802.3da SPMD TF: Discovery Revisted

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Overview

- Clause 79 “IEEE 802.3 Organizationally Specific Link Layer Discovery Protocol (LLDP) type, length, and value (TLV) information elements ” defines the use of LLDP in 802.3.
  - P802.1ABdh 2021 added support for Multiframe PDUs.
- Use Link Layer Discovery Protocol (LLDP - 802.1AB-2016.pdf) to share attributes between mixing segment members
  - LLDP supports “shared media LANs”
  - LLDP triggers on change or timeout
- Define state machines and procedures like those in clause 33.6 “Data Link Layer classification” for PoE
- Example information elements
  - MAC address
  - Capabilities (e.g., PLCA, PSE, PD, …)
  - Power request (beyond startup power), power allocation
  - <next>

LLDP elements for 802.3da

Segment Membership

- MAC address TLV
  - Local node MAC address
  - CRC of MAC address table content (consistency check)
- Each node advertises it’s MAC address, and a CRC of the segment MAC address table (ordered by MAC address) as a convergence check

Capability Exchange

- Capabilities TLV
  - Bit list – PLCA, PSE, PD, <next>
- Each node advertises it’s capabilities, and a CRC of the segment capabilities table (ordered by node MAC address) as a convergence check

Power Exchange

- Need to review 33.6 in detail, reuse concepts/approaches as much as possible
- PSE capabilities
  - Maximum power supported
  - Current power allocated
- PD requests
  - Power required
  - Power desired
- PSE Allocations (per PD)
  - Power allocated

Node physical ordering

- Use the Segment Membership and functionality like that described in [huszak_01_spmd_031120.pdf] to determine:
  - Relative order of devices on the segment
  - Physical distance between devices on the segment.
- Advertise the ordered list to the segment members

Summary

- LLDP is an existing 802.1 protocol and is widely implemented
- 802.3 already includes multiple uses of LLDP
- LLDP infrastructure can be reused for exchanging multiple different types of information
- We should reuse LLDP instead of designing something new

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Backup Material

Topic Background

Background

- Previous presentation jones_spmd_01_0720.pdf

Background

- Approved Objective 3
  - “Specify an optional PLCA node ID allocation method.”
- Other topics
  - Segment membership list
  - Capabilities exchange
  - Power assignment
- Simplicity goals
  - Limit technical complexity
  - Reuse existing protocols/techniques

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Background 2

- Previous presentation potterf_da_02_031021.pdf

Key Takeaways for SPMD

- LLDP forces transmissions at boot and new neighbor detection
  - PLCA node assignment can benefit from this compelled traffic as it causes the use of a Transmit Opportunity (TO)
  - The mere act of choosing a PLCA node ID compels a frame as the underlying PLCA Node ID MIB would have changed
  - LLDP mandates that all devices will transmit during their assigned TO within a few seconds of a new device coming online
  - Any device that fails to detect the new neighbor will typically transmit a frame within TTL/4 seconds
  - Overall, if LLDP is required by SPMD, a new node could determine within a few seconds which node IDs are available, both via LLDP TLVs received and TO usage to send those frames

Contribution to IEEE P802.3da 10 Mb/s Single Pair Multidrop Segments Enhancement Task Force 7

Background 2 cont.

- Previous presentation potterf_da_02_031021.pdf

Key Takeaways for SPMD Continued

- LLDP has mechanisms to detect node exit from the mixing segment
  - These can be used to detect both graceful and unexpected exit
  - Can be correlated with changes in current draw to determine if a powered node's budget can be returned to the pool
- **Caveat:** LLDP does allow frame intervals to be as large as 60 minutes, though this configuration is rarely encountered in the field
  - More restrictive timing requirements would be required by SPMD

Background 3

- Previous presentation huszak_01_spmd_031120.pdf

The feature

- Use reflectometry over mixing segment to **measure** absolute or relative **distance** (**order**) of devices (PHYs) and/or phenomena (shorts, branches, discontinuities etc.) over a mixing segment, to achieve any of the following:
  - Automatic location- or order-dependent configuration of devices (PHYs and/or host application)
  - Topology discovery
  - Fault finding

  Note: When wave propagation properties of the cable is known (measured or made available by the cable provider), exact distance can be measured
- Works the best with **linear** network **topology** and when the **measurer** is **at the end** of the segment, **but** can also be used in any scenario, when a one-to-one mapping (bijection) can be made between distance and node
- May be run **in conjunction with PLCA** in a coordinated matter, to avoid collisions and/or unexpected degradation of network performance

LLDP Background

LLDP overview - 802.1AB-2016.pdf

https://en.wikipedia.org/wiki/Link_Layer_Discovery_Protocol

Link Layer Discovery Protocol

From Wikipedia, the free encyclopedia

"LLDP" redirects here. For the lying position, see Decubitus.

The **Link Layer Discovery Protocol** (**LLDP**) is a vendor-neutral link layer protocol used by network devices for advertising their identity, capabilities, and neighbors on a local area network based on IEEE 802 technology, principally wired Ethernet.[1] The protocol is formally referred to by the IEEE as *Station and Media Access Control Connectivity Discovery* specified in **IEEE 802.1AB** and **IEEE 802.3 section 6 clause 79**.[2]

LLDP performs functions similar to several proprietary protocols, such as Cisco Discovery Protocol, Foundry Discovery Protocol, Nortel Discovery Protocol and Link Layer Topology Discovery.

LLDP overview - 802.1AB-2016.pdf

https://en.wikipedia.org/wiki/Link_Layer_Discovery_Protocol

Frame structure [edit]

LLDP information is sent by devices from each of their interfaces at a fixed interval, in the form of an Ethernet frame. Each frame contains one LLDP Data Unit (LLDPDU). Each LLDPDU is a sequence of type-length-value (TLV) structures.

The Ethernet frame used in LLDP typically has its destination MAC address set to a special multicast address that 802.1D-compliant bridges do not forward. Other multicast and unicast destination addresses are permitted. The EtherType field is set to 0x88cc.

Each LLDP frame starts with the following mandatory TLVs: *Chassis ID*, *Port ID*, and *Time-to-Live*. The mandatory TLVs are followed by any number of optional TLVs. The frame ends with a special TLV, named *end of LLDPDU* in which both the *type* and *length* fields are 0.

Accordingly, an Ethernet frame containing an LLDPDU has the following structure:

LLDP Ethernet frame structure

Preamble	Destination MAC	Source MAC	Ethertype	Chassis ID TLV	Port ID TLV	Time to live TLV	Optional TLVs	End of LLDPDU TLV	Frame check sequence
	01:80:c2:00:00:0e, or 01:80:c2:00:00:03, or 01:80:c2:00:00:00	Station's address	0x88CC	Type=1	Type=2	Type=3	Zero or more complete TLVs	Type=0, Length=0	

LLDP overview - 802.1AB-2016.pdf

https://en.wikipedia.org/wiki/Link_Layer_Discovery_Protocol

Media endpoint discovery extension [edit]

Media Endpoint Discovery is an enhancement of LLDP, known as **LLDP-MED**, that provides the following facilities:

- Auto-discovery of LAN policies (such as VLAN, Layer 2 Priority and Differentiated services (Diffserv) settings) enabling plug and play networking.
- Device location discovery to allow creation of location databases and, in the case of Voice over Internet Protocol (VoIP), Enhanced 911 services.
- Extended and automated power management of Power over Ethernet (PoE) end points.
- Inventory management, allowing network administrators to track their network devices, and determine their characteristics (manufacturer, software and hardware versions, serial or asset number).

The LLDP-MED protocol extension was formally approved and published as the standard ANSI/TIA-1057 by the Telecommunications Industry Association (TIA) in April 2006.[5]

LLDP & 802.3 – Clause 79

79.3 IEEE 802.3 Organizationally Specific TLVs

The currently defined IEEE 802.3 Organizationally Specific TLVs are listed in Table 79–1. Any additions or changes to these TLVs will be included in this clause.

Table 79–1—IEEE 802.3 Organizationally Specific TLVs

IEEE 802.3 subtype	TLV name	Subclause reference
1	MAC/PHY Configuration/Status	79.3.1
2	Power Via Medium Dependent Interface (MDI)	79.3.2
3	Link Aggregation (deprecated)	79.3.3
4	Maximum Frame Size	79.3.4
5	Energy-Efficient Ethernet	79.3.5
6	EEE fast wake	79.3.6
7	Additional Ethernet Capabilities	79.3.7
8 to 255	Reserved	—

LLDP & 802.3 PoE –Clause 33

33.6 Data Link Layer classification

Additional control and classification functions are supported using Data Link Layer classification using frames based on the IEEE 802.3 Organizationally Specific TLVs defined in Clause 79. Type 2 PDs that require more than 13.0 W support Data Link Layer classification (see 33.3.5). Data Link Layer classification is optional for all other devices.

All reserved fields in transmitted Power via MDI TLVs shall contain zero, and all reserved fields in received Power via MDI TLVs shall be ignored.

33.6.1 TLV frame definition

Implementations that support Data Link Layer classification shall comply with all mandatory parts of IEEE Std 802.1AB-2009; shall support the Power via MDI Type, Length, Value (TLV) defined in 79.3.2; and shall support the control state diagrams defined in 33.6.3.

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