresses used by LLDP
--

lldpV2DestAddressTable   OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2DestAddressTableEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The table that contains the set of MAC addresses used
            by LLDP for transmission and reception of LLDPDUs."
    ::= { lldpV2Configuration 9 }

lldpV2DestAddressTableEntry   OBJECT-TYPE
    SYNTAX      LldpV2DestAddressTableEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Destination MAC address information for LLDP.

            This configuration parameter identifies a MAC address
            corresponding to a LldpV2DestAddressTableIndex value.

            Rows in this table are created as necessary, to support
            MAC addresses needed by other tables in the MIB that
            are indexed by MAC address.

            A given row in this table cannot be deleted if the MAC
            address table index value is in use in any other table
            in the MIB.

            The contents of this table is persistent aacross
            re-initializations or re-boots."
     INDEX  { lldpV2AddressTableIndex  }
    ::= { lldpV2DestAddressTable 1 }

LldpV2DestAddressTableEntry ::= SEQUENCE {
      lldpV2AddressTableIndex      LldpV2DestAddressTableIndex,
      lldpV2DestMacAddress         MacAddress  }

lldpV2AddressTableIndex   OBJECT-TYPE
    SYNTAX      LldpV2DestAddressTableIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The index value used to identify the destination
            MAC address associated with this entry.

            The value of this object is used as an index to the
            lldpV2DestAddressTable."
    ::= { lldpV2DestAddressTableEntry 1 }

lldpV2DestMacAddress   OBJECT-TYPE
    SYNTAX      MacAddress
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The MAC address associated with this entry.

            The octet string identifies an individual or a group
            MAC address that is in use by LLDP as a destination
            MAC address.
            The MAC address is encoded in the octet string in
            canonical format (see IEEE Std 802)."
    ::= { lldpV2DestAddressTableEntry 2 }
```

```
--
-- lldpV2ManAddrConfigTxPortsTable : selection of management addresses
-- to be transmitted on a specified set of port/destination
-- address pairs.
--

lldpV2ManAddrConfigTxPortsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2ManAddrConfigTxPortsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The table that controls selection of LLDP management address
            TLV instances to be transmitted on individual port/
            destination address pairs."
    ::= { lldpV2Configuration 10 }

lldpV2ManAddrConfigTxPortsEntry  OBJECT-TYPE
    SYNTAX      LldpV2ManAddrConfigTxPortsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "LLDP configuration information that specifies the set
            of port/destination address pairs on which the local
            system management address instance is transmitted.

            Each active lldpManAddrConfigTxPortsTableV2Entry is
            restored from non-volatile storage and re-created
            after a re-initialization of the management system."
    INDEX {
            lldpV2ManAddrConfigIfIndex,
            lldpV2ManAddrConfigDestAddressIndex,
            lldpV2ManAddrConfigLocManAddrSubtype,
            lldpV2ManAddrConfigLocManAddr }
    ::= { lldpV2ManAddrConfigTxPortsTable 1 }

LldpV2ManAddrConfigTxPortsEntry  ::= SEQUENCE {
            lldpV2ManAddrConfigIfIndex            InterfaceIndex,
            lldpV2ManAddrConfigDestAddressIndex   LldpV2DestAddressTableIndex,
            lldpV2ManAddrConfigLocManAddrSubtype  AddressFamilyNumbers,
            lldpV2ManAddrConfigLocManAddr         LldpV2ManAddress,
            lldpV2ManAddrConfigTxEnable           TruthValue,
            lldpV2ManAddrConfigRowStatus          RowStatus
}

lldpV2ManAddrConfigIfIndex   OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The interface index value used to identify the port
            associated with this entry. Its value is an index into
            the interfaces MIB.

            The value of this object is used as an index to the
            lldpV2PortConfigTable.
            The value in this column of the table MUST match
            the IfIndex value specified in the BridgePort table."
    ::= { lldpV2ManAddrConfigTxPortsEntry 1 }

lldpV2ManAddrConfigDestAddressIndex   OBJECT-TYPE
    SYNTAX      LldpV2DestAddressTableIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The index value used to identify the destination
            MAC address associated with this entry. Its value identifies
            the row in the lldpV2DestAddressTable where the MAC address
            can be found.

            The value of this object is used as an index to the
            lldpV2PortConfigTable."
    ::= { lldpV2ManAddrConfigTxPortsEntry 2 }


lldpV2ManAddrConfigLocManAddrSubtype  OBJECT-TYPE
    SYNTAX      AddressFamilyNumbers
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The type of management address identifier encoding used in
            the associated 'lldpLocManagmentAddr' object.

            It should be noted that only a subset of the possible
            address encodings enumerated in AddressFamilyNumbers
            are appropriate for use as a LLDP management
            address, either because some are just not apliccable or
            because the maximum size of a LldpV2ManAddress octet string
            would prevent the use of some address identifier encodings."
    REFERENCE
            "8.5.9.3"
    ::= { lldpV2ManAddrConfigTxPortsEntry 3 }

lldpV2ManAddrConfigLocManAddr  OBJECT-TYPE
    SYNTAX      LldpV2ManAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The string value used to identify the management address
            component associated with the local system. The purpose of
            this address is to contact the management entity."
    REFERENCE
            "8.5.9.4"
    ::= { lldpV2ManAddrConfigTxPortsEntry 4 }



lldpV2ManAddrConfigTxEnable  OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-create
    STATUS        current
    DESCRIPTION
            "A boolean controlling the transmission of system
             management address instance for the specified port,
             destination, subtype and MAN address used to index
             this table. If set to the default value of false,
             no transmission occurs. If set to true, the
             appropriate information is transmitted out of the
             port specified in the row's index."
    REFERENCE
            "9.1.2.1"
    DEFVAL  { false }     -- not transmitted
    ::= { lldpV2ManAddrConfigTxPortsEntry 5 }

lldpV2ManAddrConfigRowStatus OBJECT-TYPE
    SYNTAX RowStatus
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "Indicates the status of an entry in this table, and is used
        to create/delete entries.
        The corresponding instances of the following objects
        must be set before this object can be made active(1):
           lldpV2ManAddrConfigDestAddressIndex
           lldpV2ManAddrConfigLocManAddrSubtype
           lldpV2ManAddrConfigLocManAddr
           lldpV2ManAddrConfigTxEnable

        The corresponding instances of the following objects
        may not be changed while this object is active(1):
           lldpV2ManAddrConfigDestAddressIndex
           lldpV2ManAddrConfigLocManAddrSubtype
           lldpV2ManAddrConfigLocManAddr "
::= { lldpV2ManAddrConfigTxPortsEntry 6 }

--
--  ***********************************************************
--
--                   L L D P    S T A T S
--
--  ***********************************************************
--
-- LLDP Stats Group

lldpV2StatsRemTablesLastChangeTime OBJECT-TYPE
    SYNTAX      TimeStamp
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The value of sysUpTime object (defined in IETF RFC 3418)
            at the time an entry is created, modified, or deleted in the
            in tables associated with the lldpV2RemoteSystemsData objects
            and all LLDP extension objects associated with remote systems.

            An NMS can use this object to reduce polling of the
            lldpV2RemoteSystemsData objects."
    ::= { lldpV2Statistics 1 }

lldpV2StatsRemTablesInserts OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    UNITS       "table entries"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The number of times the complete set of information
            advertised by a particular MSAP has been inserted into tables
            contained in lldpV2RemoteSystemsData and lldpV2Extensions objects.

            The complete set of information received from a particular
            MSAP should be inserted into related tables. If partial
            information cannot be inserted for a reason such as lack
            of resources, all of the complete set of information should
            be removed.

            This counter should be incremented only once after the
            complete set of information is successfully recorded
            in all related tables. Any failures during inserting
            information set which result in deletion of previously
            inserted information should not trigger any changes in
            lldpV2StatsRemTablesInserts since the insert is not completed
            yet or in lldpStatsRemTablesDeletes, since the deletion
            would only be a partial deletion. If the failure was the
            result of lack of resources, the lldpStatsRemTablesDrops
            counter should be incremented once."
    ::= { lldpV2Statistics 2 }

lldpV2StatsRemTablesDeletes   OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    UNITS       "table entries"
    MAX-ACCESS  read-only
    STATUS      current

    DESCRIPTION
            "The number of times the complete set of information
            advertised by a particular MSAP has been deleted from
            tables contained in lldpV2RemoteSystemsData and lldpV2Extensions
            objects.

            This counter should be incremented only once when the
            complete set of information is completely deleted from all
            related tables. Partial deletions, such as deletion of
            rows associated with a particular MSAP from some tables,
            but not from all tables are not allowed, thus should not
            change the value of this counter."
    ::= { lldpV2Statistics 3 }

lldpV2StatsRemTablesDrops  OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    UNITS       "table entries"
    MAX-ACCESS  read-only

    STATUS      current
    DESCRIPTION
            "The number of times the complete set of information
            advertised by a particular MSAP could not be entered into
            tables contained in lldpV2RemoteSystemsData and lldpV2Extensions
            objects because of insufficient resources."
    ::= { lldpV2Statistics 4 }

lldpV2StatsRemTablesAgeouts   OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    UNITS       "table entries"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
```

```
            "The number of times the complete set of information
            advertised by a particular MSAP has been deleted from tables
            contained in lldpV2RemoteSystemsData and lldpV2Extensions objects
            because the information timeliness interval has expired.

            This counter should be incremented only once when the complete
            set of information is completely invalidated (aged out)
            from all related tables. Partial ageing, similar to deletion
            case, is not allowed, and thus, should not change the value
            of this counter."
    ::= { lldpV2Statistics 5 }

--
-- TX statistics
-- Indexed by port (via ifIndex) and
-- destination MAC address.
--

lldpV2StatsTxPortTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2StatsTxPortEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "A table containing LLDP transmission statistics for
            individual port/destination address combinations.
            Entries are not required to exist in
            this table while the lldpPortConfigEntry object is equal to
            'disabled(4)'."
    ::= { lldpV2Statistics 6 }

lldpV2StatsTxPortEntry   OBJECT-TYPE
     SYNTAX      LldpV2StatsTxPortEntry
     MAX-ACCESS  not-accessible
     STATUS      current
     DESCRIPTION
             "LLDP frame transmission statistics for a particular port
             and destination MAC address.
             The port is contained in the same chassis as the
             LLDP agent.

             All counter values in a particular entry shall be
             maintained on a continuing basis and shall not be deleted
             upon expiration of rxInfoTTL timing counters in the LLDP
             remote systems MIB of the receipt of a shutdown frame from
             a remote LLDP agent.

             All statistical counters associated with a particular
             port on the local LLDP agent become frozen whenever the
             adminStatus is disabled for the same port.

             Rows in this table can only be created for MAC addresses
             that can validly be used in association with the type of
             interface concerned, as defined by table 8-2."
     INDEX  { lldpV2StatsTxIfIndex,
              lldpV2StatsTxDestMACAddress }
     ::= { lldpV2StatsTxPortTable 1 }

LldpV2StatsTxPortEntry ::= SEQUENCE {
      lldpV2StatsTxIfIndex               InterfaceIndex,
      lldpV2StatsTxDestMACAddress        LldpV2DestAddressTableIndex,
      lldpV2StatsTxPortFramesTotal       Counter32,
      lldpV2StatsTxLLDPDULengthErrors    Counter32  }

lldpV2StatsTxIfIndex   OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The interface index value used to identify the port
            associated with this entry. Its value is an index
            into the interfaces MIB

            The value of this object is used as an index to the
            lldpV2StatsTxPortTable."
    ::= { lldpV2StatsTxPortEntry 1 }

lldpV2StatsTxDestMACAddress   OBJECT-TYPE
    SYNTAX      LldpV2DestAddressTableIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The index value used to identify the destination
            MAC address associated with this entry. Its value identifies
            the row in the lldpV2DestAddressTable where the MAC address
            can be found.

            The value of this object is used as an index to the
            lldpV2StatsTxPortTable."
    ::= { lldpV2StatsTxPortEntry 2 }

lldpV2StatsTxPortFramesTotal  OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "LLDP frames"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
            "The number of LLDP frames transmitted by this LLDP agent
            on the indicated port to the destination MAC address
            associated with this row of the table."
    REFERENCE
            "9.2.6.5"
    ::= { lldpV2StatsTxPortEntry 3 }

lldpV2StatsTxLLDPDULengthErrors  OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "LLDP frames"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
            "The number of LLDPDU Length Errors recorded for the Port."
    REFERENCE
            "9.2.6.8"
    ::= { lldpV2StatsTxPortEntry 4 }



--
-- lldpV2StatsRxPortTable - RX statistics
-- This table is indexed by ifIndex and destination MAC address.
--

lldpV2StatsRxPortTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2StatsRxPortEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "A table containing LLDP reception statistics for individual
            ports and destination MAC addresses.
            Entries are not required to exist in this table while
            the lldpPortConfigEntry object is equal to 'disabled(4)'."
    ::= { lldpV2Statistics 7 }

lldpV2StatsRxPortEntry   OBJECT-TYPE
     SYNTAX      LldpV2StatsRxPortEntry
     MAX-ACCESS  not-accessible
     STATUS      current
     DESCRIPTION
             "LLDP frame reception statistics for a particular port.
             The port is contained in the same chassis as the
             LLDP agent.

             All counter values in a particular entry shall be
             maintained on a continuing basis and shall not be deleted
             upon expiration of rxInfoTTL timing counters in the LLDP
             remote systems MIB of the receipt of a shutdown frame from
             a remote LLDP agent.

             All statistical counters associated with a particular
             port on the local LLDP agent become frozen whenever the
             adminStatus is disabled for the same port.

             Rows in this table can only be created for MAC addresses
             that can validly be used in association with the type of
             interface concerned, as defined by table 8-2.

             The contents of this table is persistent across
             re-initializations or re-boots."
     INDEX  { lldpV2StatsRxDestIfIndex,
              lldpV2StatsRxDestMACAddress }
     ::= { lldpV2StatsRxPortTable 1 }

LldpV2StatsRxPortEntry ::= SEQUENCE {
      lldpV2StatsRxDestIfIndex               InterfaceIndex,
      lldpV2StatsRxDestMACAddress            LldpV2DestAddressTableIndex,
      lldpV2StatsRxPortFramesDiscardedTotal  Counter32,
      lldpV2StatsRxPortFramesErrors          Counter32,
      lldpV2StatsRxPortFramesTotal           Counter32,
      lldpV2StatsRxPortTLVsDiscardedTotal    Counter32,
      lldpV2StatsRxPortTLVsUnrecognizedTotal Counter32,
      lldpV2StatsRxPortAgeoutsTotal          ZeroBasedCounter32
}

lldpV2StatsRxDestIfIndex   OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
```

```
            "The interface index value used to identify the port
            associated with this entry. Its value is an index
            into the interfaces MIB

            The value of this object is used as an index to the
            lldpStatsRxPortV2Table."
    ::= { lldpV2StatsRxPortEntry 1 }

lldpV2StatsRxDestMACAddress   OBJECT-TYPE
    SYNTAX      LldpV2DestAddressTableIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The index value used to identify the destination
            MAC address associated with this entry. Its value identifies
            the row in the lldpV2DestAddressTable where the MAC address
            can be found.

            The value of this object is used as an index to the
            lldpStatsRxPortV2Table."
    ::= { lldpV2StatsRxPortEntry 2 }


lldpV2StatsRxPortFramesDiscardedTotal OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "LLDP frames"
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
            "The number of LLDP frames received by this LLDP agent on
            the indicated port, and then discarded for any reason.
            This counter can provide an indication that LLDP header
            formatting problems may exist with the local LLDP agent in
            the sending system or that LLDPDU validation problems may
            exist with the local LLDP agent in the receiving system."
   REFERENCE
            "9.2.6.2"
   ::= { lldpV2StatsRxPortEntry 3 }

lldpV2StatsRxPortFramesErrors  OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "LLDP frames"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
            "The number of invalid LLDP frames received by this LLDP
            agent on the indicated port, while this LLDP agent is enabled."
    REFERENCE
            "9.2.6.3"
    ::= { lldpV2StatsRxPortEntry 4 }

lldpV2StatsRxPortFramesTotal OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "LLDP frames"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
            "The number of valid LLDP frames received by this LLDP agent
            on the indicated port, while this LLDP agent is enabled."
    REFERENCE
            "9.2.6.4"
    ::= { lldpV2StatsRxPortEntry 5 }

lldpV2StatsRxPortTLVsDiscardedTotal OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "TLVs"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
            "The number of LLDP TLVs discarded for any reason by this LLDP
            agent on the indicated port."
    REFERENCE
            "9.2.6.6"
    ::= { lldpV2StatsRxPortEntry 6 }

lldpV2StatsRxPortTLVsUnrecognizedTotal  OBJECT-TYPE
    SYNTAX        Counter32
    UNITS         "TLVs"
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
            "The number of LLDP TLVs received on the given port that
            are not recognized by this LLDP agent on the indicated port.

            An unrecognized TLV is referred to as the TLV whose type value
            is in the range of reserved TLV types (000 1001 - 111 1110)
            in Table 9.1 of IEEE Std 802.1AB-2004. An unrecognized
            TLV may be a basic management TLV from a later LLDP version."
    REFERENCE
            "9.2.6.7"
    ::= { lldpV2StatsRxPortEntry 7 }

lldpV2StatsRxPortAgeoutsTotal   OBJECT-TYPE
    SYNTAX      ZeroBasedCounter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The counter that represents the number of age-outs that
            occurred on a given port. An age-out is the number of
            times the complete set of information advertised by a
            particular MSAP has been deleted from tables contained in
            lldpV2RemoteSystemsData and lldpV2Extensions objects because
            the information timeliness interval has expired.

            This counter is similar to lldpV2StatsRemTablesAgeouts, except
            that the counter is on a per port basis. This enables NMS to
            poll tables associated with the lldpV2RemoteSystemsData objects
            and all LLDP extension objects associated with remote systems
            on the indicated port only.

            This counter is set to zero during agent initialization
            and its value should not be saved in non-volatile storage.

            This counter is incremented only once when the
            complete set of information is invalidated (aged out) from
            all related tables on a particular port. Partial ageing
            is not allowed."
    REFERENCE
```

```
            "9.2.6.1"
    ::= { lldpV2StatsRxPortEntry 8 }


--  ***********************************************************
--
--          L O C A L    S Y S T E M    D A T A
--
--  ***********************************************************

lldpV2LocChassisIdSubtype  OBJECT-TYPE
    SYNTAX      LldpV2ChassisIdSubtype
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The type of encoding used to identify the chassis
            associated with the local system."
    REFERENCE
            "8.5.2.2"
    ::= { lldpV2LocalSystemData 1 }

lldpV2LocChassisId  OBJECT-TYPE
    SYNTAX      LldpV2ChassisId
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the chassis component
            associated with the local system."
    REFERENCE
            "8.5.2.3"
    ::= { lldpV2LocalSystemData 2 }

lldpV2LocSysName  OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the system name of the
            local system. If the local agent supports IETF RFC 3418,
            lldpLocSysName object should have the same value of sysName
            object."
    REFERENCE
            "8.5.6.2"
    ::= { lldpV2LocalSystemData 3 }

lldpV2LocSysDesc  OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the system description
            of the local system. If the local agent supports IETF RFC 3418,
            lldpLocSysDesc object should have the same value of sysDesc
            object."
    REFERENCE
            "8.5.7.2"
    ::= { lldpV2LocalSystemData 4 }

lldpV2LocSysCapSupported OBJECT-TYPE
```

```
    SYNTAX      LldpV2SystemCapabilitiesMap
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The bitmap value used to identify which system capabilities
            are supported on the local system."
    REFERENCE
            "8.5.8.1"
    ::= { lldpV2LocalSystemData 5 }

lldpV2LocSysCapEnabled  OBJECT-TYPE
    SYNTAX      LldpV2SystemCapabilitiesMap
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The bitmap value used to identify which system capabilities
            are enabled on the local system."
    REFERENCE
            "8.5.8.2"
    ::= { lldpV2LocalSystemData 6 }


--
-- lldpV2LocPortTable : Port specific Local system data
-- Indexed by  ifIndex.
--

lldpV2LocPortTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2LocPortEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per port
            of information associated with the local
            system known to this agent."
    ::= { lldpV2LocalSystemData 7 }

lldpV2LocPortEntry OBJECT-TYPE
    SYNTAX      LldpV2LocPortEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about a particular port component.

            Entries may be created and deleted in this table by the
            agent.

            Rows in this table can only be created for MAC addresses
            that can validly be used in association with the type of
            interface concerned, as defined by table 8-2.

            The contents of this table is persistent across
            re-initializations or re-boots."
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2LocPortTable 1 }

LldpV2LocPortEntry ::= SEQUENCE {
      lldpV2LocPortIfIndex            InterfaceIndex,
      lldpV2LocPortIdSubtype          LldpV2PortIdSubtype,
      lldpV2LocPortId                 LldpV2PortId,
      lldpV2LocPortDesc               SnmpAdminString
}

lldpV2LocPortIfIndex   OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The interface index value used to identify the port
            associated with this entry. Its value is an index
            into the interfaces MIB

            The value of this object is used as an index to the
            lldpV2LocPortTable."
    ::= { lldpV2LocPortEntry 1 }

lldpV2LocPortIdSubtype  OBJECT-TYPE
    SYNTAX      LldpV2PortIdSubtype
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The type of port identifier encoding used in the associated
            'lldpLocPortId' object."
    REFERENCE
            "8.5.3.2"
    ::= { lldpV2LocPortEntry 2 }

lldpV2LocPortId   OBJECT-TYPE
    SYNTAX      LldpV2PortId
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the port component
            associated with a given port in the local system."
    REFERENCE
            "8.5.3.3"
    ::= { lldpV2LocPortEntry 3 }

lldpV2LocPortDesc   OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the IEEE 802 LAN station's port
            description associated with the local system. If the local
            agent supports IETF RFC 2863, lldpLocPortDesc object should
            have the same value of ifDescr object."
    REFERENCE
            "8.5.5.2"
    ::= { lldpV2LocPortEntry 4 }

--
-- lldpV2LocManAddrTable : Management addresses of the local system
--

lldpV2LocManAddrTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2LocManAddrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains management address information on the
            local system known to this agent."
    ::= { lldpV2LocalSystemData 8 }

lldpV2LocManAddrEntry OBJECT-TYPE
    SYNTAX      LldpV2LocManAddrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Management address information about a particular chassis
            component. There may be multiple management addresses
            configured on the system identified by a particular
            lldpLocChassisId. Each management address should have
            distinct 'management address type' (lldpV2LocManAddrSubtype) and
            'management address' (lldpLocManAddr.)

            Entries may be created and deleted in this table by the
            agent.
            Since a variable length octetstring is used as an index
            in a table, the address length is encoded as part of the OID
            (as per IETF RFC 2578)."
    INDEX   { lldpV2LocManAddrSubtype,
              lldpV2LocManAddr }
    ::= { lldpV2LocManAddrTable 1 }

LldpV2LocManAddrEntry ::= SEQUENCE {
      lldpV2LocManAddrSubtype    AddressFamilyNumbers,
      lldpV2LocManAddr           LldpV2ManAddress,
      lldpV2LocManAddrLen        Unsigned32,
      lldpV2LocManAddrIfSubtype  LldpV2ManAddrIfSubtype,
      lldpV2LocManAddrIfId       Unsigned32,
      lldpV2LocManAddrOID        OBJECT IDENTIFIER
}

lldpV2LocManAddrSubtype  OBJECT-TYPE
    SYNTAX      AddressFamilyNumbers
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The type of management address identifier encoding used in
            the associated 'lldpLocManagmentAddr' object.

            It should be noted that only a subset of the possible
            address encodings enumerated in AddressFamilyNumbers
            are appropriate for use as a LLDP management
            address, either because some are just not apliccable or
            because the maximum size of a LldpV2ManAddress octet string
            would prevent the use of some address identifier encodings."
    REFERENCE
            "8.5.9.3"
    ::= { lldpV2LocManAddrEntry 1 }

lldpV2LocManAddr  OBJECT-TYPE
    SYNTAX      LldpV2ManAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
```

```
            "The string value used to identify the management address
            component associated with the local system. The purpose of
            this address is to contact the management entity."
    REFERENCE
            "8.5.9.4"
    ::= { lldpV2LocManAddrEntry 2 }

lldpV2LocManAddrLen  OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The total length of the management address subtype and the
            management address fields in LLDPDUs transmitted by the
            local LLDP agent.

            The management address length field is needed so that the
            receiving systems that do not implement SNMP are not
            required to implement an iana family numbers/address length
            equivalency table in order to decode the management address."
    REFERENCE
            "8.5.9.2"
    ::= { lldpV2LocManAddrEntry 3 }


lldpV2LocManAddrIfSubtype  OBJECT-TYPE
    SYNTAX      LldpV2ManAddrIfSubtype
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The enumeration value that identifies the interface numbering
            method used for defining the interface number
            (lldpV2LocManAddrIfId), associated with the local system."
    REFERENCE
            "8.5.9.5"
    ::= { lldpV2LocManAddrEntry 4 }

lldpV2LocManAddrIfId  OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the interface number
            regarding the management address component associated with
            the local system."
    REFERENCE
            "8.5.9.6"
    ::= { lldpV2LocManAddrEntry 5 }

lldpV2LocManAddrOID  OBJECT-TYPE
    SYNTAX      OBJECT IDENTIFIER
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The OID value used to identify the type of hardware component
            or protocol entity associated with the management address
            advertised by the local system agent."
    REFERENCE
            "8.5.9.8"
    ::= { lldpV2LocManAddrEntry 6 }


--  ***********************************************************
--
--          R E M O T E    S Y S T E M S    D A T A
--
--  ***********************************************************


--
-- lldpV2RemTable
-- Indexed by ifIndex and destination MAC address.
--

lldpV2RemTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2RemEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per physical network
            connection known to this agent. The agent may wish to ensure
            that only one lldpRemEntry is present for each local port
            and destination MAC address,
            or it may choose to maintain multiple lldpRemEntries for
            the same local port and destination MAC address.

            The following procedure may be used to retrieve remote
            systems information updates from an LLDP agent:

               1. NMS polls all tables associated with remote systems
                  and keeps a local copy of the information retrieved.
                  NMS polls periodically the values of the following
                  objects:
                     a. lldpV2StatsRemTablesInserts
                     b. lldpV2StatsRemTablesDeletes
                     c. lldpV2StatsRemTablesDrops
                     d. lldpV2StatsRemTablesAgeouts
                     e. lldpV2StatsRxPortAgeoutsTotal for all ports.

               2. LLDP agent updates remote systems MIB objects, and
                  sends out notifications to a list of notification
                  destinations.

               3. NMS receives the notifications and compares the new
                  values of objects listed in step 1.

                  Periodically, NMS should poll the object
                  lldpV2StatsRemTablesLastChangeTime to find out if anything
                  has changed since the last poll. if something has
                  changed, NMS polls the objects listed in step 1 to
                  figure out what kind of changes occurred in the tables.

                  if value of lldpV2StatsRemTablesInserts has changed,
                  then NMS walks all tables by employing TimeFilter
                  with the last-polled time value. This request
                  returns new objects or objects whose values have been
                  updated since the last poll.
                  if value of lldpV2StatsRemTablesAgeouts has changed,
                  then NMS walks the lldpStatsRxPortAgeoutsTotal and
                  compares the new values with previously recorded ones.
                  For ports whose lldpStatsRxPortAgeoutsTotal value is
                  greater than the recorded value, NMS can
                  retrieve objects associated with those ports from
                  table(s) without employing a TimeFilter (which is
                  performed by specifying 0 for the TimeFilter.)

                  lldpV2StatsRemTablesDeletes and lldpV2StatsRemTablesDrops
                  objects are provided for informational purposes."
    ::= { lldpV2RemoteSystemsData  1 }

lldpV2RemEntry OBJECT-TYPE
    SYNTAX      LldpV2RemEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about a particular physical network connection.
            Entries may be created and deleted in this table by the agent,
            if a physical topology discovery process is active.

            Rows in this table can only be created for MAC addresses
            that can validly be used in association with the type of
            interface concerned, as defined by table 8-2.

            The contents of this table is persistent across
            re-initializations or re-boots."
    INDEX   {
           lldpV2RemTimeMark,
           lldpV2RemLocalIfIndex,
           lldpV2RemLocalDestMACAddress,
           lldpV2RemIndex
    }
    ::= { lldpV2RemTable 1 }

LldpV2RemEntry ::= SEQUENCE {
      lldpV2RemTimeMark              TimeFilter,
      lldpV2RemLocalIfIndex          InterfaceIndex,
      lldpV2RemLocalDestMACAddress   LldpV2DestAddressTableIndex,
      lldpV2RemIndex                 Unsigned32,
      lldpV2RemChassisIdSubtype      LldpV2ChassisIdSubtype,
      lldpV2RemChassisId             LldpV2ChassisId,
      lldpV2RemPortIdSubtype         LldpV2PortIdSubtype,
      lldpV2RemPortId                LldpV2PortId,
      lldpV2RemPortDesc              SnmpAdminString,
      lldpV2RemSysName               SnmpAdminString,
      lldpV2RemSysDesc               SnmpAdminString,
      lldpV2RemSysCapSupported       LldpV2SystemCapabilitiesMap,
      lldpV2RemSysCapEnabled         LldpV2SystemCapabilitiesMap,
      lldpV2RemRemoteChanges        TruthValue,
      lldpV2RemTooManyNeighbors      TruthValue
}

lldpV2RemTimeMark  OBJECT-TYPE
    SYNTAX      TimeFilter
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
```

```
            "A TimeFilter for this entry. See the TimeFilter textual
            convention in IETF RFC 4502 and
            http://www.ietf.org/IESG/Implementations/RFC2021-Implementation.txt
            to see how TimeFilter works."
    REFERENCE
            "IETF RFC 4502 section 6"
    ::= { lldpV2RemEntry 1 }


lldpV2RemLocalIfIndex   OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The interface index value used to identify the port
            associated with this entry. Its value is an index
            into the interfaces MIB

            The value of this object is used as an index to the
            lldpV2RemTable."
    ::= { lldpV2RemEntry 2 }

lldpV2RemLocalDestMACAddress   OBJECT-TYPE
    SYNTAX      LldpV2DestAddressTableIndex
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The index value used to identify the destination
            MAC address associated with this entry. Its value identifies
            the row in the lldpV2DestAddressTable where the MAC address
            can be found.

            The value of this object is used as an index to the
            lldpV2RemTable."
    ::= { lldpV2RemEntry 3 }


lldpV2RemIndex   OBJECT-TYPE
    SYNTAX      Unsigned32(1..2147483647)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This object represents an arbitrary local integer value used
            by this agent to identify a particular connection instance,
            unique only for the indicated remote system.

            An agent is encouraged to assign monotonically increasing
            index values to new entries, starting with one, after each
            reboot. It is considered unlikely that the lldpRemIndex
            can wrap between reboots."
    ::= { lldpV2RemEntry 4 }

lldpV2RemChassisIdSubtype   OBJECT-TYPE
    SYNTAX      LldpV2ChassisIdSubtype
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The type of encoding used to identify the chassis associated
            with the remote system."
    REFERENCE
            "8.5.2.2"
    ::= { lldpV2RemEntry 5 }

lldpV2RemChassisId   OBJECT-TYPE
    SYNTAX      LldpV2ChassisId
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the chassis component
            associated with the remote system."
    REFERENCE
            "8.5.2.3"
    ::= { lldpV2RemEntry 6 }

lldpV2RemPortIdSubtype   OBJECT-TYPE
    SYNTAX      LldpV2PortIdSubtype
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The type of port identifier encoding used in the associated
            'lldpRemPortId' object."
    REFERENCE
            "8.5.3.2"
    ::= { lldpV2RemEntry 7 }

lldpV2RemPortId   OBJECT-TYPE
    SYNTAX      LldpV2PortId
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the port component
            associated with the remote system."
    REFERENCE
            "8.5.3.3"
    ::= { lldpV2RemEntry 8 }

lldpV2RemPortDesc   OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the description of
            the given port associated with the remote system."
    REFERENCE
            "8.5.5.2"
    ::= { lldpV2RemEntry 9 }

lldpV2RemSysName   OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the system name of the
            remote system."
    REFERENCE
            "8.5.6.2"
    ::= { lldpV2RemEntry 10 }
```

```
lldpV2RemSysDesc   OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(0..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the system description
            of the remote system."
    REFERENCE
            "8.5.7.2"
    ::= { lldpV2RemEntry 11 }

lldpV2RemSysCapSupported  OBJECT-TYPE
    SYNTAX      LldpV2SystemCapabilitiesMap
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The bitmap value used to identify which system capabilities
            are supported on the remote system."
    REFERENCE
            "8.5.8.1"
    ::= { lldpV2RemEntry 12 }

lldpV2RemSysCapEnabled   OBJECT-TYPE
    SYNTAX      LldpV2SystemCapabilitiesMap
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The bitmap value used to identify which system capabilities
            are enabled on the remote system."
    REFERENCE
            "8.5.8.2"
    ::= { lldpV2RemEntry 13 }

lldpV2RemRemoteChanges   OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "Indicates that there are chances in the remote systems
            MIB, as determined by the variable remoteChanges."
    REFERENCE
            "9.2.5.11"
    ::= { lldpV2RemEntry 14 }

lldpV2RemTooManyNeighbors   OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "Indicates that there are too many neighbors
             as determined by the variable tooManyNeighbors."
    REFERENCE
            "9.2.5.15"
    ::= { lldpV2RemEntry 15 }

--
-- lldpV2RemManAddrTable : Management addresses of the remote system
-- Version 2 includes additional index values for ifIndex and
-- destination MAC address.
```

```
--

lldpV2RemManAddrTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2RemManAddrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per management address
            information on the remote system learned on a particular port
            contained in the local chassis known to this agent."
    ::= { lldpV2RemoteSystemsData 2 }

lldpV2RemManAddrEntry OBJECT-TYPE
    SYNTAX      LldpV2RemManAddrEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Management address information about a particular chassis
            component. There may be multiple management addresses
            configured on the remote system identified by a particular
            lldpRemIndex whose information is received on
            an interface of the local system and a given destination
            MAC address. Each management
            address should have distinct 'management address
            type' (lldpRemManAddrSubtype) and 'management address'
            (lldpRemManAddr.)

            Entries may be created and deleted in this table by the
            agent.
            Since a variable length octetstring is used as an index
            in a table, theaddress length is encoded as part of the OID
            (as per IETF RFC 2578)."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex,
              lldpV2RemManAddrSubtype,
              lldpV2RemManAddr
 }
    ::= { lldpV2RemManAddrTable 1 }


LldpV2RemManAddrEntry ::= SEQUENCE {
      lldpV2RemManAddrSubtype      AddressFamilyNumbers,
      lldpV2RemManAddr             LldpV2ManAddress,
      lldpV2RemManAddrIfSubtype    LldpV2ManAddrIfSubtype,
      lldpV2RemManAddrIfId         Unsigned32,
      lldpV2RemManAddrOID          OBJECT IDENTIFIER
}

lldpV2RemManAddrSubtype  OBJECT-TYPE
    SYNTAX      AddressFamilyNumbers
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The type of management address identifier encoding used in
            the associated 'lldpRemManagmentAddr' object.

            It should be noted that only a subset of the possible
            address encodings enumerated in AddressFamilyNumbers
            are appropriate for use as a LLDP management
            address, either because some are just not apliccable or
            because the maximum size of a LldpV2ManAddress octet string
            would prevent the use of some address identifier encodings."
    REFERENCE
            "8.5.9.3"
    ::= { lldpV2RemManAddrEntry 1 }

lldpV2RemManAddr  OBJECT-TYPE
    SYNTAX      LldpV2ManAddress
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The string value used to identify the management address
            component associated with the remote system. The purpose
            of this address is to contact the management entity."
    REFERENCE
            "8.5.9.4"
    ::= { lldpV2RemManAddrEntry 2 }

lldpV2RemManAddrIfSubtype  OBJECT-TYPE
    SYNTAX      LldpV2ManAddrIfSubtype
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The enumeration value that identifies the interface numbering
            method used for defining the interface number, associated
            with the remote system."
    REFERENCE
            "8.5.9.5"
    ::= { lldpV2RemManAddrEntry 3 }

lldpV2RemManAddrIfId  OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the interface number
            regarding the management address component associated with
            the remote system. The value depends upon the value of the
            lldpV2RemManAddrIfSubtype for the table row."
    REFERENCE
            "8.5.9.6"
    ::= { lldpV2RemManAddrEntry 4 }

lldpV2RemManAddrOID  OBJECT-TYPE
    SYNTAX      OBJECT IDENTIFIER
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The OID value used to identify the type of hardware component
            or protocol entity associated with the management address
            advertised by the remote system agent."
    REFERENCE
            "8.5.9.8"
    ::= { lldpV2RemManAddrEntry 5 }
```

```
--
-- lldpV2RemUnknownTLVTable : Unrecognized TLV information
-- This version has additional indexes for
-- ifIndex and destination MAC address
--

lldpV2RemUnknownTLVTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2RemUnknownTLVEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains information about an incoming TLV which
            is not recognized by the receiving LLDP agent. The TLV may
            be from a later version of the basic management set.

            This table should only contain TLVs that are found in
            a single LLDP frame. Entries in this table, associated
            with an MAC service access point (MSAP, the access point
            for MAC services provided to the LCC sublayer, defined
            in IEEE 100, which is also identified with a particular
            lldpRemLocalPortNum, lldpRemIndex pair) are overwritten with
            most recently received unrecognized TLV from the same MSAP,
            or they naturally age out when the rxInfoTTL timer
            (associated with the MSAP) expires."
    REFERENCE
            "9.2.7.7.1"
    ::= { lldpV2RemoteSystemsData 3 }

lldpV2RemUnknownTLVEntry OBJECT-TYPE
    SYNTAX      LldpV2RemUnknownTLVEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about an unrecognized TLV received from a
            physical network connection. Entries may be created and
            deleted in this table by the agent, if a physical topology
            discovery process is active."
    INDEX   {
           lldpV2RemTimeMark,
           lldpV2RemLocalIfIndex,
           lldpV2RemLocalDestMACAddress,
           lldpV2RemIndex,
           lldpV2RemUnknownTLVType
    }
    ::= { lldpV2RemUnknownTLVTable 1 }

LldpV2RemUnknownTLVEntry ::= SEQUENCE {
      lldpV2RemUnknownTLVType      Unsigned32,
      lldpV2RemUnknownTLVInfo      OCTET STRING
}

lldpV2RemUnknownTLVType OBJECT-TYPE
    SYNTAX      Unsigned32(9..126)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This object represents the value extracted from the type
            field of the TLV."
    REFERENCE
            "9.2.7.7.1"
    ::= { lldpV2RemUnknownTLVEntry 1 }

lldpV2RemUnknownTLVInfo OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(0..511))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object represents the value extracted from the value
            field of the TLV."
    REFERENCE
            "9.2.7.7.1"
    ::= { lldpV2RemUnknownTLVEntry 2 }

------------------------------------------------------------------------------
-- Remote Systems Extension Table - Organizationally-Defined Information
------------------------------------------------------------------------------
--
-- lldpV2RemOrgDefInfoTable - indexed by ifIndex and destination
-- MAC address.
--

lldpV2RemOrgDefInfoTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2RemOrgDefInfoEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per physical network
            connection which advertises the organizationally defined
            information.

            Note that this table contains one or more rows of
            organizationally defined information that is not recognized
            by the local agent.

            If the local system is capable of recognizing any
            organizationally defined information, appropriate extension
            MIBs from the organization should be used for information
            retrieval."
    ::= { lldpV2RemoteSystemsData 4 }

lldpV2RemOrgDefInfoEntry OBJECT-TYPE
    SYNTAX      LldpV2RemOrgDefInfoEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about the unrecognized organizationally
            defined information advertised by the remote system.
            The lldpRemTimeMark, lldpRemLocalPortNum, lldpRemIndex,
            lldpRemOrgDefInfoOUI, lldpRemOrgDefInfoSubtype, and
            lldpRemOrgDefInfoIndex are indexes to this table. If there is
            an lldpRemOrgDefInfoEntry associated with a particular remote
            system identified by the lldpRemLocalPortNum and lldpRemIndex,
            then there is an lldpRemEntry associated with the same
            instance (i.e, using same indexes.) When the lldpRemEntry
            for the same index is removed from the lldpRemTable, the
            associated lldpRemOrgDefInfoEntry is removed from
            the lldpRemOrgDefInfoTable.

            Entries may be created and deleted in this table by the
            agent."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex,
              lldpV2RemOrgDefInfoOUI,
              lldpV2RemOrgDefInfoSubtype,
              lldpV2RemOrgDefInfoIndex }
    ::= { lldpV2RemOrgDefInfoTable 1 }

LldpV2RemOrgDefInfoEntry ::= SEQUENCE {
      lldpV2RemOrgDefInfoOUI         OCTET STRING,
      lldpV2RemOrgDefInfoSubtype     Unsigned32,
      lldpV2RemOrgDefInfoIndex       Unsigned32,
      lldpV2RemOrgDefInfo            OCTET STRING
}

lldpV2RemOrgDefInfoOUI  OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE(3))
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The Organizationally Unique Identifier (OUI), as defined
            in IEEE Std 802, is a 24 bit (three octets) globally
            unique assigned number referenced by various standards,
            of the information received from the remote system."
    REFERENCE
            "8.6.1.3"
    ::= { lldpV2RemOrgDefInfoEntry 1 }

lldpV2RemOrgDefInfoSubtype  OBJECT-TYPE
    SYNTAX      Unsigned32(1..255)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the subtype of the
            organizationally defined information received from the
            remote system.

            The subtype value is required to identify different instances
            of organizationally defined information that could not be
            retrieved without a unique identifier that indicates the
            particular type of information contained in the information
            string."
    REFERENCE
            "8.6.1.4"
    ::= { lldpV2RemOrgDefInfoEntry 2 }

lldpV2RemOrgDefInfoIndex  OBJECT-TYPE
    SYNTAX      Unsigned32(1..2147483647)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This object represents an arbitrary local integer value
            used by this agent to identify a particular unrecognized
            organizationally defined information instance, unique only
            for the lldpRemOrgDefInfoOUI and lldpRemOrgDefInfoSubtype
            from the same remote system.

            An agent is encouraged to assign monotonically increasing
            index values to new entries, starting with one, after each
            reboot. It is considered unlikely that the
            lldpRemOrgDefInfoIndex can wrap between reboots."
    ::= { lldpV2RemOrgDefInfoEntry 3 }

lldpV2RemOrgDefInfo  OBJECT-TYPE
    SYNTAX      OCTET STRING(SIZE(0..507))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify the organizationally
            defined information of the remote system. The encoding for
            this object should be as defined for SnmpAdminString TC."
    REFERENCE
            "8.6.1.5"
    ::= { lldpV2RemOrgDefInfoEntry 4 }


--
-- ************************************************************
--
--        L L D P   M I B   N O T I F I C A T I O N S
--
-- ************************************************************
--

lldpV2NotificationPrefix OBJECT IDENTIFIER ::= { lldpV2Notifications 0 }

lldpV2RemTablesChange NOTIFICATION-TYPE
    OBJECTS {
        lldpV2StatsRemTablesInserts,
        lldpV2StatsRemTablesDeletes,
        lldpV2StatsRemTablesDrops,
        lldpV2StatsRemTablesAgeouts
    }
    STATUS        current
    DESCRIPTION
            "A lldpV2RemTablesChange notification is sent when the value
            of lldpV2StatsRemTablesLastChangeTime changes. It can be
            utilized by an NMS to trigger LLDP remote systems table
            maintenance polls.

            Note that transmission of lldpV2RemTablesChange
            notifications are throttled by the agent, as specified by the
            'lldpV2NotificationInterval' object."
   ::= { lldpV2NotificationPrefix 1 }


--
-- ************************************************************
--
--           L L D P   M I B   C O N F O R M A N C E
--
-- ************************************************************
--
```

```
lldpV2Compliances OBJECT IDENTIFIER ::= { lldpV2Conformance 1 }
lldpV2Groups      OBJECT IDENTIFIER ::= { lldpV2Conformance 2 }

-- compliance statements

lldpV2TxRxCompliance MODULE-COMPLIANCE
                        --V2 to add ifGeneralInformationGroup
                        --and support re-indexed tables
    STATUS  current
    DESCRIPTION
            "A compliance statement for all SNMP entities that
            implement the LLDP MIB as either a transmitter or
            a receiver of LLDPDUs.

            This version defines compliance requirements for
            V2 of the LLDP MIB module."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2ConfigGroup,
                           ifGeneralInformationGroup
        }

    ::= { lldpV2Compliances 1 }

lldpV2TxCompliance MODULE-COMPLIANCE
                    --V2 requirements for transmitters of LLDPDUs
                       --and support re-indexed tables
    STATUS  current
    DESCRIPTION
            "A compliance statement for SNMP entities that implement
            the LLDP MIB and have the capability of transmitting
            LLDP frames.

            This version defines compliance requirements for
            V2 of the LLDP MIB module."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2ConfigTxGroup,
                           lldpV2StatsTxGroup,
                           lldpV2LocSysGroup
        }

    ::= { lldpV2Compliances 2 }

lldpV2RxCompliance MODULE-COMPLIANCE
                       --V2 requirements for receivers of LLDPDUs
                       --and support re-indexed tables
    STATUS  current
    DESCRIPTION
            "The compliance statement for SNMP entities that implement
            the LLDP MIB.

            This version defines compliance requirements for
            V2 of the LLDP MIB module."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2ConfigRxGroup,
                           lldpV2StatsRxGroup,
                           lldpV2RemSysGroup,
                           lldpV2NotificationsGroup
        }
```

```
     ::= { lldpV2Compliances 3 }

-- MIB groupings


lldpV2ConfigGroup    OBJECT-GROUP
    OBJECTS {
        lldpV2PortConfigAdminStatus
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to configure the
            LLDP implementation behavior."
    ::= { lldpV2Groups 1 }


lldpV2ConfigRxGroup    OBJECT-GROUP
    OBJECTS {
        lldpV2NotificationInterval,
        lldpV2PortConfigNotificationEnable
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to configure the
            LLDP implementation behavior."
    ::= { lldpV2Groups 2 }


lldpV2ConfigTxGroup    OBJECT-GROUP
    OBJECTS {
        lldpV2MessageTxInterval,
        lldpV2MessageTxHoldMultiplier,
        lldpV2ReinitDelay,
        lldpV2PortConfigTLVsTxEnable,
        lldpV2ManAddrConfigTxEnable,
        lldpV2ManAddrConfigRowStatus,
        lldpV2TxCreditMax,
        lldpV2MessageFastTx,
        lldpV2TxFastInit,
        lldpV2DestMacAddress
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to configure the
            LLDP implementation behavior."
    ::= { lldpV2Groups 3 }


lldpV2StatsRxGroup    OBJECT-GROUP
    OBJECTS {
        lldpV2StatsRemTablesLastChangeTime,
        lldpV2StatsRemTablesInserts,
        lldpV2StatsRemTablesDeletes,
        lldpV2StatsRemTablesDrops,
        lldpV2StatsRemTablesAgeouts,
        lldpV2StatsRxPortFramesDiscardedTotal,
        lldpV2StatsRxPortFramesErrors,
        lldpV2StatsRxPortFramesTotal,
        lldpV2StatsRxPortTLVsDiscardedTotal,
        lldpV2StatsRxPortTLVsUnrecognizedTotal,
        lldpV2StatsRxPortAgeoutsTotal
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to represent LLDP
            reception statistics."
    ::= { lldpV2Groups 4 }


lldpV2StatsTxGroup    OBJECT-GROUP
    OBJECTS {
        lldpV2StatsTxPortFramesTotal,
        lldpV2StatsTxLLDPDULengthErrors
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to represent LLDP
            transmission statistics."
    ::= { lldpV2Groups 5 }


lldpV2LocSysGroup  OBJECT-GROUP
    OBJECTS {
        lldpV2LocChassisIdSubtype,
        lldpV2LocChassisId,
        lldpV2LocPortIdSubtype,
        lldpV2LocPortId,
        lldpV2LocPortDesc,
        lldpV2LocSysDesc,
        lldpV2LocSysName,
        lldpV2LocSysCapSupported,
        lldpV2LocSysCapEnabled,
        lldpV2LocManAddrLen,
        lldpV2LocManAddrIfSubtype,
        lldpV2LocManAddrIfId,
        lldpV2LocManAddrOID
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to represent LLDP
            Local System Information."
    ::= { lldpV2Groups 6 }

lldpV2RemSysGroup  OBJECT-GROUP
    OBJECTS {
        lldpV2RemChassisIdSubtype,
        lldpV2RemChassisId,
        lldpV2RemPortIdSubtype,
        lldpV2RemPortId,
        lldpV2RemPortDesc,
        lldpV2RemSysName,
        lldpV2RemSysDesc,
        lldpV2RemSysCapSupported,
        lldpV2RemSysCapEnabled,
        lldpV2RemRemoteChanges,
        lldpV2RemTooManyNeighbors,
        lldpV2RemManAddrIfSubtype,
        lldpV2RemManAddrIfId,
        lldpV2RemManAddrOID,
        lldpV2RemUnknownTLVInfo,
        lldpV2RemOrgDefInfo
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to represent
            LLDP Remote Systems Information. The objects represent the
            information associated with the basic TLV set. Please note
            that even the agent doesn't implement some of the optional
            TLVs, it shall recognize all the optional TLV information
            that the remote system may advertise."
    ::= { lldpV2Groups 7 }

lldpV2NotificationsGroup  NOTIFICATION-GROUP
    NOTIFICATIONS {
        lldpV2RemTablesChange
    }
    STATUS  current
    DESCRIPTION
            "The collection of notifications used to indicate LLDP MIB
            data consistency and general status information."
    ::= { lldpV2Groups 8 }

END
```

Annex A

(normative)

PICS proforma[11]

A.1 Introduction

The supplier of a protocol implementation that is claimed to conform to this standard shall complete the following Protocol Implementation Conformance Statement (PICS) proforma.

A completed PICS proforma is the PICS for the implementation in question. The PICS is a statement of which capabilities and options of the protocol have been implemented. The PICS can have a number of uses, including use

a) By the protocol implementers, as a checklist to reduce the risk of failure to conform to the standard through oversight.
b) By the supplier and acquirer—or potential acquirer—of the implementation, as a detailed indication of the capabilities of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma.
c) By the user—or potential user—of the implementation, as a basis for initially checking the possibility of interworking with another implementation (note that although interworking can never be guaranteed, failure to interwork can often be predicted from incompatible PICS).
d) By a protocol tester, as the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

A.2 Abbreviations and special symbols

A.2.1 Status symbols

M	Mandatory
O	Optional
O.n	Optional, but support of at least one of the group of options labeled by the same numeral *n* is required
X	Prohibited
pred:	Conditional-item symbol, including predicate identification: See B.3.4
¬	Logical negation, applied to a conditional item's predicate

A.2.2 General abbreviations

N/A	Not applicable
PICS	Protocol Implementation Conformance Statement

[11] *Copyright release for PICS proformas:* Users of this standard may freely reproduce the PICS proforma in this annex so that it can be used for its intended purpose and may further publish the completed PICS.

A.3 Instructions for completing the PICS proforma

A.3.1 General structure of the PICS proforma

The first part of the PICS proforma, implementation identification and protocol summary, is to be completed as indicated with the information necessary to identify fully both the supplier and the implementation.

The main part of the PICS proforma is a fixed-format questionnaire, divided into several subclauses, each containing a number of individual items. Answers to the questionnaire items are to be provided in the right-most column, either by simply marking an answer to indicate a restricted choice (usually Yes or No), or by entering a value or a set or range of values. (Note that there are some items in which two or more choices from a set of possible answers can apply; all relevant choices are to be marked.)

Each item is identified by an item reference in the first column. The second column contains the question to be answered; the third column records the status of the item—whether support is mandatory, optional, or conditional; see also B.3.4. The fourth column contains the reference or references to the material that specifies the item in the main body of this standard, and the fifth column provides the space for the answers.

A supplier may also provide (or be required to provide) further information, categorized as either Additional Information or Exception Information. When present, each kind of further information is to be provided in a further subclause of items labeled *Ai* or *Xi,* respectively, for cross-referencing purposes, where *i* is any unambiguous identification for the item (e.g., simply a numeral). There are no other restrictions on its format and presentation.

A completed PICS proforma, including any Additional Information and Exception Information, is the Protocol Implementation Conformation Statement for the implementation in question.

NOTE—Where an implementation is capable of being configured in more than one way, a single PICS may be able to describe all such configurations. However, the supplier has the choice of providing more than one PICS, each covering some subset of the implementation's configuration capabilities, in case that makes for easier and clearer presentation of the information.

A.3.2 Additional information

Items of Additional Information allow a supplier to provide further information intended to assist the interpretation of the PICS. It is not intended or expected that a large quantity will be supplied, and a PICS can be considered complete without any such information. Examples might be an outline of the ways in which a (single) implementation can be set up to operate in a variety of environments and configurations, or information about aspects of the implementation that are outside the scope of this standard but that have a bearing on the answers to some items.

References to items of Additional Information may be entered next to any answer in the questionnaire and may be included in items of Exception Information.

A.3.3 Exception information

It may occasionally happen that a supplier will wish to answer an item with mandatory status (after any conditions have been applied) in a way that conflicts with the indicated requirement. No preprinted answer will be found in the Support column for this: instead, the supplier shall write the missing answer into the Support column, together with an *Xi* reference to an item of Exception Information, and shall provide the appropriate rationale in the Exception item.

An implementation for which an Exception item is required in this way does not conform to this standard.

NOTE—A possible reason for the situation described above is that a defect in this standard has been reported, a correction for which is expected to change the requirement not met by the implementation.

A.3.4 Conditional status

A.3.4.1 Conditional items

The PICS proforma contains a number of conditional items. These are items for which both the applicability of the item itself, and its status if it does apply—mandatory or optional—are dependent upon whether or not certain other items are supported.

Where a group of items is subject to the same condition for applicability, a separate preliminary question about the condition appears at the head of the group, with an instruction to skip to a later point in the questionnaire if the "Not Applicable" answer is selected. Otherwise, individual conditional items are indicated by a conditional symbol in the Status column.

A conditional symbol is of the form "pred: S," where pred is a predicate as described in B.3.4.2, and S is a status symbol, M or O.

If the value of the predicate is TRUE (see B.3.4.2), the conditional item is applicable, and its status is indicated by the status symbol following the predicate: the answer column is to be marked in the usual way. If the value of the predicate is FALSE, the "Not Applicable" (N/A)[12] answer is to be marked.

A.3.4.2 Predicates

A predicate is one of the following:

a) An item-reference for an item in the PICS proforma: The value of the predicate is TRUE if the item is marked as supported, and is FALSE otherwise.
b) A predicate-name, for a predicate defined as a Boolean expression constructed by combining item-references using the Boolean operator OR: The value of the predicate is TRUE if one or more of the items is marked as supported.
c) A predicate-name, for a predicate defined as a Boolean expression constructed by combining item-references using the Boolean operator AND: The value of the predicate is TRUE if all of the items are marked as supported.
d) The logical negation symbol "¬" prefixed to an item-reference or predicate-name: The value of the predicate is TRUE if the value of the predicate formed by omitting the "¬" symbol is FALSE, and vice versa.

Each item whose reference is used in a predicate or predicate definition, or in a preliminary question for grouped conditional items, is indicated by an asterisk[13] in the Item column.

[12] (N/A) is currently not used in this PICS.

[13] Asterisks are currently not used in this PICS.

PICS proforma for IEEE Std 802.1AB-2009

A.3.5 Implementation identification

Supplier	
Contact point for queries about the PICS	
Implementation Name(s) and Version(s)	
Other information necessary for full identification—e.g., name(s) and version(s) of machines and/or operating system names	
NOTE 1—Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirement for full identification. NOTE 2—The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).	

A.3.6 Protocol summary, IEEE Std 802.1AB-2009

Identification of protocol specification	IEEE Std 802.1AB-2009, IEEE Standard for Local and Metropolitan Area Networks: Station and Media Access Control Connectivity Discovery
Identification of amendments and corrigenda to the PICS proforma that have been completed as part of the PICS	Amd. : Corr. : Amd. : Corr. :
Have any Exception items been required? (See B.3.3: The answer Yes means that the implementation does not conform to IEEE Std 802.1AB-2009)	No [ ] Yes [ ]

Date of Statement	

A.4 Major capabilities and options

Item	Feature	Status	References	Support
cntrlport	Are LLDP exchanges through a controlled port if port access is controlled by IEEE Std 802.1X?	M	Clause 6	Yes [ ]
addr	Are LLDP addressing and LLDP Ethertype encoding in conformance with the defined requirements?			
	DA = LLDP_Multicast address	M	7.1	Yes [ ]
	SA = station MAC address	M	7.2	Yes [ ]
	LLDP Ethertype encoding	M	7.3	Yes [ ]
lldpdu	Is the LLDPDU encapsulation in conformance with the TLV order specified by the LLDPDU format?	M	7.3	Yes [ ]
tlvfmt	Is the basic TLV capability implemented?	M	8.4	Yes [ ]
basictlv	Is each TLV in the basic management set implemented?			
	End Of LLDPDU TLV	M	8.5.1	Yes [ ]
	Chassis ID TLV	M	8.5.2	Yes [ ]
	Port ID TLV	M	8.5.3	Yes [ ]
	Time To Live TLV	M	8.5.4	Yes [ ]
	Port Description TLV	M	8.5.5	Yes [ ]
	System Name TLV	M	8.5.6	Yes [ ]
	System Description TLV	M	8.5.7	Yes [ ]
	System Capabilities TLV	M	8.5.8	Yes [ ]
	Management Address TLV	M	8.5.9	Yes [ ]
xtlvfmt	Is the Organizationally Specific TLV capability implemented?	M	8.6	Yes [ ]
oprmmode	Which of the following operational modes are implemented (one is mandatory, all are allowed)?			
	Transmit and receive (if yes, answer both items **txmode** and **rxmode**)	O.1	6.1	Yes [ ] No [ ]
	Transmit only (if yes, answer item **txmode**, skip **rxmode**)	O.1	6.1	Yes [ ] No [ ]
	Receive only (if yes, skip item **txmode**, answer **rxmode**)	O.1	6.1	Yes [ ] No [ ]
txmode	If the transmit mode is implemented, is the transmit mode in conformance with all operational specifications indicated for the Tx mode in Table 9-1?	M	Clause 9	Yes [ ]

A.4 Major capabilities and options

Item	Feature	Status	References	Support
rxmode	If the receive mode is implemented, is the receive module in conformance with all operational specifications indicated for the Tx mode in Table 9-1?	M	Clause 9	Yes [ ]
lldpmib	Which type of data store/retrieval is implemented? (One is mandatory):			
	SNMP MIB is supported (if yes, answer items **snmpmib** and **snmpsupport**, and skip **equivstor**)	O.2	11.5, 5.3	Yes [ ] No [ ]
	SNMP MIB is not supported (if yes, answer **equivstor** and skip **snmpmib**)	O.2	10.1, 5.3	Yes [ ] No [ ]
snmpmib	Is the MIB module in conformance with the MIB sections indicated in Table 11-1 for the operating mode being implemented?	M	11.5, 5.3	Yes [ ]
snmpsupport	Which of the transport mappings defined by IETF RFC 3417 or IETF RFC 4789 is used to support SNMP? (Support of at least one is mandatory):			
	IETF RFC 3417	O.3	5.3, 5.4	Yes [ ] No [ ]
	IETF RFC 4789	O.3	5.3, 5.4	Yes [ ] No [ ]
equivstor	If the SNMP is not supported, is functionally equivalent storage and retrieval capability specified in Clause 8, Clause 9, Clause10 provided for the operating mode being implemented?	M	10.1	Yes [ ]

Annex B

(normative)

PTOPO MIB update

The PTOPO MIB should be updated according to the following rules:

a) If any objects in the LLDP remote systems MIB age out, the equivalent objects in the PTOPO MIB should be deleted.

b) If the TTL value in the Time To Live TLV is zero, then the port is being shutdown and the PTOPO MIB objects associated with the MSAP identifier should be deleted.

c) If the TTL field is non-zero, then the appropriate ptopoRemEntry is found or created, based on the data elements included in the LLDP frame. If the indicated entry is dynamic (i.e., ptopoConnIsStatic is FALSE), then the current sysUpTime value is stored in the ptopoConnLastVerifyTime field for the entry.

d) If a ptopoRemEntry was added then the ptopoConnTabInserts counter is incremented.

e) If any ptopoRemEntry was added or deleted, or if information other than the ptopoRemLastVerify-Time changed for any entry due to the processing of this LLDP frame, the ptopoLastChangeTime object is set with the current sysUpTime, and a ptopoConfigChange trap event is generated. (See the PTOPO MIB for information on ptopoConfigChange trap generation.)

Annex C

(informative)

Example LLDP transmission frame formats

The LLDP MAC frame format is based on the particular transmission protocol. The following example formats illustrate the indicated LLDP Ethertype encoding method.

C.1 Direct-encoded LLDP frame format

The IEEE 802.3 LLDP frame format is illustrated in Figure C.1.

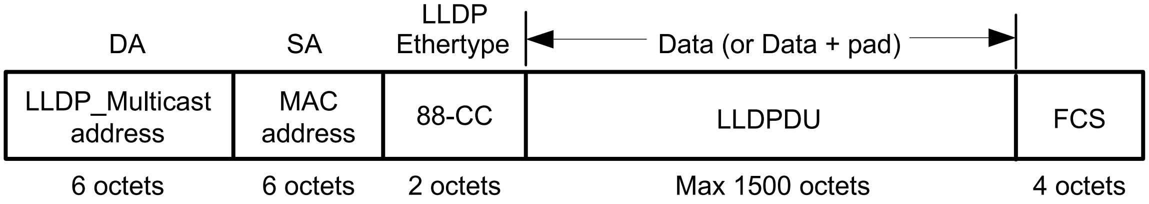


Figure C.1—IEEE 802.3 LLDP frame format

NOTE—The illustration shows the simplest form of an LLDP frame on an IEEE 802.3 medium; i.e., where the frame has had no IEEE 802.1Q tag header, or IEEE 802.1AE security tag, or any other form of encapsulation applied to it.

C.2 SNAP-encoded LLDP frame format

The IEEE 802.11 frame format is illustrated in Figure C.2, for the case where the value of To DS and From DS in the Frame Control field are both zero.

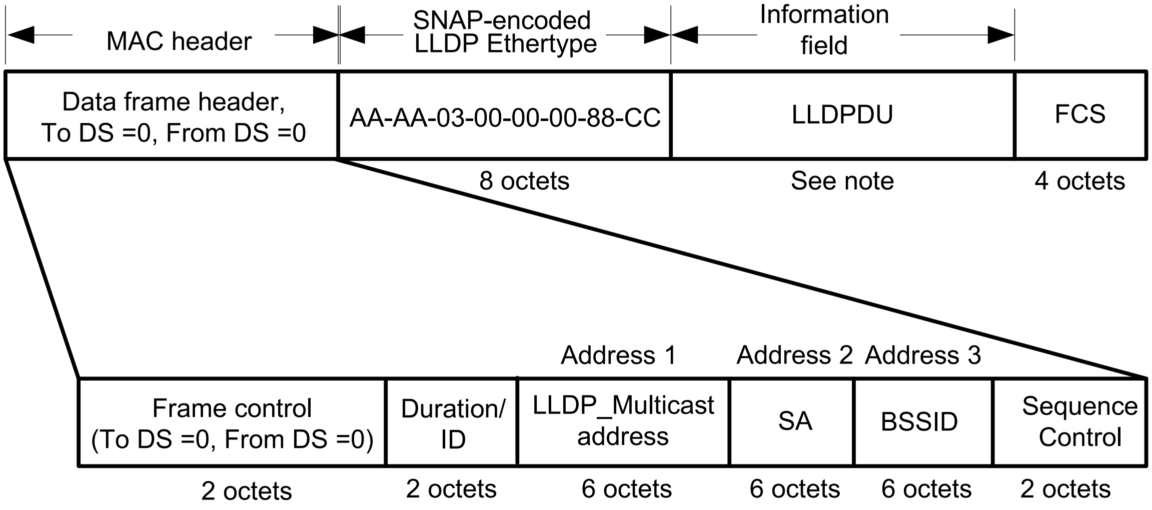


Figure C.2—IEEE 802.11 LLDP frame format

NOTE—The illustration shows the simplest form of an LLDP frame on an IEEE 802.11 medium; i.e., where the frame has had no IEEE 802.1Q tag header, or IEEE 802.1AE security tag, or any other form of encapsulation applied to it.

Annex D

(informative)

Using LLDP to detect potential communication problems

D.1 Overview

Some of the attributes exchanged via LLDP may be used to detect certain mis-configurations that may impair station communication. Under certain circumstances, while LLDPDU exchange is possible, communication between two stations may be impaired because of partial component failure or improper manual configuration of local parameters. In these cases, analysis of the information exchanged within LLDP may be used to detect potential communication or configuration problems and notify the local management entity.

LLDP does not provide a means to resolve problems due to inconsistent configuration or component failure. These actions are clearly beyond the scope of this specification. LLDP does offer an advertisement of information that can be used to detect a limited set of such problems. Whether a problem truly exists or not is also a question of local management policy and interpretation of the advertised information. In many common installations, the information exchanged in the following TLVs can indicate the associated problems.

D.2 IEEE 802.1 Organizationally Specific TLVs

D.2.1 Port VLAN ID TLV

While it is not strictly an error to have two systems configured with different port VLAN ID (PVID) values connected to the same link, in practice it can represent a mis-configuration that is prohibiting two management interfaces from talking with one another. In many deployments of IEEE 802.1Q, a management interface for a system is accessible by a management addresses that is associated with the VLAN the port has been configured on. The network addresses for two systems assumed to be on the same VLAN can assume their addresses are on the same subnet, allowing direct communication. If the systems are actually configured to be on different VLANs, but happen to be connected to a common link with different views of what is the port VLAN on that link, communication problems between the management stacks may exist. Since the PVID is a locally administered value it is possible that it may be configured to be any valid value, however, it is common practice to have the PVID of two systems connected to the same link to be the same.

D.2.2 IEEE 802.1 Port and Protocol VLAN ID TLVs

The port and protocol VLAN IDs (PPVID) are untagged VLANs for a port, which when connected to a link with other port and protocol VLAN members, can have the same issues described with port VLAN IDs. The management addresses used to access management objects should be mapped to the correct VIDs so a remote manager can properly access the system.

Port and protocol VLANs have the additional complication that specific classification rules are used to map frames to the appropriate VLAN. In many cases these classification rules should be consistent between systems on the same link. The rules are represented in the IEEE 802.1Q management structures, but it would be excessive and redundant to advertise these rules in LLDP. However, knowing the set of ports attached to the link that are capable and enabled for port and protocol VLANs is valuable for detecting a possible mis-configuration. Ports that are using a management address reachable by a port and protocol VLAN may wish to have equivalent mapping rules for frames to VLANs. The IEEE 802.1Q MIB of each system enabled with port and protocol VLANs can be consulted to verify the mapping rules.

D.2.3 VLAN Name TLVs

The MIB of managed objects for bridges with VLAN extensions [RFC 4363] defines an object, dot1qVlanStaticName, which provides a name for a VLAN. Additionally, most VLAN bridge implementations provide some method for the network manager to administratively assign a name to a VLAN. While there is no requirement for the name of a VLAN on one bridge to be consistent with the name of the same VLAN on another bridge, it is common practice that these names would be the same.

Network managers typically assign meaningful names to VLANs. For example, a VLAN with VID 10 might be called the ‘Management’ VLAN from which all bridges on the LAN can be accessed by a network management utility. A VLAN with VID 408 might be called the ‘Voice’ VLAN on which IP Telephony equipment resides. Network managers might also assign names to VLANs that help indicate what subnet addresses are used by stations on that VLAN. For example, a VLAN with VID 23 might be called ‘192.168.254.0/24’. In any case, the network manager often uses the naming facility to provide meaningful and consistent names for the VLANs.

In situations where VLAN names have been consistently applied throughout the LAN, the information carried in the VLAN Name TLV may be used to detect a mis-configuration. The VLAN Name TLV essentially provides the mapping of a VID to a VLAN name as assigned by the network manager. The same VID with two different names does not prevent communication on the associated VLAN, however, the communication may not be what the network manager intended.

D.2.4 Protocol Identity TLVs

Protocols such as Spanning Tree Protocol, the Link Aggregation Control Protocol, and numerous vendor proprietary variations are responsible for maintaining the topology and connectivity of the network. While many of these protocols have mechanisms built into them that allow interpretability with older versions, different variations or alternate modes of operation, it is possible for some of these protocols to interact improperly with one another causing breaks in the topology or interruptions in an otherwise connected network.

The Protocol Identity TLV provides a way for stations to advertise protocols that are important to the operation of the network. A management entity may be able to diagnose connectivity issues by understanding the set of topology management protocols operating on peer network devices. Stations may also be able to discover peer protocol agents that operate a preferred version of a proprietary protocol and therefore eliminate the need to develop or execute multiple independent protocol discovery mechanisms.

D.2.5 VID Usage Digest

The value of the VID Usage Digest associated with a system is obtained by applying the RC32 (IEEE Std 802.3-2008, 4.2.10) to a VID Usage Table having a fixed length of 128 octets. A bit of the VID Usage Table contains the value PBB-TE-USAGE (binary 1) if the corresponding element of the MST Configuration Table (IEEE Std 802.1Q-2005, 8.9.1) contains the value PBB-TE MSTID (hex FFE) and otherwise contains the value NON-PBB-TEUSAGE (binary 0). Differences in the value of the VID Usage Digest may be used to detect inconsistencies in the assignment of VID values to either PBB-TE usage or non- PBB-TE usage. Errors may occur when usage of a VID is inconsistent across its scope. Where VID usage has been provisioned throughout the LAN, the information carried in the VID Usage Digest TLV allows detection of a misconfiguration with high probability. Detection is not guaranteed due to the possibility of hash collisions.

D.2.6 Management VID

Systems may support the provisioning of a VID identifying a VLAN on which Bridge management traffic is to be carried. In some cases, the operator may wish to ensure that a consistent value has been assigned to this Management VID at all Bridges within the network. This may be the case when the operator wishes to forward management traffic between non-adjacent bridges without traversing an IP Routing protocol stack; that is, using VLAN forwarding. Where the value of the Management VID has been provisioned throughout the LAN, the information carried in the VID Management TLV allows detection of inconsistent configuration of the Management VID.

D.3 IEEE 802.3 Organizationally Specific TLVs

NOTE—At the time of standardization, two projects to incorporate the IEEE 802.3 organizationally specific LLDP extension TLVs and the IEEE 802.3 extension MIB module into the IEEE 802.3 family of standards had been initiated (IEEE P802.3bc and IEEE P802.3.1 respectively). Once those projects complete, the IEEE 802.3 specifications will supersede the corresponding specifications contained in this standard, and any IEEE 802.3-specific material in this annex will be removed from a subsequent revision of this standard. It is recommended that readers of this standard familiarize themselves with the IEEE 802.3 specifications when they become available.

D.3.1 Use of IEEE 802.3 Organizationally Specific TLVs on other media

While the IEEE 802.3 organizationally specific TLVs were originally developed in order to support specific aspects of the IEEE 802.3 media, there is no restriction on their use in LANs based on other media types where the TLV is of more general applicability. For example, the Maximum Frame Size TLV is relevant to all media types.

D.3.2 MAC/PHY Configuration/Status TLV

It is possible for two ends of an IEEE 802.3 link to be configured with different duplex and/or speed settings and still establish some limited network connectivity. For example:

a) In IEEE 802.3 copper links, auto-negotiation can be overridden by manual configuration and may cause the link configuration to converge in an undesirable way. The auto-negotiation supported and auto-negotiation status fields of the auto-negotiation TLVs passed between two systems attached to the same link should indicate the same settings:
   1) If auto-negotiation is supported and enabled in both systems, there should be not duplex or speed differences. The current speed and duplex settings can be determined by comparing the IEEE 802.3 PMD supported functionality field settings to determine highest common denominator level as defined in IEEE Std 802.3, Annex 28B.3
   2) If the received TLV indicates that auto-negotiation is supported but not enabled, the current duplex and speed settings of the sending system are defined by the operational MAU type field in that TLV. These can be compared with the speed and duplex settings in the receiving system to determine whether there is a mismatch.

b) In fiber links supporting data rates less than 10 Gbits/second, full duplex IEEE 802.3 MAC/PHYs can also support half duplex operation:
   1) The duplex configuration can not be auto-configured in full duplex MAC/PHYs and is set by network management.
   2) A received TLV with an operational MAU type that is different from the local system's operational MAU type can indicate the potential for frame loss.

D.3.3 Link Aggregation TLV

It is possible for one system to believe it has formed a link aggregation with a remote port while the other system is unaware of the aggregation. This type of configuration may cause network loops or unpredictable communication depending upon the distribution algorithm used to load balance traffic. This situation can occur with manual configuration of the link aggregation and the setting the LACP protocol to passive on both sides. It may also occur if manual link aggregations have been established by implementations that are not using the LACP protocol (while this approach is non-standard, it is in wide use today).

The Link Aggregation TLV informs the remote port whether or not the sending port believes it is currently in a link aggregation. It also provides Port ID information for the aggregated port so a management station can efficiently access the link aggregation management objects.

D.3.4 Power Via MDI TLV

An incompatibility of power classes may exist when there is a configuration inconsistency between the power sourcing equipment (PSE) and the powered device (PD). For example, if the PSE port supplies Class_2 (7.0 watts) and advertises it, but the PD port is class_0 (0.44 to 19.95 watts) and requires higher power (more than 7.0 watts) in some modes, connectivity problems may result.

D.3.5 Maximum Frame Size TLV

Differences in maximum frame size can result in loss of frames if a sending station transmits frames larger than the advertised maximum frame size supported by the receiving station. The Maximum Frame Size TLV can be used to detect mis-configurations or incompatibility between two stations with different maximum supported frame sizes.

Annex E

(normative)

IEEE 802.1 Organizationally Specific TLVs

E.1 Requirements of the IEEE 802.1 Organizationally Specific TLV set

The IEEE 802.1 Organizationally Specific TLVs may be supported in conjunction with any of the destination MAC addresses identified in 7.1.

NOTE—These TLVs are intended to be used by IEEE 802.1 Bridges, and not by end stations.

If any IEEE 802.1 Organizationally Specific TLV is supported, all IEEE 802.1 Organizationally Specific TLVs shall be supported. All IEEE 802.1 Organizationally Specific TLVs shall conform to the LLDPDU bit and octet ordering conventions of 9.1.

The currently defined IEEE 802.1 Organizationally Specific TLVs are listed in Table E.1. Any additions or changes to these TLVs will be included in this annex.

Table E.1— IEEE 802.1 Organizationally Specific TLVs

IEEE 802.1 subtype	TLV name	Reference
01	Port VLAN ID	E.2
02	Port And Protocol VLAN ID	E.3
03	VLAN Name	E.4
04	Protocol Identity	E.5
05	VID Usage Digest	E.6
06	Management VID	E.7
07	Link Aggregation	E.8
08–FF	Reserved	—

E.2 Port VLAN ID TLV

The Port VLAN ID TLV is an optional fixed length TLV that allows a VLAN bridge port to advertise the port’s VLAN identifier (PVID) that is associated with untagged or priority tagged frames (see IEEE 802.1Q-2005, 8.4.4).

Figure E.1 shows the Port VLAN ID TLV format.

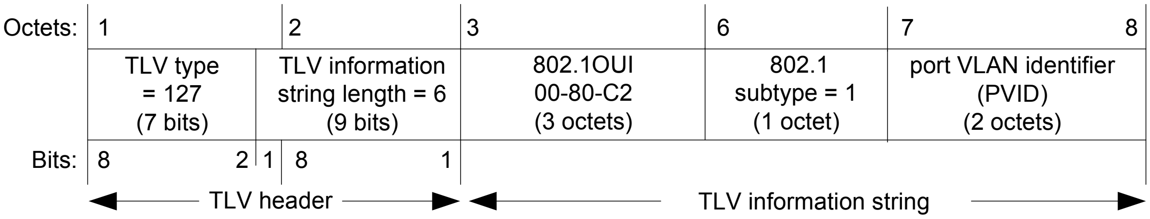

Octets: 1
2
3
6
7
8
TLV type = 127 (7 bits)
TLV information string length = 6 (9 bits)
802.1OUI 00-80-C2 (3 octets)
802.1 subtype = 1 (1 octet)
port VLAN identifier (PVID) (2 octets)
Bits: 8
2
1
8
1
TLV header
TLV information string

Figure E.1—Port VLAN ID TLV Format

E.2.1 port VLAN identifier (PVID)

The port VLAN identifier field shall contain the VLAN ID for the bridge port as defined in 8.4.4 of IEEE Std 802.1Q-2005. A value of zero shall be used if the system either does not know the PVID or does not support port-based VLAN operation.

E.2.2 Port VLAN ID usage rules

An LLDPDU should contain no more than one Port VLAN ID TLV.

E.3 Port And Protocol VLAN ID TLV

The Port And Protocol VLAN ID TLV is an optional TLV that allows a bridge port to advertise a port and protocol VLAN ID. Figure E.2 shows the Port And Protocol VLAN ID TLV format.

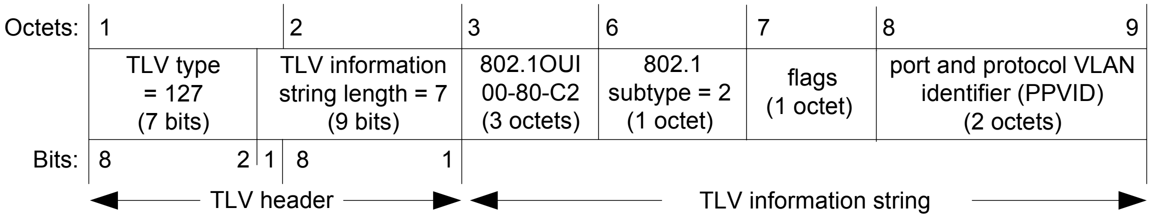

Octets: 1
2
3
6
7
8
9
TLV type = 127 (7 bits)
TLV information string length = 7 (9 bits)
802.1OUI 00-80-C2 (3 octets)
802.1 subtype = 2 (1 octet)
flags (1 octet)
port and protocol VLAN identifier (PPVID) (2 octets)
Bits: 8
2
1
8
1
TLV header
TLV information string

Figure E.2—Port And Protocol VLAN ID TLV Format

E.3.1 flags

The flags field shall contain a bit map indicating the port and protocol VLAN capability and status as defined in Table E.2.

E.3.2 port and protocol VLAN ID (PPVID)

The port and protocol VLAN ID field shall contain the PPVID number for this IEEE 802 LAN station. If the port is not capable of supporting port and protocol VLANs and/or the port is not enabled with any port and protocol VLAN, the PPVID number should be zero.

E.3.3 Port And Protocol VLAN ID TLV usage rules

Table E.2—Port and protocol capability/status

Bit	Function	Value/meaning
1	Port and protocol VLAN supported	1 = supported 0 = not supported
2	Port and protocol VLAN enabled	1 = enabled 0 = not enabled
3–8	reserved for future standardization	(set to zero)

Port And Protocol VLAN ID TLVs are subject to the following rules:

a) If more than one Port And Protocol VLAN ID TLV is defined for a port, the PPVID value shall be different from any other PPVID defined for the port.
b) If the support bit (bit 1) of the flag field indicates that the port is not capable of supporting port and protocol VLANs but the enabled bit (bit 2) indicates that the port is enabled with one or more port and protocol VLANs, the Port And Protocol VLAN ID TLV is interpreted as containing an error and will be discarded.
c) If the PPVID reference number is greater than 4094, the Port And Protocol VLAN ID TLV is interpreted as containing an error and is discarded.

E.4 VLAN Name TLV

The VLAN Name TLV is an optional TLV that allows an IEEE 802.1Q-compatible IEEE 802 LAN station to advertise the assigned name of any VLAN with which it is configured.

Figure E.3 shows the VLAN Name TLV format.

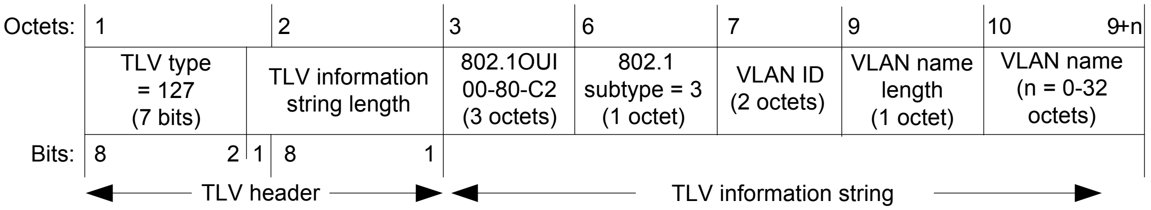

Octets:
1
2
3
6
7
9
10
9+n
TLV type = 127 (7 bits)
TLV information string length
802.1OUI 00-80-C2 (3 octets)
802.1 subtype = 3 (1 octet)
VLAN ID (2 octets)
VLAN name length (1 octet)
VLAN name (n = 0-32 octets)
Bits:
8
2
1
8
1
TLV header
TLV information string

Figure E.3—VLAN Name TLV format

E.4.1 TLV information string length

The TLV information string length field shall contain the length, in octets, of the (VLAN name + 7).

E.4.2 VLAN ID (VID)

The VLAN ID field shall contain the VID number associated with the VLAN name.

E.4.3 VLAN name length

The VLAN name length field shall contain the length, in octets, of the VLAN name. A VLAN name length of zero indicates that there is no VLAN name associated with this VLAN.

E.4.4 VLAN name

If present, the VLAN name field shall contain the VLAN’s name. If implementations support IETF RFC 4363, the dot1QVLANStaticName object should be used for this field.

E.4.5 VLAN Name TLV usage rules

If more than one VLAN Name TLV is defined for a port, the VLAN ID and the associated VLAN name combination shall be different from any other VLAN ID and VLAN name combination defined for the port.

E.5 Protocol Identity TLV

The Protocol Identity TLV is an optional TLV that allows an IEEE 802 LAN station to advertise particular protocols that are accessible through the port. Figure E.4 shows the protocol identity TLV format.

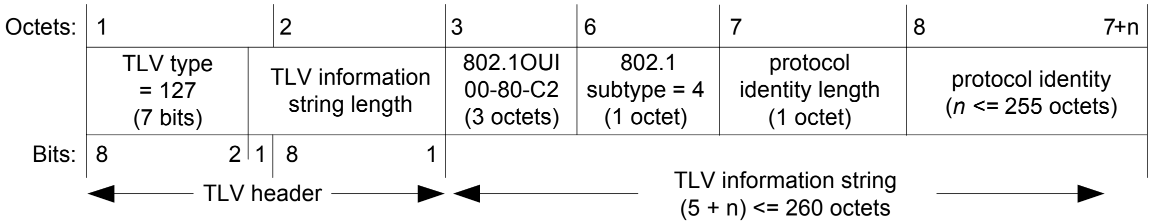

Octets:
1
2
3
6
7
8
7+n
TLV type = 127 (7 bits)
TLV information string length
802.1OUI 00-80-C2 (3 octets)
802.1 subtype = 4 (1 octet)
protocol identity length (1 octet)
protocol identity (n <= 255 octets)
Bits:
8
2
1
8
1
TLV header
TLV information string (5 + n) <= 260 octets

Figure E.4—Protocol Identity TLV format

E.5.1 TLV information string length

The TLV information string length field shall contain the length, in octets, of the (protocol identity + 5)

E.5.2 protocol identity length

The protocol identity length field shall contain the length, in octets, of the protocol identity.

E.5.3 protocol identity

The protocol identity field shall contain the first n octets of the protocol after the layer 2 addresses (i.e.for example, starting with the Ethertype field) that the sender would like to advertise. The value of *n* is determined by the need for the protocol to disambiguate itself. The protocol information string shall include enough octets to allow the receiver to correctly identify the protocol and its version. To advertise Spanning Tree Protocols, for example, the protocol identity field would need to include at least eight octets: IEEE 802.3 length (two octets), LLC addresses (two octets), IEEE 802.3 control (one octet), Protocol ID (two octets), and the protocol version (one octet).

E.5.4 Protocol Identity TLV usage rules

If more than one Protocol Identity TLV is defined for a port, the protocol identity field value shall be different from any other Protocol Identity TLV defined for the port.

E.6 VID Usage Digest TLV

The VID Usage Digest TLV is an optional TLV that allows an IEEE Std 802.1Q-compatible IEEE 802 LAN station to advertise the value of a VID Usage Digest associated with the system. The value of the VID Usage Digest is obtained by applying the CRC32 function (IEEE Std 802.3-2008, 4.2.10) to a VID Usage Table having a fixed length of 128 octets. A bit of the VID Usage Table contains the value PBB-TE-USAGE (binary 1) if the corresponding element of the MST Configuration Table (IEEE Std 802.1Q-2005, 8.9.1) contains the value PBB-TE MSTID (hex FFE) and otherwise contains the value NON-PBB-TE-USAGE (binary 0).

Figure E.5 shows the VID Usage Digest TLV format.

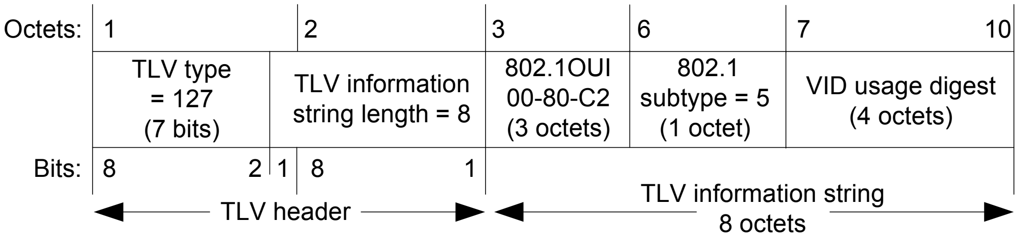

Octets:
1
2
3
6
7
10
TLV type = 127 (7 bits)
TLV information string length = 8
802.1OUI 00-80-C2 (3 octets)
802.1 subtype = 5 (1 octet)
VID usage digest (4 octets)
Bits:
8
2
1
8
1
TLV header
TLV information string 8 octets

Figure E.5—VID Usage Digest TLV format

E.6.1 VID Usage Digest

The VID Usage Digest field shall contain a VID Usage Digest value obtained by applying the CRC32 function to the 128-octet VID Usage Table. A bit of the VID Usage Table contains the value PBB-TE-USAGE (binary 1) if the corresponding element of the MST Configuration Table (IEEE Std 802.1Q-2005, 8.9.1) contains the value PBB-TE MSTID (hex FFE) and otherwise contains the value NON-PBB-TE-USAGE (binary 0).

E.7 Management VID TLV

The Management VID TLV is an optional TLV that allows an IEEE 802.1Q-compatible IEEE 802 LAN station to advertise the value of a Management VID associated with the system.

Figure E.6 shows the Management VID TLV format.

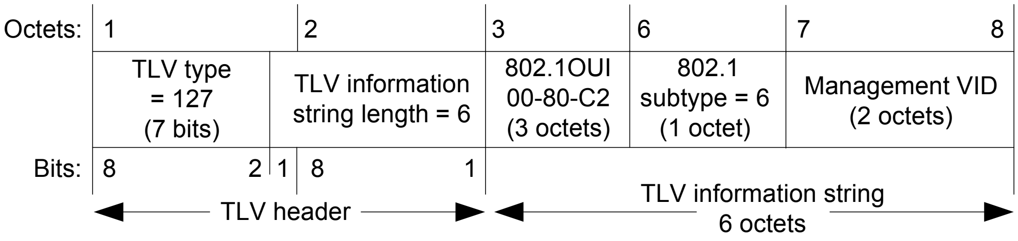

Octets:
1
2
3
6
7
8
TLV type = 127 (7 bits)
TLV information string length = 6
802.1OUI 00-80-C2 (3 octets)
802.1 subtype = 6 (1 octet)
Management VID (2 octets)
Bits:
8
2
1
8
1
TLV header
TLV information string 6 octets

Figure E.6—Management VID TLV format

E.7.1 Management VID

The Management VID field shall contain the value configured for the Management VID, or the value 0 if a Management VID has not been provisioned.

E.8 Link Aggregation TLV

The Link Aggregation TLV indicates whether the link is capable of being aggregated, whether the link is currently in an aggregation, as specified in IEEE Std 802.1AX, and if in an aggregation, the port identification of the aggregation. Figure E.7 shows the format for this TLV.

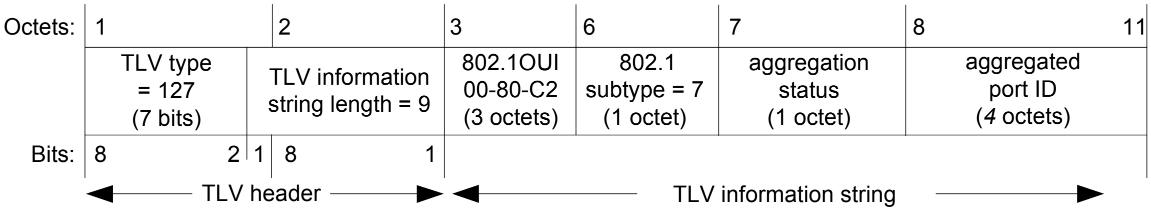

Octets:
1
2
3
6
7
8
11
TLV type = 127 (7 bits)
TLV information string length = 9
802.1OUI 00-80-C2 (3 octets)
802.1 subtype = 7 (1 octet)
aggregation status (1 octet)
aggregated port ID (*4* octets)
Bits:
8
2
1
8
1
TLV header
TLV information string

Figure E.7—Link Aggregation TLV format

E.8.1 aggregation status

The link aggregation status field shall contain a bit map of the link aggregation capabilities and the current aggregation status of the link as defined in Table E.3.

Table E.3—Link aggregation capability/status

Bit	Function	Value/meaning
0	Aggregation capability	0 = not capable of being aggregated 1 = capable of being aggregated
1	Aggregation status	0 = not currently in aggregation 1 = currently in aggregation
2–7	reserved for future standardization	—

E.8.2 aggregated port ID

The aggregated port ID field shall contain the IEEE 802.3 aggregated port identifier, aAggPortID, derived from the ifNumber in the ifIndex for the interface.

NOTE—This field is meaningful only if the link concerned is currently a member of an aggregation.

E.8.3 Link Aggregation TLV usage rules

An LLDPDU should contain no more than one Link Aggregation TLV.

E.9 IEEE 802.1 Organizationally Specific TLV management

E.9.1 IEEE 802.1 Organizationally Specific TLV selection management

TLV selection management consists of providing the network manager with the means to select which specific IEEE 802.1 Organizationally Specific TLVs are enabled for inclusion in an LLDPDU. The following LLDP variables cross reference to LLDP local systems configuration MIB tables indicate which specific TLVs are enabled for the particular port(s) on the system. The specific port(s) through which each TLV is enabled for transmission may be set (or reset) by the network manager:

a) **mibXdot1PortVlanTxEnable:** This variable lists the VLAN ID of the port through which the referenced TLV is enabled for transmission.

b) **mibXdot1VlanNameConfigTxEnable:** This variable lists the different VLAN name/PPVID TLVs that are defined for the system, each with a bit map indicating the system ports through which the particular VLAN name TLV is enabled for transmission.

c) **mibXdot1ProtoVlanConfigTxEnable:** This variable lists the port and protocol VLAN TLVs that are defined for the system, each with a bit map indicating the system ports through which the particular port and protocol VLAN TLV is enabled for transmission.

d) **mibXdot1ProtocolConfigTxEnable:** This variable lists the protocol identity TLVs that are defined for the system, each with a bit map indicating the system ports through which the particular protocol TLV is enabled for transmission.

E.9.2 IEEE 802.1 managed objects—TLV variables

E.9.2.1 Port VLAN ID TLV managed objects

a) **PVID:** The port VLAN identifier (see E.2.1).

E.9.2.2 Port And Protocol VLAN ID TLV managed objects

a) **Port and protocol VLAN supported:** A flag indicating whether port and protocol VLANs are supported (see E.3.1).

b) **Port and protocol VLAN enabled:** A flag indicating whether port and protocol VLANs are enabled (see E.3.1).

c) **PPVID:** The advertised port and protocol VLAN ID (see E.3.2).

E.9.2.3 VLAN Name TLV managed objects

a) VID: The VLAN ID associated with the VLAN name (see E.4.2).

b) **VLAN name length:** The length of the VLAN name (see E.4.3).

c) **VLAN name:** The VLAN's name (see E.4.4).

E.9.2.4 Protocol Identity TLV managed objects

a) **protocol identity length:** The length of the protocol identity (see E.5.2).

b) **protocol identity:** The protocol's identity (see E.5.3).

E.9.2.5 VID Usage Digest TLV managed objects

a) VID Usage Digest: The VID Usage Digest value (see E.6.1)

E.9.2.6 Management VID TLV managed objects

a) Management VID: The Management VID value (see E.7.1)

E.9.2.7 Link Aggregation TLV managed objects

a) **aggregation status:** The capability and current aggregation status of the link (see E.8.1).

b) **aggregated port ID:** The aggregated port identifier (see E.8.2).

E.10 IEEE 802.1/LLDP extension MIB

E.10.1 Internet Standard Management Framework

LLDP MIBs are designed to operate in a manner consistent with the principles of the Internet Standard Management Framework, which describes the separation of a data modeling language (for example, SMIv2) from content specific data models (for example the LLDP remote systems MIB), and from messages and protocol operations used to manipulate the data (for example SNMPv3).

For a detailed overview of the documents that describe the current Internet Standard Management Framework, please refer to section 7 of IETF RFC 3410 (2002).

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This clause specifies a MIB module that is compliant to the SMIv2, which is described in IETF STD 58, IETF RFC 2578, IETF RFC 2579, and IETF RFC 2580.

E.10.2 Structure of the IEEE 802.1/LLDP extension MIB

Table E.4 summarizes the particular object groups that are required for each operating mode. The implemented MIB shall comply with the MIB conformance section for the particular operating mode being supported.

Table E.4—IEEE 802.1 extension MIB object group conformance requirements

MIB group	Rx mode	Tx mode	Tx/Rx mode
lldpV2Xdot1ConfigGroup	M[a]	M	M
lldpV2Xdot1LocSysGroup	M	—	M
lldpV2Xdot1RemSysGroup	—	M	M
ifGeneralInformationGroup	M	M	M

[a] M=Mandatory

Table E.5 shows the structure of the MIB and the relationship of the MIB objects to the LLDP operational status/control variables, LLDP statistics variables, and TLV variables.

E.10.3 Relationship to other MIBs

Version 2 of the IEEE 802.1 LLDP extension MIB module appears in E.10.5. Version 1 of the MIB module that was published in the initial 2005 publication of this standard has been superseded by version 2 of the MIB module, and support of the version 2 module is a requirement for conformance to the required or optional capabilities (Clause 5) in this revision of the standard. The version 2 MIB module reflects changes in indexation of the MIB objects that support the use of LLDP with multiple destination MAC addresses, as discussed in Clause 6.

The relationship of the IEEE 802.1 LLDP extension MIB module to other MIBs, and coexistence between version 1 and version 2 implementations, is further discussed in 11.3.

Table E.5—IEEE 802.1/LLDP extension MIB object cross reference

MIB table	MIB object	LLDP reference
Configuration group		
lldpV2Xdot1ConfigPortVlanTable		Augments lldpV2Xdot1ConfigPortVlanTable
	lldpV2Xdot1ConfigPortVlanTxEnable	Normal LLPDUs, 9.1.2.1
lldpV2Xdot1ConfigVlanNameTable		Augments lldpV2Xdot1LocVlanNameEntry
	lldpV2Xdot1ConfigVlanNameTxEnable	Normal LLPDUs, 9.1.2.1
lldpV2Xdot1ConfigProtoVlanTable		Augments lldpV2Xdot1LocProtoVlanEntry
	lldpV2Xdot1ConfigProtoVlanTxEnable	Normal LLPDUs, 9.1.2.1
lldpV2Xdot1ConfigProtocolTable		Augments lldpV2Xdot1LocProtocolEntry
	lldpV2Xdot1ConfigProtocolTxEnable	Normal LLPDUs, 9.1.2.1
lldpV2Xdot1ConfigVidUsageDigestTable		Augments lldpV2Xdot1LocVidUsageDigestEntry
	lldpV2Xdot1ConfigVidUsageDigestTxEnable	Normal LLPDUs, 9.1.2.1
lldpV2Xdot1ConfigManVidTable		Augments lldpV2Xdot1LocManVidEntry
	lldpV2Xdot1ConfigManVidTxEnable	Normal LLPDUs, 9.1.2.1
Local system information		
lldpV2Xdot1LocTable		E.2
	lldpV2LocPortIfIndex	(Table index)
	lldpV2Xdot1LocPortVlanId	port VLAN identifier, E.2.1
lldpV2Xdot1LocProtoVlanTable		E.3
	lldpV2LocPortIfIndex	(Table index)
	lldpV2Xdot1LocProtoVlanId	port and protocol VLAN ID, E.3.2
	lldpV2Xdot1LocProtoVlanSupported	flags, E.3.1
	lldpV2Xdot1LocProtoVlanEnabled	flags, E.3.1
lldpV2Xdot1LocVlanNameTable		E.4
	lldpV2LocPortIfIndex	(Table index)
	lldpV2Xdot1LocVlanId	VLAN ID, E.4.2 (Table index)
	lldpV2Xdot1LocVlanName	VLAN name, E.4.4
lldpV2Xdot1LocProtocolTable		E.5
	lldpV2LocPortIfIndex	(Table index)
	lldpV2Xdot1LocProtocolIndex	(Table index)
	lldpV2Xdot1LocProtocolId	protocol identity, E.5.3

Table E.5—IEEE 802.1/LLDP extension MIB object cross reference *(continued)*

MIB table	MIB object	LLDP reference
lldpV2Xdot1LocVidUsageDigestTable		E.6
	lldpV2LocPortIfIndex	(Table index)
	lldpV2Xdot1LocVidUsageDigest	VID usage digest, E.6.1
lldpV2Xdot1LocManVidTable		E.7
	lldpV2LocPortIfIndex	(Table index)
	lldpV2Xdot1LocManVid	Management VID, E.7.1
lldpV2Xdot1LocLinkAggTable		E.8
	lldpV2LocPortIfIndex	(Table index)
	lldpV2Xdot1LocLinkAggStatus	aggregation status, E.8.1
	lldpV2Xdot1LocLinkAggPortId	aggregated port ID, E.8.2
Remote system information		
lldpV2Xdot1RemTable		E.2
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2Xdot1RemPortVlanId	port VLAN identifier, E.2.1
lldpV2Xdot1RemProtoVlanTable		E.3
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2Xdot1RemProtoVlanId	port and protocol VLAN ID, E.3.2 (Table index)
	lldpV2Xdot1RemProtoVlanSupported	flags, E.3.1
	lldpV2Xdot1RemProtoVlanEnabled	flags, E.3.1
lldpV2Xdot1RemVlanNameTable		E.4
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2Xdot1RemVlanId	VLAN ID, E.4.2 (Table index)
	lldpV2Xdot1RemVlanName	VLAN name, E.4.4
lldpV2Xdot1RemProtocolTable		E.5

Table E.5—IEEE 802.1/LLDP extension MIB object cross reference *(continued)*

MIB table	MIB object	LLDP reference
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2Xdot1RemProtocolIndex	(Table index)
	lldpV2Xdot1RemProtocolId	protocol identity, E.5.3
lldpV2Xdot1RemVidUsageDigestTable		E.6
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2Xdot1RemVidUsageDigest	VID usage digest, E.6.1
lldpV2Xdot1RemManVidTable		E.7
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2Xdot1RemManVid	Management VID, E.7.1
lldpV2Xdot1RemLinkAggTable		E.8
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2Xdot1RemLinkAggStatus	aggregation status, E.8.1
	lldpV2Xdot1RemLinkAggPortId	aggregation port ID, E.8.2

E.10.4 Security considerations for IEEE 802.1 LLDP extension MIB module

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write[14]. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

Setting the following objects to incorrect values can result in improper operation of LLDP when in the transmit mode:

a) lldpV2Xdot1ConfigPortVlanTxEnableV2

[14] In IETF MIB definitions, the MAX-ACCESS clause defines the type of access that is allowed for particular data elements in the MIB. An explanation of the MAX-ACCESS mappings is given in section 7.3 of IETF RFC 2578 [B11].

b) lldpV2Xdot1ConfigVlanNameTxEnable
c) lldpV2Xdot1ConfigProtoVlanTxEnable
d) lldpV2Xdot1ConfigProtocolTxEnable
e) lldpV2Xdot1ConfigVidUsageDigestTxEnable
f) lldpV2Xdot1ConfigManVidTxEnable

The following readable objects in this MIB module may be considered to be sensitive or vulnerable in some network environments:

g) MIB objects that are related to the transmit mode
   1) lldpV2Xdot1LocPortVlanId
   2) lldpV2Xdot1LocProtoVlanSupported
   3) lldpV2Xdot1LocProtoVlanEnabled
   4) lldpV2Xdot1LocVlanName
   5) lldpV2Xdot1LocProtocolId
   6) lldpV2Xdot1LocVidUsageDigest
   7) lldpV2Xdot1LocManVidTxEnable
   8) lldpV2Xdot1LocLinkAggStatus
   9) lldpV2Xdot1LocLinkAggPortId
h) MIB objects that are related to the receive mode
   1) lldpV2Xdot1RemPortVlanId
   2) lldpV2Xdot1RemProtoVlanSupported
   3) lldpV2Xdot1RemProtoVlanEnabled
   4) lldpV2Xdot1RemVlanName
   5) lldpV2Xdot1RemProtocolId
   6) lldpV2Xdot1RemVidUsageDigest
   7) lldpV2Xdot1RemManVidTxEnable
   8) lldpV2Xdot1RemLinkAggStatus
   9) lldpV2Xdot1RemLinkAggPortId

This concern applies both to objects that describe the configuration of the local host, as well as for objects that describe information from the remote hosts, acquired via LLDP and displayed by the objects in this MIB module. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

Implementers should consider the security features as provided by the SNMPv3 framework (see RFC 3410, section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, implementers should not deploy SNMP versions prior to SNMPv3. Instead**,** implementers should deploy SNMPv3 to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

E.10.5 IEEE 802.1 LLDP extension MIB module—version 2 [15],[16]

In the following MIB definition, should any discrepancy between the DESCRIPTION text and the corresponding definition in E.2 through E.10 occur, the definition in E.2 through E.10 shall take precedence.

```
LLDP-EXT-DOT1-V2-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Unsigned32
        FROM SNMPv2-SMI
    TruthValue
        FROM SNMPv2-TC
    SnmpAdminString
        FROM SNMP-FRAMEWORK-MIB
    MODULE-COMPLIANCE,
    OBJECT-GROUP
        FROM SNMPv2-CONF
    ifGeneralInformationGroup
        FROM IF-MIB
    lldpV2Extensions,
    lldpV2LocPortIfIndex,
    lldpV2RemTimeMark,
    lldpV2RemLocalIfIndex,
    lldpV2RemLocalDestMACAddress,
    lldpV2RemIndex,
    lldpV2PortConfigEntry
        FROM LLDP-V2-MIB
    VlanId
        FROM Q-BRIDGE-MIB
    LldpV2LinkAggStatusMap
        FROM LLDP-V2-TC-MIB;

lldpV2Xdot1MIB MODULE-IDENTITY
    LAST-UPDATED "200906080000Z" -- June 08, 2009
    ORGANIZATION "IEEE 802.1 Working Group"
    CONTACT-INFO
           "WG-URL: http://grouper.ieee.org/groups/802/1/index.html
            WG-EMail: STDS-802-1-L@LISTSERV.IEEE.ORG

            Contact: Tony Jeffree
            Postal:  11a Poplar Grove
                     Sale
                     Cheshire M33 3AX
                     UK
            Tel:     +44-161-973-4278
            E-mail:  tony@jeffree.co.uk"
    DESCRIPTION
            "The LLDP Management Information Base extension module for
            IEEE 802.1 organizationally defined discovery information.

            In order to assure the uniqueness of the LLDP-V2-MIB,
```

[15] *Copyright release for MIBs:* Users of this standard may freely reproduce the MIB contained in this subclause so that it can be used for its intended purpose.

[16] An ASCII version of this MIB module can be obtained by Web browser from the IEEE 802.1 Website at http://www.ieee802.org/1/pages/MIBS.html.

```
            lldpV2Xdot1MIB is branched from lldpV2Extensions using an
            OUI value as the node.  An OUI/’company_id’ is a 24 bit
            globally unique assigned number referenced
            by various standards.

            Unless otherwise indicated, the references in this
            MIB module are to IEEE 802.1AB-2009.

            Copyright (C) IEEE (2009).  This version of this MIB module
            is published as Annex E.10.5 of IEEE Std 802.1AB-2009;
            see the standard itself for full legal notices.”

    REVISION “200906080000Z” -- June 08, 2009

    DESCRIPTION
            “Published as part of IEEE Std 802.1AB-2009 revision.
            This revision incorporated changes to the MIB to
            support the use of LLDP with multiple destination MAC
            addresses, and to import the Link Aggregation TLV
            from the 802.3 extension MIB”

-- OUI for IEEE 802.1 is 32962 (00-80-C2)
   ::= { lldpV2Extensions 32962 }

------------------------------------------------------------------------------
------------------------------------------------------------------------------
--
-- Organizationally Defined Information Extension - IEEE 802.1
--
------------------------------------------------------------------------------
------------------------------------------------------------------------------

lldpV2Xdot1Objects    OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 1 }

-- LLDP IEEE 802.1 extension MIB groups
lldpV2Xdot1Config     OBJECT IDENTIFIER ::= { lldpV2Xdot1Objects 1 }
lldpV2Xdot1LocalData  OBJECT IDENTIFIER ::= { lldpV2Xdot1Objects 2 }
lldpV2Xdot1RemoteData OBJECT IDENTIFIER ::= { lldpV2Xdot1Objects 3 }

------------------------------------------------------------------------------
-- IEEE 802.1 - Configuration
------------------------------------------------------------------------------

--
-- lldpV2Xdot1ConfigPortVlanTable : configure the transmission of the
--                                  Port VLAN-ID TLVs on set of ports.
--

lldpV2Xdot1ConfigPortVlanTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1ConfigPortVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “A table that controls selection of LLDP Port VLAN-ID TLVs
            to be transmitted on individual ports.”
    ::= { lldpV2Xdot1Config 1 }

lldpV2Xdot1ConfigPortVlanEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1ConfigPortVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "LLDP configuration information that controls the
            transmission of IEEE 802.1 organizationally defined Port
            VLAN-ID TLV on LLDP transmission capable ports.

            This configuration object augments the lldpV2PortConfigEntry of
            the LLDP-MIB, therefore it is only present along with the port
            configuration defined by the associated lldpV2PortConfigEntry
            entry.

            Each active lldpConfigEntry is restored from non-volatile
            storage (along with the corresponding lldpV2PortConfigEntry)
            after a re-initialization of the management system."
    AUGMENTS { lldpV2PortConfigEntry }
    ::= { lldpV2Xdot1ConfigPortVlanTable 1 }

LldpV2Xdot1ConfigPortVlanEntry ::= SEQUENCE {
      lldpV2Xdot1ConfigPortVlanTxEnable  TruthValue
}

lldpV2Xdot1ConfigPortVlanTxEnable OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
            "The lldpV2Xdot1ConfigPortVlanTxEnable, which is defined
            as a truth value and configured by the network management,
            determines whether the IEEE 802.1 organizationally defined
            port VLAN TLV transmission is allowed on a given LLDP
            transmission capable port.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    REFERENCE
            "9.1.2.1"
    DEFVAL  { false }
    ::= { lldpV2Xdot1ConfigPortVlanEntry 1 }


--
-- lldpV2Xdot1ConfigVlanNameTable : configure the transmission of the
--                                  VLAN name instances on set of ports.
--

lldpV2Xdot1ConfigVlanNameTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1ConfigVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The table that controls selection of LLDP VLAN name TLV
            instances to be transmitted on individual ports."
    ::= { lldpV2Xdot1Config 2 }

lldpV2Xdot1ConfigVlanNameEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1ConfigVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “LLDP configuration information that specifies the set of
            ports (represented as a PortList) on which the Local System
            VLAN name instance is transmitted.

            This configuration object augments the lldpV2LocVlanEntry,
            therefore it is only present along with the VLAN Name instance
            contained in the associated lldpV2LocVlanNameEntry entry.

            Each active lldpV2Xdot1ConfigVlanNameEntry is restored
            from non-volatile storage (along with the corresponding
            lldpV2Xdot1LocVlanNameEntry) after a re-initialization of
            the management system.”
    AUGMENTS { lldpV2Xdot1LocVlanNameEntry }
    ::= { lldpV2Xdot1ConfigVlanNameTable 1 }



LldpV2Xdot1ConfigVlanNameEntry ::= SEQUENCE {
      lldpV2Xdot1ConfigVlanNameTxEnable  TruthValue
}

lldpV2Xdot1ConfigVlanNameTxEnable  OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
            “The boolean value that indicates whether the corresponding
            Local System VLAN name instance is transmitted on the
            port defined by the given lldpV2Xdot1LocVlanNameEntry.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system.”
    REFERENCE
            “9.1.2.1”
    DEFVAL  { false }
    ::= { lldpV2Xdot1ConfigVlanNameEntry 1 }


--
-- lldpV2Xdot1ConfigProtoVlanTable : configure the transmission of the
--                                   protocol VLAN instances on set
--                                   of ports.
--

lldpV2Xdot1ConfigProtoVlanTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1ConfigProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “The table that controls selection of LLDP Port and Protocol
            VLAN ID TLV instances to be transmitted on individual ports.”
    ::= { lldpV2Xdot1Config 3 }

lldpV2Xdot1ConfigProtoVlanEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1ConfigProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
```

```
            "LLDP configuration information that specifies the set of
            ports (represented as a PortList) on which the Local System
            Protocol VLAN instance is transmitted.

            This configuration object augments the lldpV2Xdot1LocVlanEntry,
            therefore it is only present along with the Port and
            Protocol VLAN ID instance contained in the associated
            lldpV2Xdot1LocVlanEntry entry.

            Each active lldpV2Xdot1ConfigProtoVlanEntry is restored
            from non-volatile storage (along with the corresponding
            lldpV2Xdot1LocProtoVlanEntry) after a re-initialization of
            the management system."

    AUGMENTS { lldpV2Xdot1LocProtoVlanEntry }
    ::= { lldpV2Xdot1ConfigProtoVlanTable 1 }


LldpV2Xdot1ConfigProtoVlanEntry ::= SEQUENCE {
      lldpV2Xdot1ConfigProtoVlanTxEnable   TruthValue
}

lldpV2Xdot1ConfigProtoVlanTxEnable OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
            "The boolean value that indicates whether the corresponding
            Local System Port and Protocol VLAN instance is
            transmitted on the port defined by the given
            lldpV2Xdot1LocProtoVlanEntry.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    REFERENCE
            "9.1.2.1"
    DEFVAL  { false }
    ::= { lldpV2Xdot1ConfigProtoVlanEntry 1 }


--
-- lldpV2Xdot1ConfigProtocolTable : configure the transmission of the
--                                  protocol instances on set
--                                  of ports.
--

lldpV2Xdot1ConfigProtocolTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1ConfigProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The table that controls selection of LLDP Protocol
            TLV instances to be transmitted on individual ports."
    ::= { lldpV2Xdot1Config 4 }

lldpV2Xdot1ConfigProtocolEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1ConfigProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “LLDP configuration information that specifies the set of
            ports (represented as a PortList) on which the Local System
            Protocol instance is transmitted.

            This configuration object augments the lldpV2Xdot1LocProtoEntry,
            therefore it is only present along with the Protocol instance
            contained in the associated lldpV2Xdot1LocProtoEntry entry.

            Each active lldpV2Xdot1ConfigProtocolEntry is restored
            from non-volatile storage (along with the corresponding
            lldpV2Xdot1LocProtocolEntry) after a re-initialization of the
            management system.”
    AUGMENTS { lldpV2Xdot1LocProtocolEntry }
    ::= { lldpV2Xdot1ConfigProtocolTable 1 }


LldpV2Xdot1ConfigProtocolEntry ::= SEQUENCE {
      lldpV2Xdot1ConfigProtocolTxEnable   TruthValue
}

lldpV2Xdot1ConfigProtocolTxEnable  OBJECT-TYPE
    SYNTAX        TruthValue
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
            “The boolean value that indicates whether the corresponding
            Local System Protocol Identity instance is transmitted
            on the port defined by the given lldpV2Xdot1LocProtocolEntry.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system.”
    REFERENCE
            “9.1.2.1”
    DEFVAL  { false }
    ::= { lldpV2Xdot1ConfigProtocolEntry 1 }

--
-- lldpV2Xdot1ConfigVidUsageDigestTable: configure the transmission of the
-- VID Usage Digest TLVs on set of ports.
--
lldpV2Xdot1ConfigVidUsageDigestTable OBJECT-TYPE
     SYNTAX SEQUENCE OF LldpV2Xdot1ConfigVidUsageDigestEntry
     MAX-ACCESS not-accessible
     STATUS current
     DESCRIPTION
          “A table that controls selection of LLDP VID Usage Digest TLVs to be
          transmitted on individual ports.”
::= { lldpV2Xdot1Config 5 }

lldpV2Xdot1ConfigVidUsageDigestEntry OBJECT-TYPE
     SYNTAX LldpV2Xdot1ConfigVidUsageDigestEntry
     MAX-ACCESS not-accessible
     STATUS current
     DESCRIPTION
          “LLDP configuration information that specifies the set of ports
          (represented as a PortList) on which the local system VID
          Usage Digest instance will be transmitted.
          This configuration object augments the lldpLocVidUsageDigestEntry,
          therefore it is only present along with the VID Usage Digest instance
          contained in the associated lldpV2Xdot1LocVidUsageDigestEntry entry.
          Each active lldpConfigVidUsageDigestEntry must be restored from
          non-volatile storage and re-created (along with the
          corresponding lldpV2Xdot1LocVidUsageDigestEntry)
          after a re-initialization of the management system."
     AUGMENTS { lldpV2Xdot1LocVidUsageDigestEntry }
::= { lldpV2Xdot1ConfigVidUsageDigestTable 1 }

LldpV2Xdot1ConfigVidUsageDigestEntry ::= SEQUENCE {
     lldpV2Xdot1ConfigVidUsageDigestTxEnable TruthValue
     }

lldpV2Xdot1ConfigVidUsageDigestTxEnable OBJECT-TYPE
     SYNTAX TruthValue
     MAX-ACCESS read-write
     STATUS current
     DESCRIPTION
          "The boolean value that indicates whether the corresponding
          Local System VID Usage Digest instance will be transmitted
          on the port defined by the given lldpV2Xdot1LocVidUsageDigestEntry.
          The value of this object must be restored from non-volatile
          storage after a reinitialization of the management system."
     REFERENCE
          "9.1.2.1"
     DEFVAL { false }
::= { lldpV2Xdot1ConfigVidUsageDigestEntry 1 }


--
-- lldpV2Xdot1ConfigManVidTable : configure the transmission of the
-- Management VID TLVs on set of ports.
--
lldpV2Xdot1ConfigManVidTable OBJECT-TYPE
     SYNTAX SEQUENCE OF LldpV2Xdot1ConfigManVidEntry
     MAX-ACCESS not-accessible
     STATUS current
     DESCRIPTION
          "A table that controls selection of LLDP Management VID
          TLVs to be transmitted on individual ports."
::= { lldpV2Xdot1Config 6 }

lldpV2Xdot1ConfigManVidEntry OBJECT-TYPE
     SYNTAX LldpV2Xdot1ConfigManVidEntry
     MAX-ACCESS not-accessible
     STATUS current
     DESCRIPTION
          "LLDP configuration information that specifies the set of
          port/destination address pairs on which the Local
          System Management VID will be transmitted.
          This configuration object augments the
          lldpV2Xdot1LocManVidEntry, therefore it is
          only present along with the Management VID contained
          in the associated lldpV2Xdot1LocManVidEntry entry.
          Each active lldpV2Xdot1ConfigManVidEntry must be
          restored from non-volatile storage (along with the
          corresponding lldpV2Xdot1LocManVidEntry) after a
          re-initialization of the management system."
     AUGMENTS { lldpV2Xdot1LocManVidEntry }
```

```
::= { lldpV2Xdot1ConfigManVidTable 1 }

LldpV2Xdot1ConfigManVidEntry ::= SEQUENCE {
     lldpV2Xdot1ConfigManVidTxEnable TruthValue
     }

lldpV2Xdot1ConfigManVidTxEnable OBJECT-TYPE
     SYNTAX TruthValue
     MAX-ACCESS read-write
     STATUS current
     DESCRIPTION
          “The lldpV2Xdot1ConfigManVidTxEnable, which is defined as a
          truth value and configured by the network management,
          determines whether the IEEE 802.1 organizationally
          defined Management VID TLV transmission is allowed on a given
          LLDP transmission capable port.
          The value of this object must be restored from
          non-volatile storage after a re-initialization of the
          management system.”
     REFERENCE
          “9.1.2.1”
     DEFVAL { false }
::= { lldpV2Xdot1ConfigManVidEntry 1 }


------------------------------------------------------------------------------
-- IEEE 802.1 - Local System Information
------------------------------------------------------------------------------

--
-- lldpV2Xdot1LocTable - indexed by ifIndex.
--

lldpV2Xdot1LocTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “This table contains one row per port for IEEE 802.1
            organizationally defined LLDP extension on the local system
            known to this agent.”
    ::= { lldpV2Xdot1LocalData 1 }

lldpV2Xdot1LocEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “Information about IEEE 802.1 organizationally defined
            LLDP extension.”
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot1LocTable 1 }

LldpV2Xdot1LocEntry ::= SEQUENCE {
         lldpV2Xdot1LocPortVlanId       Unsigned32
}

lldpV2Xdot1LocPortVlanId OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..4094)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the port's VLAN identifier
            associated with the local system.   A value of zero shall
            be used if the system either does not know the PVID or does
            not support port-based VLAN operation."
    REFERENCE
            "E.2.1"
    ::= { lldpV2Xdot1LocEntry 1 }



--
-- lldpV2Xdot1LocProtoVlanTable: Port and Protocol VLAN information
-- re-indexed by ifIndex.
--

lldpV2Xdot1LocProtoVlanTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per Port and Protocol
            VLAN information about the local system."
    ::= { lldpV2Xdot1LocalData 2 }

lldpV2Xdot1LocProtoVlanEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Port and protocol VLAN ID Information about a particular
            port component.  There may be multiple port and protocol VLANs,
            identified by a particular lldpV2Xdot1LocProtoVlanId, configured
            on the given port."
    INDEX   { lldpV2LocPortIfIndex,
              lldpV2Xdot1LocProtoVlanId }
    ::= { lldpV2Xdot1LocProtoVlanTable 1 }

LldpV2Xdot1LocProtoVlanEntry ::= SEQUENCE {
      lldpV2Xdot1LocProtoVlanId        Unsigned32,
      lldpV2Xdot1LocProtoVlanSupported TruthValue,
      lldpV2Xdot1LocProtoVlanEnabled   TruthValue
}

lldpV2Xdot1LocProtoVlanId  OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..4094)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the port and protocol
            VLANs associated with the given port associated with the
            local system.  A value of zero shall be used if the system
            either does not know the protocol VLAN ID (PPVID) or does
            not support port and protocol VLAN operation."
    REFERENCE
            "E.3.2"
    ::= { lldpV2Xdot1LocProtoVlanEntry 1 }
```

```
lldpV2Xdot1LocProtoVlanSupported  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            “The truth value used to indicate whether the given port
            (associated with the local system) supports port and protocol
            VLANs.”
    REFERENCE
            “E.3.1”
    ::= { lldpV2Xdot1LocProtoVlanEntry 2 }

lldpV2Xdot1LocProtoVlanEnabled  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            “The truth value used to indicate whether the port and
            protocol VLANs are enabled on the given port associated with
            the local system.”
    REFERENCE
            “E.3.1”
    ::= { lldpV2Xdot1LocProtoVlanEntry 3 }



--
-- lldpV2Xdot1LocVlanNameTable : VLAN name information about the local system
-- indexed by ifIndex.
--

lldpV2Xdot1LocVlanNameTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “This table contains one or more rows per IEEE 802.1Q VLAN
            name information on the local system known to this agent.”
    ::= { lldpV2Xdot1LocalData 3 }

lldpV2Xdot1LocVlanNameEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “VLAN name Information about a particular port component.
            There may be multiple VLANs, identified by a particular
            lldpV2Xdot1LocVlanId, configured on the given port.”
    INDEX   { lldpV2LocPortIfIndex,
              lldpV2Xdot1LocVlanId }
    ::= { lldpV2Xdot1LocVlanNameTable 1 }

LldpV2Xdot1LocVlanNameEntry ::= SEQUENCE {
      lldpV2Xdot1LocVlanId            VlanId,
      lldpV2Xdot1LocVlanName          SnmpAdminString
}

lldpV2Xdot1LocVlanId  OBJECT-TYPE
```

```
    SYNTAX      VlanId
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the IEEE 802.1Q
            VLAN IDs with which the given port is compatible."
    REFERENCE
            "E.4.2"
    ::= { lldpV2Xdot1LocVlanNameEntry 1 }

lldpV2Xdot1LocVlanName  OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(1..32))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify VLAN name identified by the
            Vlan Id associated with the given port on the local system.

            This object should contain the value of the dot1QVLANStaticName
            object (defined in IETF RFC 4363) identified with the given
            lldpV2Xdot1LocVlanId."
    REFERENCE
            "E.4.4"
    ::= { lldpV2Xdot1LocVlanNameEntry 2 }



--
-- lldpV2Xdot1LocProtocolTable : Protocol Identity information
-- re-indexed by ifIndex and destination address
--

lldpV2Xdot1LocProtocolTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per protocol identity
            information on the local system known to this agent."
    REFERENCE
            "E.5"
    ::= { lldpV2Xdot1LocalData 4 }

lldpV2Xdot1LocProtocolEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about particular protocols that are accessible
            through the given port component.

            There may be multiple protocols, identified by particular
            lldpV2Xdot1ProtocolIndex, lldpV2LocPortIfIndex"
    REFERENCE
            "E.5"
    INDEX   { lldpV2LocPortIfIndex,
              lldpV2Xdot1LocProtocolIndex }
    ::= { lldpV2Xdot1LocProtocolTable 1 }
```

```
LldpV2Xdot1LocProtocolEntry ::= SEQUENCE {
      lldpV2Xdot1LocProtocolIndex Unsigned32,
      lldpV2Xdot1LocProtocolId    OCTET STRING
}


lldpV2Xdot1LocProtocolIndex  OBJECT-TYPE
    SYNTAX      Unsigned32(1..2147483647)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This object represents an arbitrary local integer value used
            by this agent to identify a particular protocol identity."
    ::= { lldpV2Xdot1LocProtocolEntry 1 }

lldpV2Xdot1LocProtocolId  OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (1..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The octet string value used to identify the protocols
            associated with the given port of the local system."
    REFERENCE
            "E.5.3"
    ::= { lldpV2Xdot1LocProtocolEntry 2 }

--
-- lldpV2Xdot1LocVidUsageDigestTable: Table of hash values of
-- system VID Usage Table transmitted
-- via VID Usage Digest TLV.
--


lldpV2Xdot1LocVidUsageDigestTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocVidUsageDigestEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per ifIndex/
            destination MAC address pair for usage digest
            information on the local system known to this agent."
    REFERENCE
            "E.6"
    ::= { lldpV2Xdot1LocalData 5 }

lldpV2Xdot1LocVidUsageDigestEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocVidUsageDigestEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Usage digest information to be transmitted
            through the given port."
    REFERENCE
            "E.6"
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot1LocVidUsageDigestTable 1 }

LldpV2Xdot1LocVidUsageDigestEntry ::= SEQUENCE {
      lldpV2Xdot1LocVidUsageDigest Unsigned32
}


lldpV2Xdot1LocVidUsageDigest OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The integer value obtained by applying the CRC32 function
        to the 128-octet VID Usage Table. A bit of the VID Usage
        Table contains the value PBB-TE-USAGE (binary 1) if the
        corresponding element of the MST Configuration Table
        (IEEE Std 802.1Q 8.9.1) contains the value PBB-TE MSTID (hex FFE)
        and otherwise contains the value NON-PBB-TE-USAGE (binary 0)."
    REFERENCE
        "E.6.1"
::= { lldpV2Xdot1LocVidUsageDigestEntry 1 }

--
-- lldpV2Xdot1LocManVidTable: Table of values configured on the Local
-- system for the Management VID, or the value 0 if a Management VID has not
-- been provisioned.
--

lldpV2Xdot1LocManVidTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocManVidEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per ifIndex/
            destination MAC address pair for usage digest
            information on the local system known to this agent."
    REFERENCE
            "E.7"
    ::= { lldpV2Xdot1LocalData 6 }

lldpV2Xdot1LocManVidEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocManVidEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Usage digest information to be transmitted
            through the given port."
    REFERENCE
            "E.7"
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot1LocManVidTable 1 }

LldpV2Xdot1LocManVidEntry ::= SEQUENCE {
      lldpV2Xdot1LocManVid Unsigned32
}

lldpV2Xdot1LocManVid OBJECT-TYPE
    SYNTAX Unsigned32 (0|1..4094)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The integer value configured on the Local system for
        the Management VID, or
        the value 0 if a Management VID has not been provisioned.”
    REFERENCE
        “E.7.1”
::= { lldpV2Xdot1LocManVidEntry 1 }


------------------------------------------------------------------------------
-- IEEE 802.1 - Local System Information - Link Aggregation
------------------------------------------------------------------------------

---
---
--- lldpV2Xdot1LocLinkAggTable: Link Aggregation Information Table
---
---
lldpV2Xdot1LocLinkAggTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1LocLinkAggEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “This table contains one row per port of link aggregation
            information (as a part of the LLDP 802.1 organizational
            extension) on the local system known to this agent.”
    ::= { lldpV2Xdot1LocalData 7 }

lldpV2Xdot1LocLinkAggEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1LocLinkAggEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “Link Aggregation information about a particular port
            component.”
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot1LocLinkAggTable 1 }

LldpV2Xdot1LocLinkAggEntry ::= SEQUENCE {
      lldpV2Xdot1LocLinkAggStatus       LldpV2LinkAggStatusMap,
      lldpV2Xdot1LocLinkAggPortId       Unsigned32
}

lldpV2Xdot1LocLinkAggStatus OBJECT-TYPE
    SYNTAX      LldpV2LinkAggStatusMap
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            “The bitmap value contains the link aggregation capabilities
            and the current aggregation status of the link.”
    REFERENCE
            “E.8.1”
    ::= { lldpV2Xdot1LocLinkAggEntry 1 }

lldpV2Xdot1LocLinkAggPortId OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            “This object contains the IEEE 802.1 aggregated port
            identifier, aAggPortID (IEEE Std 802.1AX, 6.3.2.1.1),
            derived from the ifNumber of the  ifIndex for the port
            component in link aggregation.

            If the port is not in link aggregation state and/or it
            does not support link aggregation, this value should be set
            to zero.”
    REFERENCE
            “E.8.1”
    ::= { lldpV2Xdot1LocLinkAggEntry 2 }



------------------------------------------------------------------------------
-- IEEE 802.1 - Remote System Information
------------------------------------------------------------------------------

--
-- lldpV2Xdot1RemTable - re-indexed for ifIndex and destination MAC address
--

lldpV2Xdot1RemTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “This table contains one or more rows per physical network
            connection known to this agent.  The agent may wish to
            ensure that only one lldpV2Xdot1RemEntry is present for
            each local port, or it may choose to maintain multiple
            lldpV2Xdot1RemEntries for the same local port.”
    ::= { lldpV2Xdot1RemoteData 1 }

lldpV2Xdot1RemEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            “Information about a particular port component.”
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpV2Xdot1RemTable 1 }

LldpV2Xdot1RemEntry ::= SEQUENCE {
            lldpV2Xdot1RemPortVlanId           Unsigned32
}

lldpV2Xdot1RemPortVlanId OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..4094)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            “The integer value used to identify the port’s VLAN identifier
            associated with the remote system.  if the remote system
            either does not know the PVID or does not support port-based
            VLAN operation, the value of lldpV2Xdot1RemPortVlanId should
            be zero.”
    REFERENCE
            “E.2.1”
    ::= { lldpV2Xdot1RemEntry 1 }



--
-- lldpV2Xdot1RemProtoVlanTable - re-indexed by ifIndex and
-- destination MAC address
--

lldpV2Xdot1RemProtoVlanTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per Port and Protocol
            VLAN information about the remote system, received on the
            given port."
    ::= { lldpV2Xdot1RemoteData 2 }

lldpV2Xdot1RemProtoVlanEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemProtoVlanEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Port and protocol VLAN name Information about a particular
            port component.  There may be multiple protocol VLANs,
            identified by a particular lldpV2Xdot1RemProtoVlanId, configured
            on the remote system."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex,
              lldpV2Xdot1RemProtoVlanId }
    ::= { lldpV2Xdot1RemProtoVlanTable 1 }

LldpV2Xdot1RemProtoVlanEntry ::= SEQUENCE {
            lldpV2Xdot1RemProtoVlanId           Unsigned32,
            lldpV2Xdot1RemProtoVlanSupported   TruthValue,
            lldpV2Xdot1RemProtoVlanEnabled     TruthValue
}

lldpV2Xdot1RemProtoVlanId  OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..4094)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the port and protocol
            VLANs associated with the given port associated with the
            remote system.

            If port and protocol VLANs are not supported on the given
            port associated with the remote system, or if the port is
            not enabled with any port and protocol VLAN, the value of
            lldpV2Xdot1RemProtoVlanId should be zero."
    REFERENCE
            "E.3.2"
    ::= { lldpV2Xdot1RemProtoVlanEntry 1 }

lldpV2Xdot1RemProtoVlanSupported  OBJECT-TYPE
```

```
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether the given port
            (associated with the remote system) is capable of supporting
            port and protocol VLANs."
    REFERENCE
            "E.3.1"
    ::= { lldpV2Xdot1RemProtoVlanEntry 2 }

lldpV2Xdot1RemProtoVlanEnabled  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether the port and
            protocol VLANs are enabled on the given port associated with
            the remote system."
    REFERENCE
            "E.3.1"
    ::= { lldpV2Xdot1RemProtoVlanEntry 3 }



--
-- lldpV2Xdot1RemVlanNameTable : VLAN name information of the remote
--                               systems
-- Re-indexed by ifIndex and destination MAC address
--

lldpV2Xdot1RemVlanNameTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per IEEE 802.1Q VLAN
            name information about the remote system, received on the
            given port."
    REFERENCE
            "E.4"
    ::= { lldpV2Xdot1RemoteData 3 }

lldpV2Xdot1RemVlanNameEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemVlanNameEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "VLAN name Information about a particular port component.
            There may be multiple VLANs, identified by a particular
            lldpV2Xdot1RemVlanId, received on the given port."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex,
              lldpV2Xdot1RemVlanId }
    ::= { lldpV2Xdot1RemVlanNameTable 1 }

LldpV2Xdot1RemVlanNameEntry ::= SEQUENCE {
```

```
            lldpV2Xdot1RemVlanId       VlanId,
            lldpV2Xdot1RemVlanName     SnmpAdminString
}


lldpV2Xdot1RemVlanId  OBJECT-TYPE
    SYNTAX      VlanId
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "The integer value used to identify the IEEE 802.1Q
            VLAN IDs with which the given port of the remote system
            is compatible."
    REFERENCE
            "E.4.2"
    ::= { lldpV2Xdot1RemVlanNameEntry 1 }

lldpV2Xdot1RemVlanName  OBJECT-TYPE
    SYNTAX      SnmpAdminString (SIZE(1..32))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The string value used to identify VLAN name identified by the
            VLAN Id associated with the remote system."
    REFERENCE
            "E.4.4"
    ::= { lldpV2Xdot1RemVlanNameEntry 2 }



--
-- lldpV2Xdot1RemProtocolTable : Protocol information of the remote systems
-- Re-indexed by ifIndex and destination MAC address
--

lldpV2Xdot1RemProtocolTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one or more rows per protocol information
            about the remote system, received on the given port."
    ::= { lldpV2Xdot1RemoteData 4 }

lldpV2Xdot1RemProtocolEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemProtocolEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Protocol information about a particular port component.
            There may be multiple protocols, identified by a particular
            lldpV2Xdot1ProtocolIndex, received on the given port."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex,
              lldpV2Xdot1RemProtocolIndex }
    ::= { lldpV2Xdot1RemProtocolTable 1 }
```

```
LldpV2Xdot1RemProtocolEntry ::= SEQUENCE {
            lldpV2Xdot1RemProtocolIndex     Unsigned32,
            lldpV2Xdot1RemProtocolId        OCTET STRING
}

lldpV2Xdot1RemProtocolIndex  OBJECT-TYPE
    SYNTAX      Unsigned32(1..2147483647)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This object represents an arbitrary local integer value used
            by this agent to identify a particular protocol identity."
    ::= { lldpV2Xdot1RemProtocolEntry 1 }

lldpV2Xdot1RemProtocolId  OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (1..255))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The octet string value used to identify the protocols
            associated with the given port of remote system."
    REFERENCE
            "E.5.3"
    ::= { lldpV2Xdot1RemProtocolEntry 2 }



--
-- lldpV2Xdot1RemVidUsageDigestTable: Table of hash values of
-- system VID Usage Table received
-- via VID Usage Digest TLV.
--


lldpV2Xdot1RemVidUsageDigestTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemVidUsageDigestEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per ifIndex/
            destination MAC address pair for usage digest
            information received by the local system."
    REFERENCE
            "E.6"
    ::= { lldpV2Xdot1RemoteData 5 }

lldpV2Xdot1RemVidUsageDigestEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemVidUsageDigestEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Usage digest information received on
            the given port/destination address pair."
    REFERENCE
            "E.6"
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress }
    ::= { lldpV2Xdot1RemVidUsageDigestTable 1 }
```

```
LldpV2Xdot1RemVidUsageDigestEntry ::= SEQUENCE {
      lldpV2Xdot1RemVidUsageDigest  Unsigned32
}


lldpV2Xdot1RemVidUsageDigest OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The integer value obtained by applying the CRC32 function
        to the 128-octet VID Usage Table. A bit of the VID Usage
        Table contains the value PBB-TE-USAGE (binary 1) if the
        corresponding element of the MST Configuration Table
        (IEEE Std 802.1Q 8.9.1) contains the value PBB-TE MSTID (hex FFE)
        and otherwise contains the value NON-PBB-TE-USAGE (binary 0)."
    REFERENCE
        "E.6.1"
::= { lldpV2Xdot1RemVidUsageDigestEntry 1 }

--
-- lldpV2Xdot1RemManVidTable: Table of values configured on remote
-- systems for the Management VID, or the value 0 if a Management VID has not
-- been provisioned.
--

lldpV2Xdot1RemManVidTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemManVidEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per ifIndex/
            destination MAC address pair for management VID
            information received from remote systems."
    REFERENCE
            "E.7"
    ::= { lldpV2Xdot1RemoteData 6 }

lldpV2Xdot1RemManVidEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemManVidEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Management VID information received
            through the given port/destination address pair."
    REFERENCE
            "E.7"
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress }
    ::= { lldpV2Xdot1RemManVidTable 1 }

LldpV2Xdot1RemManVidEntry ::= SEQUENCE {
      lldpV2Xdot1RemManVid            Unsigned32
}

lldpV2Xdot1RemManVid OBJECT-TYPE
    SYNTAX Unsigned32 (0|1..4094)
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "The integer value configured on a system for
        the Management VID, or
        the value 0 if a Management VID has not been provisioned."
    REFERENCE
        "E.7.1"
::= { lldpV2Xdot1RemManVidEntry 1 }



------------------------------------------------------------------------------
-- Remote System Information - Link Aggregation
------------------------------------------------------------------------------

---
---
--- lldpV2Xdot1RemLinkAggTable: Link Aggregation Information Table
---
---
lldpV2Xdot1RemLinkAggTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot1RemLinkAggEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains port link aggregation information
            (as a part of the LLDP IEEE 802.1 organizational extension)
            of the remote system."
    ::= { lldpV2Xdot1RemoteData 7 }

lldpV2Xdot1RemLinkAggEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot1RemLinkAggEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Link Aggregation information about remote system's port
            component."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpV2Xdot1RemLinkAggTable 1 }

LldpV2Xdot1RemLinkAggEntry ::= SEQUENCE {
            lldpV2Xdot1RemLinkAggStatus        LldpV2LinkAggStatusMap,
            lldpV2Xdot1RemLinkAggPortId        Unsigned32
}

lldpV2Xdot1RemLinkAggStatus OBJECT-TYPE
    SYNTAX      LldpV2LinkAggStatusMap
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The bitmap value contains the link aggregation capabilities
            and the current aggregation status of the link."
    REFERENCE
            "E.8.1"
    ::= { lldpV2Xdot1RemLinkAggEntry 1 }
```

```
lldpV2Xdot1RemLinkAggPortId OBJECT-TYPE
    SYNTAX      Unsigned32(0|1..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the IEEE 802.1 aggregated port
            identifier, aAggPortID (IEEE Std 802.1AX, 6.3.2.1.1),
            derived from the ifNumber of the  ifIndex for the port
            component associated with the remote system.

            If the remote port is not in link aggregation state and/or
            it does not support link aggregation, this value should be
            zero."
    REFERENCE
            "E.8.1"
    ::= { lldpV2Xdot1RemLinkAggEntry 2 }


------------------------------------------------------------------------------
-- Conformance Information
------------------------------------------------------------------------------

lldpV2Xdot1Conformance OBJECT IDENTIFIER ::= { lldpV2Xdot1MIB 2 }
lldpV2Xdot1Compliances OBJECT IDENTIFIER ::= { lldpV2Xdot1Conformance 1 }
lldpV2Xdot1Groups      OBJECT IDENTIFIER ::= { lldpV2Xdot1Conformance 2 }

-- compliance statements


lldpV2Xdot1TxRxCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "A compliance statement for SNMP entities that implement
            the IEEE 802.1 organizationally defined LLDP extension MIB.

            This group is mandatory for agents which implement the
            LLDP 802.1 organizational extension in TX and/or RX mode.

            This version defines compliance requirements for
            V2 of the LLDP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2Xdot1ConfigGroup,
                           ifGeneralInformationGroup
        }
    ::= { lldpV2Xdot1Compliances 1 }


lldpV2Xdot1TxCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "A compliance statement for SNMP entities which implement
            the IEEE 802.1 organizationally defined LLDP extension MIB.

            This group is mandatory for agents which implement the
            LLDP 802.1 organizational extension in the RX mode.

            This version defines compliance requirements for
            V2 of the LLDP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2Xdot1LocSysGroup }

    ::= { lldpV2Xdot1Compliances 2 }

lldpV2Xdot1RxCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            “A compliance statement for SNMP entities which implement
            the IEEE 802.1 organizationally defined LLDP extension MIB.

            This group is mandatory for agents which implement the
            LLDP 802.1 organizational extension in the RX mode.

            This version defines compliance requirements for
            V2 of the LLDP MIB.”
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2Xdot1RemSysGroup }

    ::= { lldpV2Xdot1Compliances 3 }

-- MIB groupings

lldpV2Xdot1ConfigGroup    OBJECT-GROUP
    OBJECTS {
        lldpV2Xdot1ConfigPortVlanTxEnable,
        lldpV2Xdot1ConfigVlanNameTxEnable,
        lldpV2Xdot1ConfigProtoVlanTxEnable,
        lldpV2Xdot1ConfigProtocolTxEnable,
        lldpV2Xdot1ConfigVidUsageDigestTxEnable,
        lldpV2Xdot1ConfigManVidTxEnable
    }
    STATUS  current
    DESCRIPTION
            “The collection of objects which are used to configure the
            IEEE 802.1 organizationally defined LLDP extension
            implementation behavior.”
    ::= { lldpV2Xdot1Groups 1 }

lldpV2Xdot1LocSysGroup  OBJECT-GROUP
    OBJECTS {
        lldpV2Xdot1LocPortVlanId,
        lldpV2Xdot1LocProtoVlanSupported,
        lldpV2Xdot1LocProtoVlanEnabled,
        lldpV2Xdot1LocVlanName,
        lldpV2Xdot1LocProtocolId,
        lldpV2Xdot1LocVidUsageDigest,
        lldpV2Xdot1LocManVid,
        lldpV2Xdot1LocLinkAggStatus,
        lldpV2Xdot1LocLinkAggPortId
    }
    STATUS  current
    DESCRIPTION
            “The collection of objects which are used to represent
            IEEE 802.1 organizationally defined LLDP extension associated
            with the Local Device Information.”
    ::= { lldpV2Xdot1Groups 2 }

lldpV2Xdot1RemSysGroup  OBJECT-GROUP
```

```
    OBJECTS {
        lldpV2Xdot1RemPortVlanId,
        lldpV2Xdot1RemProtoVlanSupported,
        lldpV2Xdot1RemProtoVlanEnabled,
        lldpV2Xdot1RemVlanName,
        lldpV2Xdot1RemProtocolId,
        lldpV2Xdot1RemVidUsageDigest,
        lldpV2Xdot1RemManVid,
        lldpV2Xdot1RemLinkAggStatus,
        lldpV2Xdot1RemLinkAggPortId
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to represent LLDP
            802.1 organizational extension Local Device Information."
    ::= { lldpV2Xdot1Groups 3 }


END
```

E.11 PICS proforma for IEEE 802.1 Organizationally Specific TLV extensions[17]

E.11.1 Implementation identification

Supplier	
Contact point for queries about the PICS	
Implementation Name(s) and Version(s)	
Other information necessary for full identification—e.g., name(s) and version(s) of machines and/or operating system names	
NOTE 1—Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirement for full identification. NOTE 2—The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).	

E.11.2 Protocol summary, IEEE Std 802.1AB-2009

Identification of protocol specification	IEEE Std 802.1AB-2009, IEEE Standard for Local and Metropolitan Area Networks: Station and Media Access Control Connectivity Discovery
Identification of amendments and corrigenda to the PICS proforma that have been completed as part of the PICS	Amd. : Corr. : Amd. : Corr. :
Have any Exception items been required? (See B.3.3: The answer Yes means that the implementation does not conform to IEEE Std 802.1AB-2009.)	No [ ] Yes [ ]

Date of Statement	

[17] Instructions for completing the PICS Proforma are given in A.3.

E.11.3 Major capabilities and options

Item	Feature	Status	References	Support
dot1xset	Is the IEEE 802.1 Organizationally Specific TLV set implemented?	O	Annex E	Yes [ ] No [ ]
dot1xtlv	Is each TLV in the IEEE 802.1 Organizationally Specific TLV set implemented?			
	Port VLAN ID TLV Port And Protocol VLAN ID TLV VLAN Name TLV Protocol Identity TLV VID Usage Digest TLV Management VID TLV	dot1xtlv:M dot1xtlv:M dot1xtlv:M dot1xtlv:M dot1xtlv:M dot1xtlv:M	E.2 E.3 E.4 E.5 E.6 E.7	Yes [ ] Yes [ ] Yes [ ] Yes [ ] Yes [ ] Yes [ ]
lldpmib	Which type of MIB is implemented (one is mandatory)?			
	SNMP is supported (if yes, answer item **snmpmib** and skip **equivstor**)	O.1	E.10	Yes [ ] No [ ]
	SNMP is not supported (if yes, answer **equivstor** and skip **snmpmib**)	O.1	E.10	Yes [ ] No [ ]
snmpmib	If the SNMP MIB is implemented, is the MIB module in conformance with the MIB sections indicated in Table E.4 for the operating mode being implemented?	M	E.10	Yes [ ]
equivstor	If the SNMP is not supported, is the provided storage and retrieval capability functionally equivalent with the indicated specifications of this clause for the operating mode being implemented?	M	E.2. E.3, E.4, E.5, and E.8	Yes [ ]

Annex F

(normative)

IEEE 802.3 Organizationally Specific TLVs

NOTE—At the time of standardization, two projects to incorporate the IEEE 802.3 organizationally specific LLDP extension TLVs and the IEEE 802.3 extension MIB module into the IEEE 802.3 family of standards had been initiated (IEEE P802.3bc and IEEE P802.3.1 respectively). Once those projects complete, the IEEE 802.3 specifications will supersede the corresponding specifications contained in this annex, and this annex will be removed from a subsequent revision of this standard. It is recommended that readers of this standard familiarize themselves with the IEEE 802.3 specifications when they become available.

F.1 Requirements of the IEEE 802.3 Organizationally Specific TLV set

The IEEE 802.3 Organizationally Specific TLVs may be supported in conjunction with the ***Nearest device*** group MAC addresses listed in Table 7-1; however, they shall not be supported in conjunction with any of the other addresses listed in Table 7-1. If any IEEE 802.3 Organizationally Specific TLV is supported, all IEEE 802.1 Organizationally Specific TLVs shall be supported. All IEEE 802.3 Organizationally Specific TLVs shall conform to the LLDPDU bit and octet ordering conventions of 9.1.

NOTE—The *nearest device* group MAC address is the only one of the addresses in Table 7-1 that cannot be forwarded by any IEEE 802.1 relay device. Hence, when using either of the other addresses in Table 7-1, the data transmitted may or may not be received by a device attached to the same individual LAN as the sender, as there could be a TPMR or a Bridge in between, so the characteristics of the MAC may change between sender and receiver of an LLDPDU when these addresses are used. Hence, it makes no sense, and would be potentially misleading, to transmit MAC-specific TLVs on any address other than the *nearest device* group MAC address.

The currently defined IEEE 802.3 Organizationally Specific TLVs are listed in Table F.1. Any adds or changes to these TLVs will be included in this annex.

Table F.1—IEEE 802.3 Organizationally Specific TLVs

IEEE 802.3 subtype	TLV name	Subclause reference
1	MAC/PHY Configuration/Status	F.2
2	Power Via Medium Dependent Interface (MDI)	F.3
3	Link Aggregation (deprecated)	N/A
4	Maximum Frame Size	F.4
5–255	Reserved	—

F.2 MAC/PHY Configuration/Status TLV

The MAC/PHY Configuration/Status TLV is an optional TLV that identifies the following:

a) The duplex and bit-rate capability of the sending IEEE 802.3 LAN node that is connected to the physical medium.
b) The current duplex and bit-rate settings of the sending IEEE 802.3 LAN node.

c) Whether these settings are the result of auto-negotiation during link initiation or of manual set override action.

Figure F.1 shows the format of this TLV.

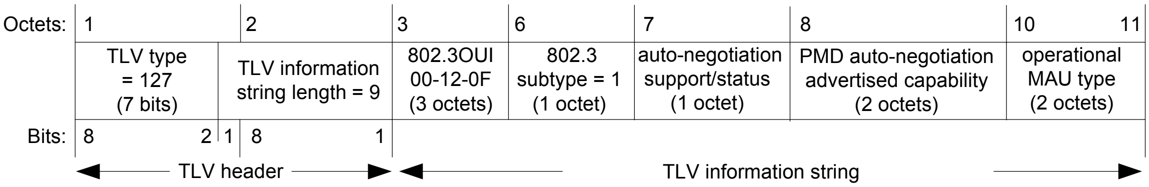

Octets: 1
2
3
6
7
8
10
11
TLV type = 127 (7 bits)
TLV information string length = 9
802.3OUI 00-12-0F (3 octets)
802.3 subtype = 1 (1 octet)
auto-negotiation support/status (1 octet)
PMD auto-negotiation advertised capability (2 octets)
operational MAU type (2 octets)
Bits: 8
2
1
8
1
TLV header
TLV information string

Figure F.1—MAC/PHY configuration/status TLV format

F.2.1 auto-negotiation support/status

The auto-negotiation support/status field shall contain a bit map that identifies the auto-negotiation support and current status of the local IEEE 802.3 LAN station as defined in Table F.2. If the auto-negotiation support bit (bit 0) is one and the auto-negotiation status bit (bit 1) is zero, the IEEE 802.3 physical media dependent sublayer (PMD) operating mode is determined by the operational Medium Attachment Unit (MAU) type field value rather than by auto-negotiation.

Table F.2—IEEE 802.3 auto-negotiation support/status

Bit	Function	Value/meaning	IETF RFC 4836 reference
0	Auto-negotiation support	1 = supported 0 = not supported	ifMauAutoNegSupported
1	Auto-negotiation status	1 = enabled 0 = not enabled	ifMauAutoNegAdminStatus
2–7	—	reserved for future standardization	—

F.2.2 PMD auto-negotiation advertised capability field

The “PMD auto-negotiation capability” field shall use the BITS pseudotype encoding, where zero is the high order (left-most) bit in an octet string. See 8.1, LLDP bit and octet ordering conventions.

F.2.3 operational MAU type

The operational MAU type field contains an integer value indicating the MAU type of the sending device. This value is derived from the list position of the corresponding dot3MauType as listed in IETF RFC 4836 (or subsequent revisions) and is equal to the last number in the respective dot3MauType OID. For example, if the ifMauType object is dot3MauType1000BaseTHD which corresponds to ‘dot3MauType 29’, the numerical value of this field is 29. For MAU types not listed in IETF RFC 4836 (or subsequent revisions), the value of this field shall be set to zero. For more information, see IEEE Std 802.3.

F.2.4 MAC/PHY Configuration/Status TLV usage rules

An LLDPDU should contain no more than one MAC/PHY Configuration/Status TLV.

F.3 Power Via MDI TLV

Three IEEE 802.3 PMD implementations (10BASE-T, 100BASE-TX, and 1000BASE-T) allow power to be supplied over the link for connected non-powered systems. The Power Via MDI TLV allows network management to advertise and discover the MDI power support capabilities of the sending IEEE 802.3 LAN station. Figure F.2 shows the format of this TLV.

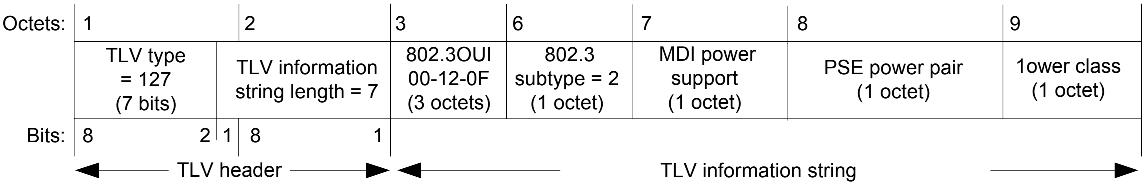


Figure F.2—Power Via MDI TLV format

F.3.1 MDI power support

The MDI power support field shall contain a bit-map of the MDI power capabilities and status as defined in Figure F.3.

Table F.3—MDI power capabilities/status

Bit	Function	Value/meaning	IETF RFC 3621 object reference
0	Port class	1 = PSE 0 = PD	See Note 1
1	Power Sourcing Equipment (PSE) MDI power support	1 = supported 0 = not supported	See Note 2 and Note 3
2	PSE MDI power state	1 = enabled 0 = disabled	pethPsePortAdminEnable
3	PSE pairs control ability	1 = pair selection can be controlled 0 = pair selection can not be controlled	pethPsePortPowerPairContolAbility
4–7	reserved for future standardization	—	—

NOTE 1—Port class information is implied by the support of the PSE or Powered Device (PD) groups.

NOTE 2—MDI power support information is implied by support of IETF RFC 3621.

NOTE 3—If bit 1 is zero, bit 2 has no meaning.

F.3.2 PSE power pair

The PSE power pair field shall contain an integer value as defined by the pethPsePortPowerPairs object in IETF RFC 3621.

F.3.3 power class

The power class field shall contain an integer value as defined by the pethPsePortPowerClassifications object in IETF RFC 3621.

F.3.4 Power Via MDI TLV usage rules

An LLDPDU should contain no more than one Power Via MDI TLV.

F.4 Maximum Frame Size TLV

The Maximum Frame Size TLV indicates the maximum frame size capability of the implemented MAC and PHY. Figure F.3 shows the format of this TLV.

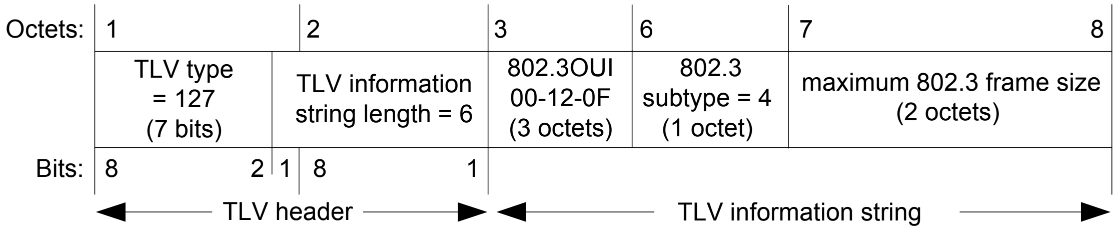

Octets:
1
2
3
6
7
8
TLV type = 127 (7 bits)
TLV information string length = 6
802.3OUI 00-12-0F (3 octets)
802.3 subtype = 4 (1 octet)
maximum 802.3 frame size (2 octets)
Bits:
8
2
1
8
1
TLV header
TLV information string

Figure F.3—Maximum Frame Size TLV format

F.4.1 maximum frame size

The maximum frame size field shall contain an integer value indicating the maximum supported frame size in octets as determined by the following:

a) If the MAC/PHY supports only the basic MAC frame format as defined in 3.1.1 of IEEE Std 802.3-2008, the maximum frame size field shall be set to 1518.
b) If the MAC/PHY supports an extension of the basic MAC frame format for Tagged MAC frames as defined 3.5 of IEEE Std 802.3-2008, the maximum frame size field shall be set to 1522.
c) If the MAC/PHY supports an extension of the MAC frame format that is different from either of the above, the maximum frame size field shall be set to the maximum value supported.

F.4.2 Maximum Frame Size TLV usage rules

An LLDPDU should contain no more than one Maximum Frame Size TLV.

F.5 IEEE 802.3 Organizationally Specific TLV selection management

TLV selection management consists of providing the network manager with the means to select which specific IEEE 802.3 Organizationally Specific TLVs are enabled for inclusion in an LLDPDU. The following LLDP variables cross reference to LLDP local systems configuration MIB tables indicate which specific TLVs are enabled for the particular port(s) on the system. The specific port(s) through which each TLV is enabled for transmission may be set (or reset) by the network manager:

a) **mibXdot3TLVsTxEnable:** This variable lists the single-instance use IEEE 802.3 Organizationally Specific TLVs, each with a bit map indicating the system ports through which the referenced TLV is enabled for transmission.

F.5.1 IEEE 802.3 managed objects—TLV variables

F.5.1.1 MAC/PHY Configuration/Status TLV managed objects

a) **Auto-negotiation support:** Indication of whether auto-negotiation is supported (see F.2.1).
b) **Auto-negotiation status:** Indication of whether auto-negotiation is enabled (see F.2.1).
c) **PMD auto-negotiation advertised capability:** The auto-negotiation and speed capabilities of the PMD (see F.2.2).
d) **operational MAU type:** The operational MAU type (see F.2.2).

F.5.1.2 Power Via MDI TLV managed objects

a) **Port class:** Indication of whether the port is PSE or PD (see F.3.1).
b) **PSE MDI power support:** Indication of whether MDI power is supported (see F.3.1).
c) **PSE MDI power state:** Indication of whether MDI power is enabled (see F.3.1).
d) **PSE Pairs control ability:** Indication of whether pair selection can be controlled (see F.3.1).
e) **PSE power pair:** Indication of which pair is powered (see F.3.2).
f) **power class:** Indication of the required power level required (see F.3.3).

F.5.1.3 Maximum Frame Size TLV managed object

a) **maximum IEEE 802.3 frame size:** The maximum supported IEEE 802.3 frame size.

F.6 IEEE 802.3/LLDP extension MIB

F.6.1 Internet Standard Management Framework

LLDP MIBs are designed to operate in a manner consistent with the principles of the Internet Standard Management Framework, which describes the separation of a data modeling language (for example, SMIv2) from content specific data models (for example the LLDP remote systems MIB), and from messages and protocol operations used to manipulate the data (for example SNMPv3).

For a detailed overview of the documents that describe the current Internet Standard Management Framework, please refer to section 7 of IETF RFC 3410 (2002).

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This clause specifies a MIB module that is compliant to the SMIv2, which is described in IETF STD 58, IETF RFC 2578, IETF RFC 2579, and IETF RFC 2580.

F.6.2 Structure of the IEEE 802.3/LLDP extension MIB

Table F.4 summarizes the particular object groups that are required for each operating mode. The implemented MIB shall comply with the MIB conformance section for the particular operating mode being supported.

Table F.5 shows the structure of the MIB and the relationship of the MIB objects to the LLDP operational status/control variables, LLDP statistics variables, and TLV variables.

Table F.4—IEEE 802.1 extension MIB object group conformance requirements

MIB group	Rx mode	Tx mode	Tx/Rx mode
lldpV2Xdot3ConfigGroup	M[a]	M	M
lldpV2Xdot1LocSysGroup	M	—	M
lldpV2Xdot1RemSysGroup	—	M	M
ifGeneralInformationGroup	M	M	M

[a] M=Mandatory

Table F.5—IEEE 802.3/LLDP extension MIB cross reference

MIB table	MIB object	LLDP reference
Configuration group		
lldpV2Xdot3PortConfigTable		Augments lldpV2PortConfigEntry
	lldpV2Xdot3PortConfigTLVsTxEnable	Normal LLPDUs, 9.1.2.1
Local devices information group		
lldpV2Xdot3LocPortTable		
	lldpV2LocPortIfIndex	(Table index)
	lldpV2Xdot3LocPortAutoNegSupported	auto-negotiation support/status, F.2.1
	lldpV2Xdot3LocPortAutoNegEnabled	auto-negotiation support/status, F.2.1
	lldpV2Xdot3LocPortAutoNegAdvertisedCap	auto-negotiation advertised, F.2.2
	lldpV2Xdot3LocPortOperMauType	operational MAU type, F.2.3
lldpV2Xdot3LocPowerTable		
	lldpV2LocPortIfIndex	(Table index)
	lldpV2Xdot3LocPowerPortClass	MDI power support, F.3.1
	lldpV2Xdot3LocPowerMDISupported	MDI power support, F.3.1
	lldpV2Xdot3LocPowerMDIEnabled	MDI power support, F.3.1
	lldpV2Xdot3LocPowerPairControlable	MDI power support, F.3.1
	lldpV2Xdot3LocPowerPairs	PSE power pair, F.3.2
	lldpV2Xdot3LocPowerClass	power class, F.3.3
lldpV2Xdot3LocMaxFrameSizeTable		
	lldpV2LocPortIfIndex	(Table index)
	lldpV2Xdot3LocMaxFrameSize	maximum frame size, F.4.1
Remote devices information group		
lldpV2Xdot3RemPortTable		

Table F.5—IEEE 802.3/LLDP extension MIB cross reference *(continued)*

MIB table	MIB object	LLDP reference
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2Xdot3RemPortAutoNegSupported	auto-negotiation support/status, F.2.1
	lldpV2Xdot3RemPortAutoNegEnabled	auto-negotiation support/status, F.2.1
	lldpV2Xdot3RemPortAutoNegAdvertisedCap	auto-negotiation advertised, F.2.2
	lldpV2Xdot3RemPortOperMauType	operational MAU type, F.2.3
lldpV2Xdot3RemPowerTable		
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2Xdot3RemPowerPortClass	MDI power support, F.3.1
	lldpV2Xdot3RemPowerMDISupported	MDI power support, F.3.1
	lldpV2Xdot3RemPowerMDIEnabled	MDI power support, F.3.1
	lldpV2Xdot3RemPowerPairControlable	MDI power support, F.3.1
	lldpV2Xdot3RemPowerPairs	PSE power pair, F.3.2
	lldpV2Xdot3RemPowerClass	power class, F.3.3
lldpV2Xdot3RemMaxFrameSizeTable		
	lldpV2RemTimeMark	(Table index)
	lldpV2RemLocalIfIndex	(Table index)
	lldpV2RemLocalDestMACAddress	(Table index)
	lldpV2RemIndex	(Table index)
	lldpV2Xdot3RemMaxFrameSize	maximum frame size, F.4.1

F.6.3 Relationship to other MIBs

Version 2 of the IEEE 802.3 LLDP extension MIB module appears in F.6.5. Version 1 of the MIB module that was published in the initial 2005 publication of this standard has been superseded by version 2 of the

MIB module, and support of the version 2 MIB module is a requirement for conformance to the required or optional capabilities (Clause 5) in this revision of the standard. The version 2 MIB module reflects changes in indexation of the MIB objects that support the use of LLDP with multiple destination MAC addresses, as discussed in Clause 6.

The relationship of the IEEE 802.1 LLDP extension MIB module to other MIBs, and coexistence between version 1 and version 2 implementations, is further discussed in 11.3.

F.6.4 Security considerations for IEEE 802.3 LLDP extension MIB module

There are a number of management objects defined in this MIB module with a MAX-ACCESS clause of read-write.[18] Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

Setting the object, lldpXdot3PortConfigTLVsTxEnable, to incorrect values can result in improper operation of LLDP.

The following readable objects in this MIB module may be considered to be sensitive of vulnerable in some network environments:

a) Objects that are associated with the transmit mode:
   1) lldpV2Xdot3LocPortAutoNegSupported,
   2) lldpV2Xdot3LocPortAutoNegEnabled,
   3) lldpV2Xdot3LocPortAutoNegAdvertisedCap,
   4) lldpV2Xdot3LocPortOperMauType,
   5) lldpV2Xdot3LocPowerPortClass,
   6) lldpV2Xdot3LocPowerMDISupported,
   7) lldpV2Xdot3LocPowerMDIEnabled,
   8) lldpV2Xdot3LocPowerPairControlable,
   9) lldpV2Xdot3LocPowerPairs,
   10) lldpV2Xdot3LocPowerClass,
   11) lldpV2Xdot3LocMaxFrameSize
b) Objects that are associated with the receive mode:
   1) lldpV2Xdot3RemPortAutoNegSupported,
   2) lldpV2Xdot3RemPortAutoNegEnabled,
   3) lldpV2Xdot3RemPortAutoNegAdvertisedCap,
   4) lldpV2Xdot3RemPortOperMauType,
   5) lldpV2Xdot3RemPowerPortClass,
   6) lldpV2Xdot3RemPowerMDISupported,
   7) lldpV2Xdot3RemPowerMDIEnabled,
   8) lldpV2Xdot3RemPowerPairControlable,
   9) lldpV2Xdot3RemPowerPairs,
   10) lldpV2Xdot3RemPowerClass,
   11) lldpV2Xdot3RemMaxFrameSize

This concern applies both to objects that describe the configuration of the local host, as well as for objects that describe information from the remote hosts, acquired via LLDP and displayed by the objects in this MIB module. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP.

[18] In IETF MIB definitions, the MAX-ACCESS clause defines the type of access that is allowed for particular data elements in the MIB. An explanation of the MAX-ACCESS mapping is given in section 7.3 of IETF RFC 2578 [B10].

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

Implementers consider the security features as provided by the SNMPv3 framework (see IETF RFC 3410, section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, implementers should not deploy SNMP versions prior to SNMPv3. Instead, implementers should deploy SNMPv3 to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

F.6.5 IEEE 802.3 LLDP extension MIB module—version 2 [19, 20]

In the following MIB definition, should any discrepancy between the DESCRIPTION text and the corresponding definition in F.2 through F.4 of this annex occur, the definitions in F.2 through F.4 shall take precedence.

```
LLDP-EXT-DOT3-V2-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY,
    OBJECT-TYPE,
    Unsigned32
        FROM SNMPv2-SMI
    TruthValue
        FROM SNMPv2-TC
    MODULE-COMPLIANCE,
    OBJECT-GROUP
        FROM SNMPv2-CONF
    ifGeneralInformationGroup
        FROM IF-MIB
    lldpV2Extensions,
    lldpV2LocPortIfIndex,
    lldpV2RemTimeMark,
    lldpV2RemLocalIfIndex,
    lldpV2RemLocalDestMACAddress,
    lldpV2RemIndex,
    lldpV2PortConfigEntry
        FROM LLDP-V2-MIB
    LldpV2PowerPortClass
        FROM LLDP-V2-TC-MIB;

lldpV2Xdot3MIB MODULE-IDENTITY
    LAST-UPDATED "200906080000Z" -- June 08, 2009
    ORGANIZATION "IEEE 802.1 Working Group"
    CONTACT-INFO
            "WG-URL: http://grouper.ieee.org/groups/802/1/index.html
            WG-EMail: STDS-802-1-L@LISTSERV.IEEE.ORG
```

[19] *Copyright release for MIBs:* Users of this standard may freely reproduce the MIB contained in this subclause so that it can be used for its intended purpose.

[20] An ASCII version of this MIB module can be obtained by Web browser from the IEEE 802.1 Website at http://www.ieee802.org/1/pages/MIBS.html.

```
            Contact: Tony Jeffree
            Postal:  11a Poplar Grove
                     Sale
                     Cheshire M33 3AX
                     UK
            Tel:     +44-161-973-4278
            E-mail:  tony@jeffree.co.uk"
    DESCRIPTION
            "The LLDP Management Information Base extension module for
            IEEE 802.3 organizationally defined discovery information.

            In order to assure the uniqueness of the LLDP-MIB,
            lldpV2Xdot3MIB is branched from lldpV2Extensions using OUI value
            as the node.  An OUI/'company_id' is a 24 bit globally unique
            assigned number referenced by various standards.

            Unless otherwise indicated, the references in this
            MIB module are to IEEE 802.1AB-2009.

            Copyright (C) IEEE (2009).  This version of this MIB module
            is published as Annex F.6.5 of IEEE Std 802.1AB-2009;
            see the standard itself for full legal notices."

    REVISION "200906080000Z" -- June 08, 2009

    DESCRIPTION
            "Published as part of IEEE Std 802.1AB-2009 revision.
            This revision incorporated changes to the MIB to
            support the use of LLDP with multiple destination MAC
            addresses, and to deprecate the Link Aggregation TLV
            (now moved to the 802.1 extension MIB)."

-- OUI for IEEE 802.3 is 4623 (00-12-0F)
   ::= { lldpV2Extensions 4623 }

------------------------------------------------------------------------------
------------------------------------------------------------------------------
--
-- Organizationally Defined Information Extension - IEEE 802.3
--
------------------------------------------------------------------------------
------------------------------------------------------------------------------

lldpV2Xdot3Objects    OBJECT IDENTIFIER ::= { lldpV2Xdot3MIB 1 }

-- LLDP IEEE 802.3 extension MIB groups
lldpV2Xdot3Config     OBJECT IDENTIFIER ::= { lldpV2Xdot3Objects 1 }
lldpV2Xdot3LocalData  OBJECT IDENTIFIER ::= { lldpV2Xdot3Objects 2 }
lldpV2Xdot3RemoteData OBJECT IDENTIFIER ::= { lldpV2Xdot3Objects 3 }



------------------------------------------------------------------------------
-- IEEE 802.3 - Configuration
------------------------------------------------------------------------------


--
```

```
-- Version 2 of lldpV2Xdot3PortConfigTable
-- supports use of multiple destination MAC addresses
--


lldpV2Xdot3PortConfigTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot3PortConfigEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "A table that controls selection of LLDP TLVs to be transmitted
            on individual ports."
    ::= { lldpV2Xdot3Config 1 }

lldpV2Xdot3PortConfigEntry  OBJECT-TYPE
    SYNTAX      LldpV2Xdot3PortConfigEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "LLDP configuration information that controls the
            transmission of IEEE 802.3 organizationally defined TLVs on
            LLDP transmission capable ports.

            This configuration object augments the lldpV2PortConfigEntry of
            the LLDP-MIB, therefore it is only present along with the port
            configuration defined by the associated lldpV2PortConfigEntry
            entry.

            Each active lldpV2Xdot3PortConfigEntry is restored from non-volatile
            storage (along with the corresponding lldpV2PortConfigEntry)
            after a re-initialization of the management system."
    AUGMENTS { lldpV2PortConfigEntry }
    ::= { lldpV2Xdot3PortConfigTable 1 }

LldpV2Xdot3PortConfigEntry ::= SEQUENCE {
      lldpV2Xdot3PortConfigTLVsTxEnable  BITS
}

lldpV2Xdot3PortConfigTLVsTxEnable  OBJECT-TYPE
    SYNTAX      BITS {
            macPhyConfigStatus(0),
            powerViaMDI(1),
            unused(2), --avoids re-use of the old link agg bit number
            maxFrameSize(3)
    }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
            "The lldpV2Xdot3PortConfigTLVsTxEnable, defined as a bitmap,
            includes the IEEE 802.3 organizationally defined set of LLDP
            TLVs whose transmission is allowed on the local LLDP agent by
            the network management.  Each bit in the bitmap corresponds
            to an IEEE 802.3 subtype associated with a specific IEEE
            802.3 optional TLV.  The bit 0 is not used since there is
            no corresponding subtype.

            The bit 'macPhyConfigStatus(0)' indicates that LLDP agent
            should transmit 'MAC/PHY configuration/status TLV'.
            The bit 'powerViaMDI(1)' indicates that LLDP agent should
            transmit 'Power via MDI TLV'.

            The bit 'unused(2)' is no longer used; this was used for
            the 'Link Aggregation TLV' in the previous version.

            The bit 'maxFrameSize(3)' indicates that LLDP agent should
            transmit 'Maximum-frame-size TLV'.

            The default value for lldpV2Xdot3PortConfigTLVsTxEnable object
            is an empty set, which means no enumerated values are set.

            The value of this object is restored from non-volatile
            storage after a re-initialization of the management system."
    REFERENCE
            "9.1.2.1"
    DEFVAL  { { } }
    ::= { lldpV2Xdot3PortConfigEntry  1 }



------------------------------------------------------------------------------
-- IEEE 802.3 - Local Device Information
------------------------------------------------------------------------------

---
--- lldpV2Xdot3LocPortTable: Ethernet Port AutoNeg/Speed/Duplex
---                        Information Table
--- V2 modified to be indexed by ifIndex.
---

lldpV2Xdot3LocPortTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot3LocPortEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per port of Ethernet port
            information (as a part of the LLDP 802.3 organizational
            extension) on the local system known to this agent."
    ::= { lldpV2Xdot3LocalData 1 }

lldpV2Xdot3LocPortEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot3LocPortEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about a particular port component."
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot3LocPortTable 1 }

LldpV2Xdot3LocPortEntry ::= SEQUENCE {
         lldpV2Xdot3LocPortAutoNegSupported     TruthValue,
         lldpV2Xdot3LocPortAutoNegEnabled       TruthValue,
         lldpV2Xdot3LocPortAutoNegAdvertisedCap OCTET STRING,
         lldpV2Xdot3LocPortOperMauType          Unsigned32
}

lldpV2Xdot3LocPortAutoNegSupported OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether the given port
            (associated with the local system) supports Auto-negotiation."
    REFERENCE
            "F.2.1"
    ::= { lldpV2Xdot3LocPortEntry 1 }

lldpV2Xdot3LocPortAutoNegEnabled  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether port
            Auto-negotiation is enabled on the given port associated
            with the local system."
    REFERENCE
            "F.2.1"
    ::= { lldpV2Xdot3LocPortEntry 2 }

lldpV2Xdot3LocPortAutoNegAdvertisedCap OBJECT-TYPE
    SYNTAX      OCTET STRING(SIZE(2))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the value (bitmap) of the
            ifMauAutoNegCapAdvertisedBits object (defined in IETF RFC
            3636) which is associated with the given port on the
            local system."
    REFERENCE
            "F.2.2"
    ::= { lldpV2Xdot3LocPortEntry 3 }

lldpV2Xdot3LocPortOperMauType  OBJECT-TYPE
    SYNTAX      Unsigned32(0..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "An integer value that indicates the operational MAU type
            of the given port on the local system.

            This object contains the integer value derived from the
            list position of the corresponding dot3MauType as listed
            in IETF RFC 4836 (or subsequent revisions) and is equal
            to the last number in the respective dot3MauType OID.

            For example, if the ifMauType object is dot3MauType1000BaseTHD
            which corresponds to {dot3MauType 29}, the numerical value of
            this field is 29. For MAU types not listed in RFC 4836
            (or subsequent revisions), the value of this field shall be
            set to zero."
    REFERENCE
            "F.2.3"
    ::= { lldpV2Xdot3LocPortEntry 4 }
```

```
---
--- lldpV2Xdot3LocPowerTable: Power Ethernet Information Table
--- V2 modified to be indexed by ifIndex.
---
---

lldpV2Xdot3LocPowerTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot3LocPowerEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per port of power ethernet
            information (as a part of the LLDP 802.3 organizational
            extension) on the local system known to this agent."
    ::= { lldpV2Xdot3LocalData 2 }

lldpV2Xdot3LocPowerEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot3LocPowerEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about a particular port component."
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot3LocPowerTable 1 }

LldpV2Xdot3LocPowerEntry ::= SEQUENCE {
         lldpV2Xdot3LocPowerPortClass           LldpV2PowerPortClass,
         lldpV2Xdot3LocPowerMDISupported        TruthValue,
         lldpV2Xdot3LocPowerMDIEnabled           TruthValue,
         lldpV2Xdot3LocPowerPairControlable     TruthValue,
         lldpV2Xdot3LocPowerPairs               Unsigned32,
         lldpV2Xdot3LocPowerClass               Unsigned32
}


lldpV2Xdot3LocPowerPortClass  OBJECT-TYPE
    SYNTAX      LldpV2PowerPortClass
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The value that identifies the port Class of the given port
            associated with the local system."
    REFERENCE
            "F.3.1"
    ::= { lldpV2Xdot3LocPowerEntry 1 }

lldpV2Xdot3LocPowerMDISupported  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether the MDI power is
            supported on the given port associated with the local system."
    REFERENCE
            "F.3.1"
    ::= { lldpV2Xdot3LocPowerEntry 2 }

lldpV2Xdot3LocPowerMDIEnabled  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to identify whether MDI power is
            enabled on the given port associated with the local system."
    REFERENCE
            "F.3.1"
    ::= { lldpV2Xdot3LocPowerEntry 3 }

lldpV2Xdot3LocPowerPairControlable  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value is derived from the value of
            pethPsePortPowerPairsControlAbility object (defined in IETF
            RFC 3621) and is used to indicate whether the pair selection
            can be controlled on the given port associated with the
            local system."
    REFERENCE
            "F.3.1"
    ::= { lldpV2Xdot3LocPowerEntry 4 }

lldpV2Xdot3LocPowerPairs  OBJECT-TYPE
    SYNTAX      Unsigned32(1|2)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the value of the pethPsePortPowerPairs
            object (defined in IETF RFC 3621) which is associated with
            the given port on the local system."
    REFERENCE
            "F.3.2"
    ::= { lldpV2Xdot3LocPowerEntry 5 }

lldpV2Xdot3LocPowerClass  OBJECT-TYPE
    SYNTAX      Unsigned32(1|2|3|4|5)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the value of the
            pethPsePortPowerClassifications object (defined in IETF
            RFC 3621) which is associated with the given port on the
            local system."
    REFERENCE
            "F.3.3"
    ::= { lldpV2Xdot3LocPowerEntry 6 }



---
---
--- lldpV2Xdot3LocMaxFrameSizeTable: Maximum Frame Size information
--- V2 modified to be indexed by ifIndex.
---
---
lldpV2Xdot3LocMaxFrameSizeTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot3LocMaxFrameSizeEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per port of maximum frame
            size information (as a part of the LLDP 802.3 organizational
            extension) on the local system known to this agent."
    ::= { lldpV2Xdot3LocalData 3 }

lldpV2Xdot3LocMaxFrameSizeEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot3LocMaxFrameSizeEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Maximum Frame Size information about a particular port
            component."
    INDEX   { lldpV2LocPortIfIndex }
    ::= { lldpV2Xdot3LocMaxFrameSizeTable 1 }

LldpV2Xdot3LocMaxFrameSizeEntry ::= SEQUENCE {
        lldpV2Xdot3LocMaxFrameSize             Unsigned32
}

lldpV2Xdot3LocMaxFrameSize OBJECT-TYPE
    SYNTAX      Unsigned32(0..65535)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "An integer value indicating the maximum supported frame
             size in octets on the given port of the local system."
    REFERENCE
            "F.4.1"
    ::= { lldpV2Xdot3LocMaxFrameSizeEntry 1 }



------------------------------------------------------------------------------
-- IEEE 802.3 - Remote Devices Information
------------------------------------------------------------------------------

---
---
--- lldpV2Xdot3RemPortTable: Ethernet Information Table
--- V2 modified to be indexed by ifIndex and destination MAC address.
---
---

lldpV2Xdot3RemPortTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot3RemPortEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains Ethernet port information (as a part
            of the LLDP 802.3 organizational extension) of the remote
            system."
    ::= { lldpV2Xdot3RemoteData 1 }

lldpV2Xdot3RemPortEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot3RemPortEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about a particular physical network connection."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpV2Xdot3RemPortTable 1 }

LldpV2Xdot3RemPortEntry ::= SEQUENCE {
              lldpV2Xdot3RemPortAutoNegSupported     TruthValue,
              lldpV2Xdot3RemPortAutoNegEnabled       TruthValue,
              lldpV2Xdot3RemPortAutoNegAdvertisedCap OCTET STRING,
              lldpV2Xdot3RemPortOperMauType          Unsigned32
}


lldpV2Xdot3RemPortAutoNegSupported OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether the given port
            (associated with remote system) supports Auto-negotiation."
    REFERENCE
            "F.2.1"
    ::= { lldpV2Xdot3RemPortEntry 1 }

lldpV2Xdot3RemPortAutoNegEnabled  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether port
            Auto-negotiation is enabled on the given port associated
            with the remote system."
    REFERENCE
            "F.2.1"
    ::= { lldpV2Xdot3RemPortEntry 2 }

lldpV2Xdot3RemPortAutoNegAdvertisedCap  OBJECT-TYPE
    SYNTAX      OCTET STRING(SIZE(2))
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the value (bitmap) of the
            ifMauAutoNegCapAdvertisedBits object (defined in IETF RFC
            3636) which is associated with the given port on the
            remote system."
    REFERENCE
            "F.2.2"
    ::= { lldpV2Xdot3RemPortEntry 3 }

lldpV2Xdot3RemPortOperMauType OBJECT-TYPE
    SYNTAX      Unsigned32(0..2147483647)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "An integer value that indicates the operational MAU type
            of the sending device.
            This object contains the integer value derived from the
            list position of the corresponding dot3MauType as listed in
            in IETF RFC 4836 (or subsequent revisions) and is equal
            to the last number in the respective dot3MauType OID.

            For example, if the ifMauType object is dot3MauType1000BaseTHD
            which corresponds to {dot3MauType 29}, the numerical value of
            this field is 29. For MAU types not listed in RFC 4836
            (or subsequent revisions), the value of this field shall be
            set to zero."
    REFERENCE
            "F.2.3"
    ::= { lldpV2Xdot3RemPortEntry 4 }


---
---
--- lldpV2Xdot3RemPowerTable: Power Ethernet Information Table
--- V2 modified to be indexed by ifIndex and destination MAC address.
---
---

lldpV2Xdot3RemPowerTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot3RemPowerEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains Ethernet power information (as a part
            of the LLDP 802.3 organizational extension) of the remote
            system."
    ::= { lldpV2Xdot3RemoteData 2 }

lldpV2Xdot3RemPowerEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot3RemPowerEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Information about a particular physical network connection."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpV2Xdot3RemPowerTable 1 }

LldpV2Xdot3RemPowerEntry ::= SEQUENCE {
              lldpV2Xdot3RemPowerPortClass           LldpV2PowerPortClass,
              lldpV2Xdot3RemPowerMDISupported        TruthValue,
              lldpV2Xdot3RemPowerMDIEnabled          TruthValue,
              lldpV2Xdot3RemPowerPairControlable     TruthValue,
              lldpV2Xdot3RemPowerPairs               Unsigned32,
              lldpV2Xdot3RemPowerClass               Unsigned32
}


lldpV2Xdot3RemPowerPortClass  OBJECT-TYPE
    SYNTAX      LldpV2PowerPortClass
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The value that identifies the port Class of the given port
            associated with the remote system."
    REFERENCE
            "F.3.1"
    ::= { lldpV2Xdot3RemPowerEntry 1 }

lldpV2Xdot3RemPowerMDISupported  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to indicate whether the MDI power
            is supported on the given port associated with the remote
            system."
    REFERENCE
            "F.3.1"
    ::= { lldpV2Xdot3RemPowerEntry 2 }

lldpV2Xdot3RemPowerMDIEnabled  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value used to identify whether MDI power is
            enabled on the given port associated with the remote system."
    REFERENCE
            "F.3.1"
    ::= { lldpV2Xdot3RemPowerEntry 3 }

lldpV2Xdot3RemPowerPairControlable  OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The truth value is derived from the value of
            pethPsePortPowerPairsControlAbility object (defined in IETF
            RFC 3621) and is used to indicate whether the pair selection
            can be controlled on the given port associated with the
            remote system."
    REFERENCE
            "F.3.1"
    ::= { lldpV2Xdot3RemPowerEntry 4 }

lldpV2Xdot3RemPowerPairs  OBJECT-TYPE
    SYNTAX      Unsigned32(1|2)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the value of the pethPsePortPowerPairs
            object (defined in IETF RFC 3621) which is associated with
            the given port on the remote system."
    REFERENCE
            "F.3.2"
    ::= { lldpV2Xdot3RemPowerEntry 5 }

lldpV2Xdot3RemPowerClass  OBJECT-TYPE
    SYNTAX      Unsigned32(1|2|3|4|5)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This object contains the value of the
            pethPsePortPowerClassifications object (defined in IETF
            RFC 3621) which is associated with the given port on the
            remote system."
    REFERENCE
            "F.3.3"
    ::= { lldpV2Xdot3RemPowerEntry 6 }



---
--- lldpV2Xdot3RemMaxFrameSizeTable: Maximum Frame Size information
--- V2 modified to be indexed by ifIndex and destination MAC address.
---
---

lldpV2Xdot3RemMaxFrameSizeTable  OBJECT-TYPE
    SYNTAX      SEQUENCE OF LldpV2Xdot3RemMaxFrameSizeEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "This table contains one row per port/destination
            address pair of maximum frame
            size information (as a part of the LLDP IEEE 802.3
            organizational extension) of the remote system."
    ::= { lldpV2Xdot3RemoteData 3 }

lldpV2Xdot3RemMaxFrameSizeEntry OBJECT-TYPE
    SYNTAX      LldpV2Xdot3RemMaxFrameSizeEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "Maximum Frame Size information about a particular port
            component."
    INDEX   { lldpV2RemTimeMark,
              lldpV2RemLocalIfIndex,
              lldpV2RemLocalDestMACAddress,
              lldpV2RemIndex }
    ::= { lldpV2Xdot3RemMaxFrameSizeTable 1 }

LldpV2Xdot3RemMaxFrameSizeEntry ::= SEQUENCE {
              lldpV2Xdot3RemMaxFrameSize   Unsigned32
}

lldpV2Xdot3RemMaxFrameSize OBJECT-TYPE
    SYNTAX      Unsigned32(0..65535)
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "An integer value indicating the maximum supported frame
             size in octets on the port component associated with the
             remote system."
    REFERENCE
            "F.4.1"
    ::= { lldpV2Xdot3RemMaxFrameSizeEntry 1 }
```

```
-------------------------------------------------------------------------------
-- Conformance Information
-------------------------------------------------------------------------------
lldpV2Xdot3Conformance OBJECT IDENTIFIER ::= { lldpV2Xdot3MIB 2 }
lldpV2Xdot3Compliances OBJECT IDENTIFIER ::= { lldpV2Xdot3Conformance 1 }
lldpV2Xdot3Groups      OBJECT IDENTIFIER ::= { lldpV2Xdot3Conformance 2 }

-- compliance statements


lldpV2Xdot3TxRxCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "A compliance statement for SNMP entities that implement
            the LLDP 802.3 organizational extension MIB.

            This group is mandatory for all agents that implement the
            LLDP 802.3 organizational extension in TX and/or RX mode.

            This version defines compliance requirements for
            V2 of the LLDP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2Xdot3ConfigGroup,
                           ifGeneralInformationGroup
        }
    ::= { lldpV2Xdot3Compliances 1 }

lldpV2Xdot3TxCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "The compliance statement for SNMP entities which implement
            the LLDP 802.3 organizational extension MIB.

            This group is mandatory for agents which implement the
            LLDP 802.3 organizational extension in the TX mode.

            This version defines compliance requirements for
            V2 of the LLDP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2Xdot3LocSysGroup }
    ::= { lldpV2Xdot3Compliances 2 }

lldpV2Xdot3RxCompliance MODULE-COMPLIANCE
    STATUS  current
    DESCRIPTION
            "The compliance statement for SNMP entities which implement
            the LLDP 802.3 organizational extension MIB.

            This group is mandatory for agents which implement the
            LLDP 802.3 organizational extension in the RX mode.

            This version defines compliance requirements for
            V2 of the LLDP MIB."
    MODULE  -- this module
        MANDATORY-GROUPS { lldpV2Xdot3RemSysGroup }
    ::= { lldpV2Xdot3Compliances 3 }


-- MIB groupings
```

```
lldpV2Xdot3ConfigGroup    OBJECT-GROUP
    OBJECTS {
        lldpV2Xdot3PortConfigTLVsTxEnable
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to configure the
            LLDP 802.3 organizational extension implementation behavior. "
    ::= { lldpV2Xdot3Groups 1 }

lldpV2Xdot3LocSysGroup  OBJECT-GROUP
    OBJECTS {
        lldpV2Xdot3LocPortAutoNegSupported,
        lldpV2Xdot3LocPortAutoNegEnabled,
        lldpV2Xdot3LocPortAutoNegAdvertisedCap,
        lldpV2Xdot3LocPortOperMauType,
        lldpV2Xdot3LocPowerPortClass,
        lldpV2Xdot3LocPowerMDISupported,
        lldpV2Xdot3LocPowerMDIEnabled,
        lldpV2Xdot3LocPowerPairControlable,
        lldpV2Xdot3LocPowerPairs,
        lldpV2Xdot3LocPowerClass,
        lldpV2Xdot3LocMaxFrameSize
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to represent LLDP
            802.3 organizational extension Local Device Information. "
    ::= { lldpV2Xdot3Groups 2 }

lldpV2Xdot3RemSysGroup  OBJECT-GROUP
    OBJECTS {
        lldpV2Xdot3RemPortAutoNegSupported,
        lldpV2Xdot3RemPortAutoNegEnabled,
        lldpV2Xdot3RemPortAutoNegAdvertisedCap,
        lldpV2Xdot3RemPortOperMauType,
        lldpV2Xdot3RemPowerPortClass,
        lldpV2Xdot3RemPowerMDISupported,
        lldpV2Xdot3RemPowerMDIEnabled,
        lldpV2Xdot3RemPowerPairControlable,
        lldpV2Xdot3RemPowerPairs,
        lldpV2Xdot3RemPowerClass,
        lldpV2Xdot3RemMaxFrameSize
    }
    STATUS  current
    DESCRIPTION
            "The collection of objects which are used to represent LLDP
            802.3 organizational extension Local Device Information. "
    ::= { lldpV2Xdot3Groups 3 }

END
```

F.7 PICS proforma for IEEE 802.3 TLV extensions[21]

F.7.1 Implementation identification

Supplier	
Contact point for queries about the PICS	
Implementation Name(s) and Version(s)	
Other information necessary for full identification—e.g., name(s) and version(s) of machines and/or operating system names	
NOTE 1—Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirement for full identification. NOTE 2—The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).	

F.7.2 Protocol summary, IEEE Std 802.1AB-2009

Identification of protocol specification	IEEE Std 802.1AB-2009, IEEE Standard for Local and Metropolitan Area Networks: Station and Media Access Control Connectivity Discovery
Identification of amendments and corrigenda to the PICS proforma that have been completed as part of the PICS	Amd. : Corr. : Amd. : Corr. :
Have any Exception items been required? (See B.3.3: The answer Yes means that the implementation does not conform to IEEE 802.1AB.)	No [ ] Yes [ ]

Date of Statement	

[21] Instructions for completing the PICS Proforma are given in A.3.

F.7.3 Major capabiities and options

Item	Feature	Status	References	Support
dot3xset	Is the IEEE 802.3 Organizationally Specific TLV set implemented?	O	Annex G	Yes [ ] No [ ]
dot3xtlv	Is each TLV in the IEEE 802.3 extension set implemented?			
	Auto-negotiation TLV Power Via MDI TLV Maximum Frame Size TLV	dot3xtlv:M dot3xtlv:M dot3xtlv:M	F.2 F.3 F.4	Yes [ ] Yes [ ] Yes [ ]
lldpmib	Which type of MIB is implemented (one is mandatory)?			
	SNMP is supported (if yes, answer item **snmpmib** and skip **equivstor**)	O.2	F.6	Yes [ ] No [ ]
	SNMP is not supported (if yes, answer **equivstor** and skip **snmpmib**)	O.2	F.6	Yes [ ] No [ ]
snmpmib	If the SNMP MIB is implemented, is the MIB module in conformance with the MIB sections indicated in Table E.4 for the operating mode being implemented?	M	F.6	Yes [ ]
equivstor	If the SNMP is not supported, is the provided storage and retrieval capability functionally equivalent with the indicated specifications of this clause for the operating mode being implemented?	M	F.2, F.3, F.4, F.4, and F.5	Yes [ ]

Annex G

(informative)

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[B2] IEEE P802.1aj, Draft Standard for Local and Metropolitan Area Networks—Virtual Bridged Local Area Networks—Amendment: Two-port Media Access Control (MAC) Relay.[23]

[B3] IEEE Std 802.5, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 5: Token ring access method and physical layer specifications.[24]

[B4] IEEE Std 802.11, Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications.

[B5] IEEE Std 802.16™, Standard for Local and metropolitan area networks—Part 16: Air Interface for Fixed Broadband Wireless Access Systems.

[B6] IEEE Std 802.17™, Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements—Part 17: Resilient packet ring (RPR) access method and physical layer specifications.

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[B10] IETF RFC 2284, PPP Extensible Authentication Protocol (EAP), Blunk, L. and Vollbrecht, J., March 1998.

[B11] IETF STD 58, RFC 2578, Structure of Management Information for Version 2 of the Simple Network Management Protocol (SNMPv2), McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M., Waldbusser, S., April 1999.

[22] ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10035, USA. (http://www.ansi.org/)

[23] This IEEE standards project was not approved by the IEEE-SA Standards Board at the time this publication went to press. For information about obtaining a draft, contact the IEEE.

[24] IEEE publications are available from the Institute of Electrical and Electronic Engineers, 445 Hoes Lane, Piscataway, NJ 08854, USA. (http://standards.ieee.org.)

[25] Internet RFCs are retrievable by Web browser at http://www.ietf.org/rfc/rfcNNNN.txt (where NNNN is the RFC number prefixed with zeroes as necessary to make a four digit number).

[B12] IETF STD 58, RFC 2579, Textual Conventions for Version 2 of the Simple Network Management Protocol (SNMPv2), McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M., Waldbusser, S., April 1999.

[B13] IETF STD 58, RFC 2580, Conformance Statements for SMIv2, McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M., Waldbusser, S., April 1999.

[B14] IETF RFC 2922, Physical Topology MIB, Bierman, A., and Jones, K., November 1998.