802.1AB Overview
Link Layer Discovery Protocol

IEEE 802.3 Frame Expansion Study Group
Ottawa
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Motivation

- Link layer discovery is considered highly useful for:
  - topology discovery
  - network troubleshooting
  - automation of network management
- Numerous proprietary discovery protocols exist today. None of these interoperate.

Background / History

- An IETF Working Group (PTOPOMIB) addressed this problem beginning in 1996, with the following goals:
  - to agree on and document the common framework/model for discussing physical topology
  - to standardize a set of managed objects that provide physical topology information
  - to document media specific mechanisms to communicate topology information.

- They completed an informational MIB (RFC 2922, Physical Topology MIB, published Sept 2000), but didn't progress the discovery protocol
  - Could never get closure on MAC address assignment
  - Patent claims concerned developers (IBM, US Patent 5,276,440)
  - No committed developers to meet interoperability requirement
  - Some unresolved disagreement on the protocol design (e.g. ASN encoding)

- The IEEE effort was first proposed to 802.1 in January 2002 to pick-up where the IETF effort left off.

802.1AB Scope

(from IEEE 802.1AB-D10)

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 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 document defines a Link Layer Discovery Protocol that:

a) Advertises connectivity and management information about the local station to adjacent stations on the same 802 LAN.

b) Receives network management information from adjacent stations on the same 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].

802.1AB Purpose

(from IEEE 802.1AB-D10)

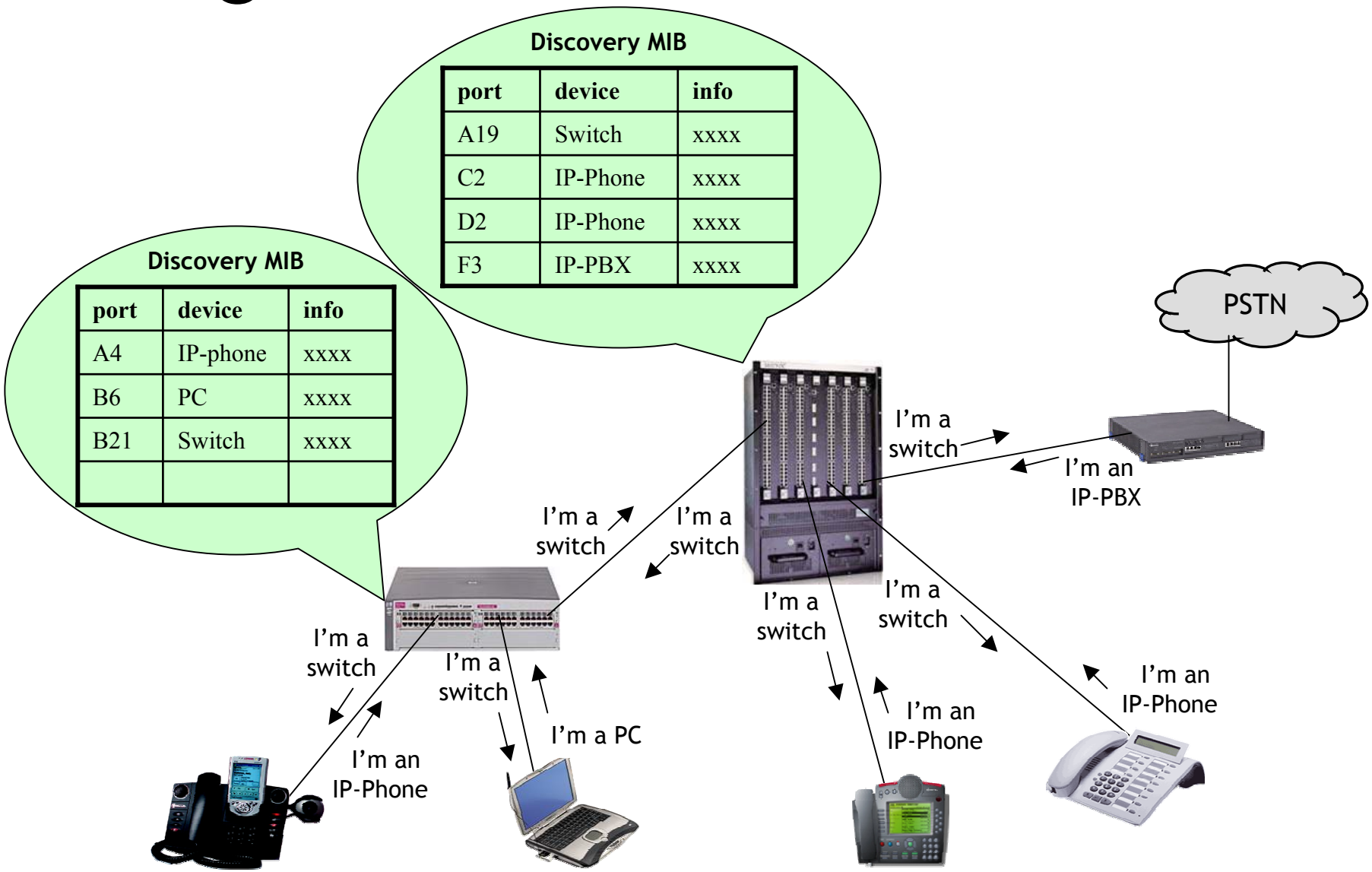
1.2 Purpose

An IETF standard MIB [IETF RFC 2922], as well as a number of vendor-specific MIB, have been created to describe a network's physical topology and associated systems within that topology. However, there is no standard protocol for populating these MIBs or communicating this information among stations on the 802 LAN.

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.

High-level how LLDP works



LLDP Block Diagram

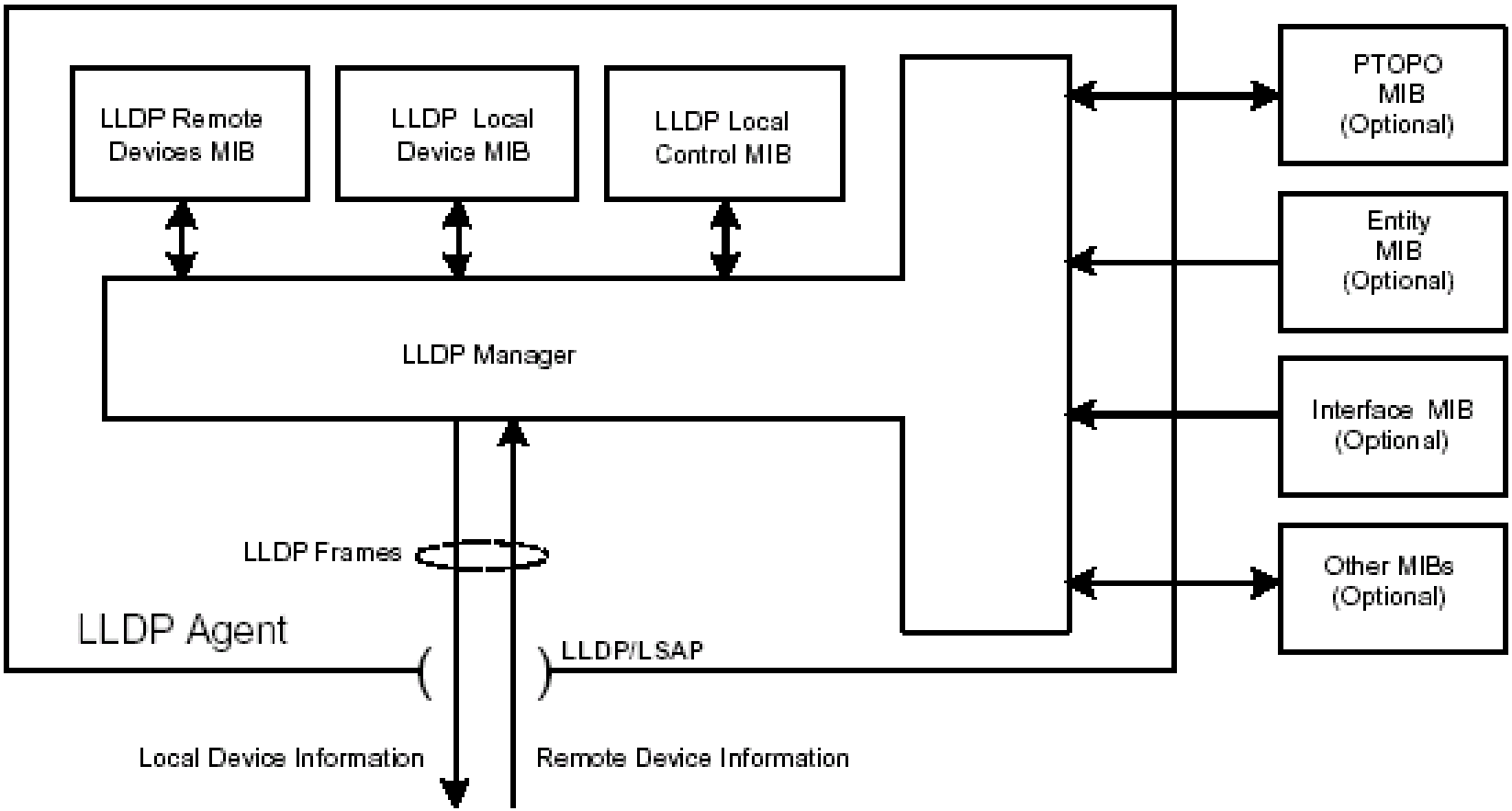


Figure 6-2—LLDP block diagram

LLDP Overview

- One-way protocol with periodic retransmissions out each port (30 sec default)
- Frames are sent to a Layer-2 BPDU address that isn't forwarded by bridges
- Frames contain formatted records (TLVs)
  - Includes mandatory Chassis-ID and Port-ID TLVs to identify stations
  - Includes mandatory Time-to-live information for aging purposes.
  - Optionally includes additional device describing TLVs such as the management address and system name (defined in 802.1AB).
  - Optionally includes Organization Specific TLVs (defined by the organizations themselves, e.g. IEEE 802.1, IEEE 802.3, TIA, etc)
  - Includes End-of-PDU TLV to consistently mark the end of processing (now mandatory in D11).
- Participants populate mandatory and other optional Local MIBs as needed, and advertise to far end.
- Receivers hold received records in Remote MIBs and age appropriately
- Management entities and other applications may make decisions based upon received data (out of scope of the standard)
- All advertised information ages together, multiple different LLDP advertisements on same port not allowed (makes LLDPDU space limited).

LLDP Frame Formats

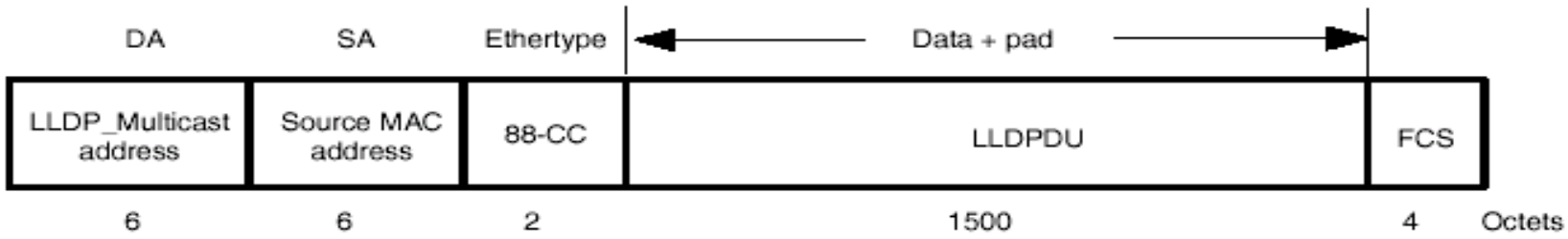
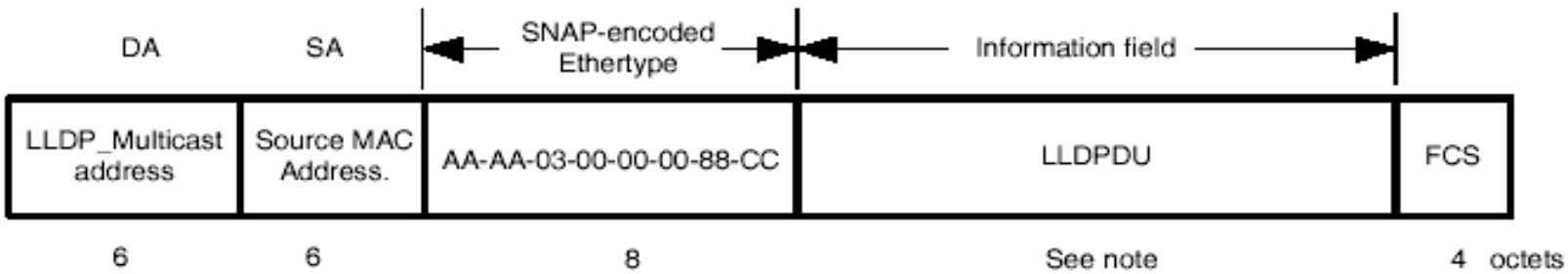


Figure D-1—IEEE 802.3 LLDP frame format



NOTE---the maximum length for the LLDPDU is dependent on the maximum information field size for the transmission rate and protocol. See 9.1.

Figure D-2—Token Ring/FDDI LLDP frame format

LLDPDU and TLV Formats

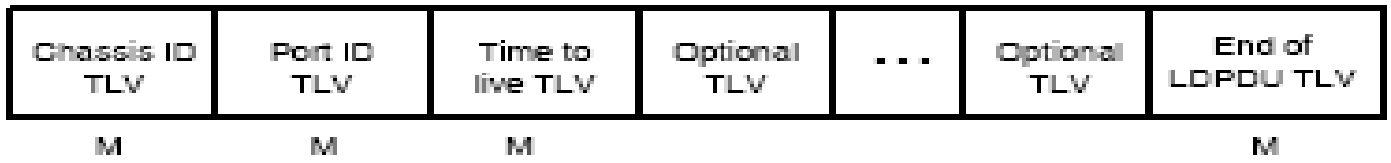


Figure 9-1—LLDPDU Format

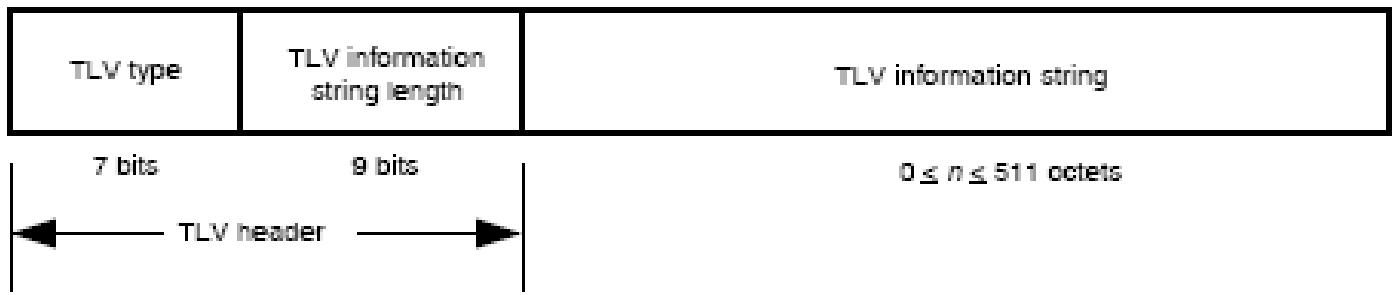


Figure 9-2—Basic TLV format

LLDP TLVs

Table 9-1—Currently assigned TLV type values

TLV Type *	TLV Name	Usage in LLDPDU	Subclause Reference
000 0000	End-of-LLDPDU	Mandatory	9.4.1
000 0001	Chassis ID	Mandatory	9.4.2
000 0010	Port ID	Mandatory	9.4.3
000 0011	Time-to-live	Mandatory	9.4.4
000 0100	Port Description	Optional	9.4.5
000 0101	System Name	Optional	9.4.6
000 0110	System Description	Optional	9.4.7
000 0111	System Capabilities	Optional	9.4.8
000 1000	Management Address	Optional	9.4.9
000 1001 - 111 1110	reserved for future standardization		
111 1111	Organizationally-Specific TLVs	Optional	IEEE 802.1 extensions, Annex F IEEE 802.3 extensions, Annex G

*TLVs with type values 000 0000 - 000 1000 are members of the basic management set.

Extensibility Considerations

- Organizationally Specific TLVs allow extensions
- Currently three organizations are using this
  - IEEE 802.1 (Port VLAN, Port & Protocol VLANs, VLAN Name, Protocol Entity)
  - IEEE 802.3 (MAC/PHY configuration, Power, Link Aggregation, Maximum Frame Size)
  - TIA TR 41.4, VoIP Infrastructure (various VoIP parameters)

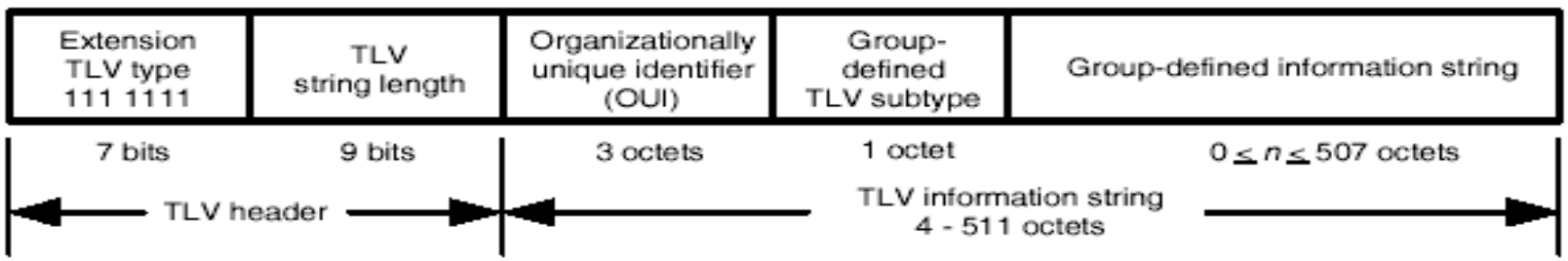


Figure 9-12—Basic format for organizationally-defined extension TLVs

802.3 Extension – MAC/PHY Configuration

- Auto-negotiation
  - Supported (ifMauAutoNegSupported) and Enabled (ifMauAutoNegAdminStatus)
- Advertised capability
  - What negotiation is possible (ifMauAutoNegCapAdvertisedBits)
- Operational MAU type
  - Current running configuration (last index of dot3MauType OUI)

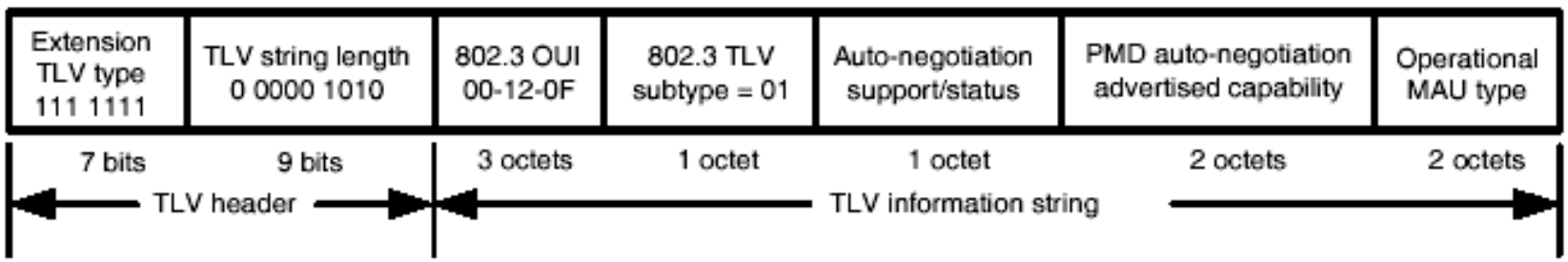


Figure G-1—IEEE 802.3 MAC/PHY configuration/status TLV format

802.3 Extension – Power via MDI

- Power Support
  - Port Class, Support capability, Enabled (pethPsePortAdminEnable), Pair control ability (pethPsePortPowerPairContolAbility)
- Power Pairs
  - As defined in pethPsePortPowerPairs
- Power Class
  - As defined in pethPsePortPowerClassification

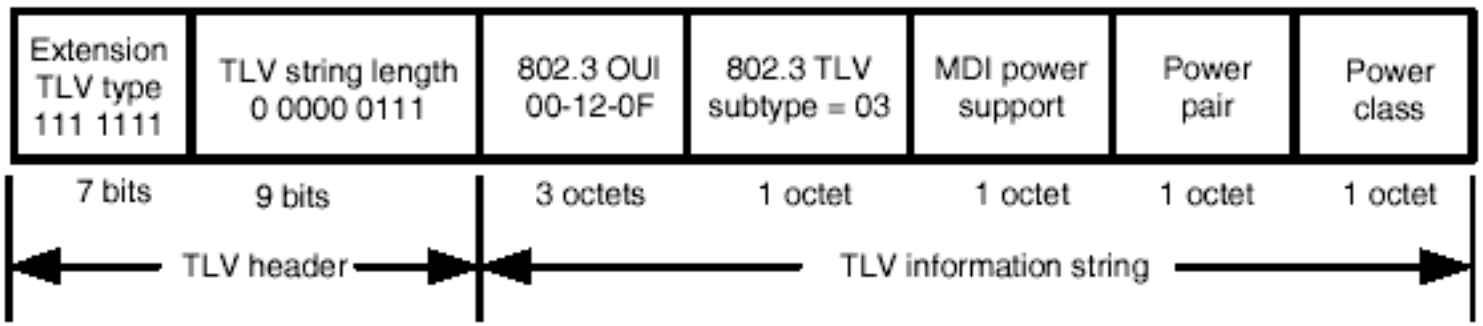


Figure G-2—Power-via-MDI TLV format

802.3 Extension – Link Aggregation

- Capability and Status
  - Bit mask for capability and current aggregation status
- Port Identifier
  - Derived from ifNumber in ifIndex (aAggPortID)

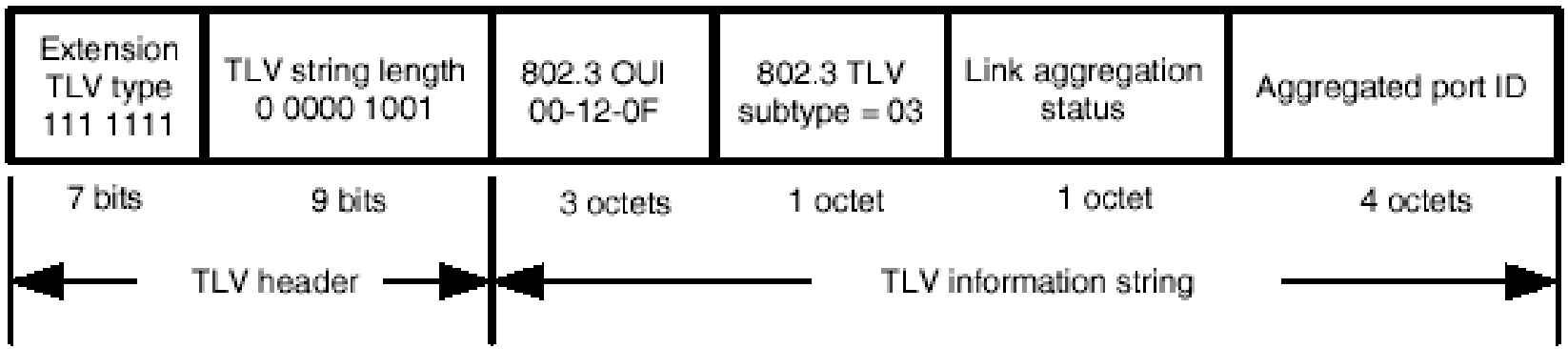


Figure G-3—Link-aggregation TLV format

802.3 Extension – Max Frame Size

- Maximum Frame Size
  - Basic MAC frame size (subclause 3.1.1) is 1518
  - Tagged MAC frame size (subclause 3.5) is 1522
  - Other frame sizes are implementation dependent

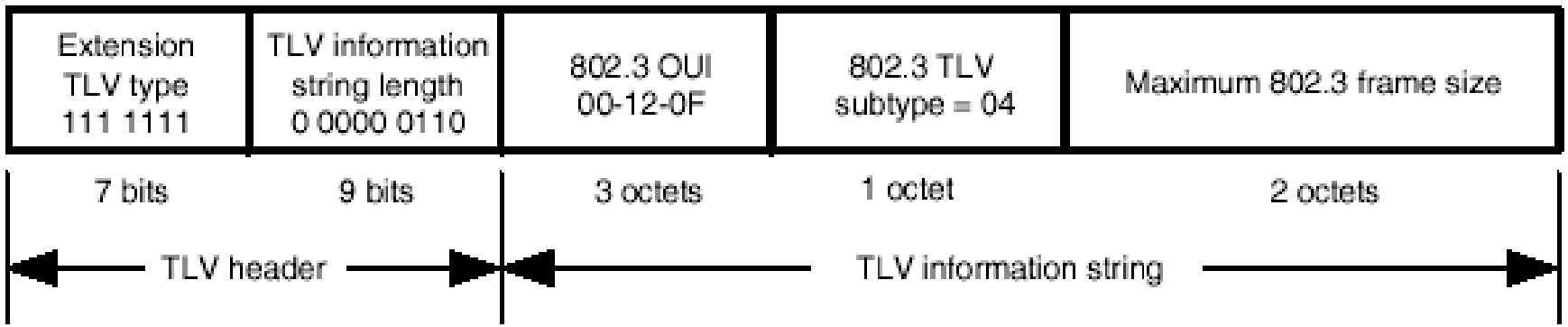


Figure G-4—IEEE802.3 Maximum Frame Size TLV format

IEEE 802.1AB Status

- Sponsor 1st re-circulation ballot on Draft-11
- Hope to submit to REVCOM by November
- Recent changes involve MIB structure, 802.3 extension TLVs (max frame size)
- Many vendors are implementing now
- Other SDOs working on extension (e.g. TIA LLDP-MED)