# LLDP-MED

**Ethernet Switch**

**ZyNOS 4.10**

# Support Notes

Version 4.10 Sep 2013


# Purpose

Resolving network topology and diagnosing configuration problems is a challenge for network administrators, especially when the topology covers a wide range. LLDP (Link Layer Discovery Protocol) provides the solution for network administrators to collect device information easily and more efficiently.

However, LLDP is inadequate for IP voice and video applications. Based on the basic discovery capabilities of LLDP, LLDP-MED (Medium Endpoint Device) can provide network policies for voice/video streaming, location identification of emergency call service and other extra discovery capabilities.

# LLDP Overview

Using LLDP, devices on the network advertise information about the device over every interface, allowing any device in the network to “know” everything it is connected to. LLDP uses two databases for discovery: Local & Remote.

**LLDP Discovery Flow:**

1. Collect local status or configuration to construct the local database.
2. Transmit information (with LLDP PDU) from local database to neighbors.
3. Receive information from neighbors and construct remote database.
4. Network administrators can access the discovery database via SNMP to get the overall topology information.

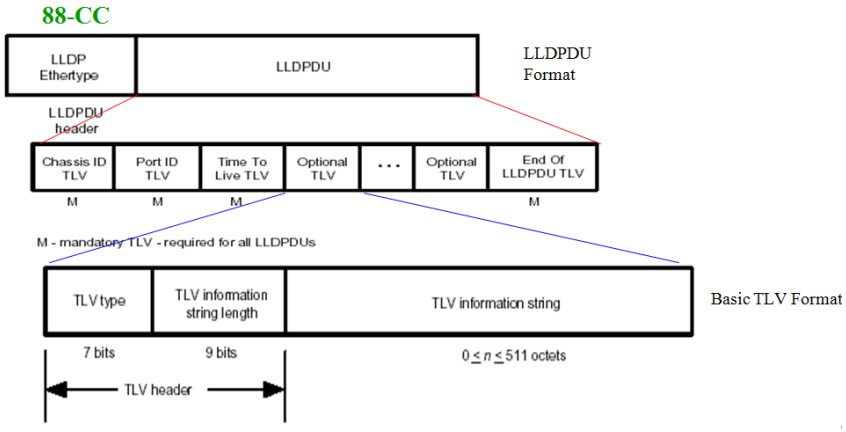
**LLDP Data Unit and TLV**

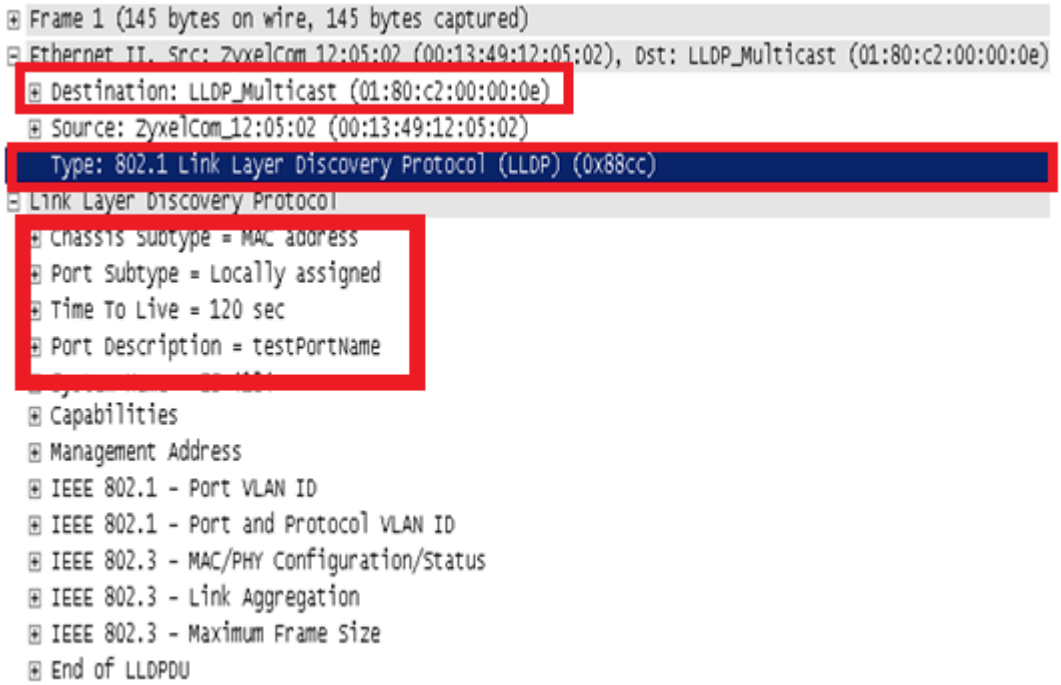
**LLDP PDU (Protocol Data Unit)**

- EtherType: 88-CC
- Destination MAC address:
  LLDP_Multicast address (=> 01-80-c2-00-00-0e)
- Each LLDP PDU is a sequence of TLV structure

**TLV (Type-Length-Value)**

- Mandatory TLVs (type 0~3)
- Optional TLVs (type 4~8)
- Organizationally Specific TLVs (type =127)
  - IEEE 802.1 Organizationally Specific TLVs (OUI 00-80-c2)
    - Port VLAN ID, Port & Protocol VLAN ID, VLAN Name, Protocol Identity
  - IEEE 802.3 Organizationally Specific TLVs (OUI 00-12-0f)
    - MAC/PHY Configuration/Status, Power via MDI, Link Aggregation, Maximum Frame Size



# LLDP-MED

While LLDP can provide base discovery capabilities, it is not adequate for IP telephony and video.

- **An extension of LLDP is needed for VoIP applications.**
  - LLDP-MED (LLDP – Media Endpoint Discovery)
    - TIA-1057-2006 (Telecommunications Industry Association)

**Why do we need LLDP-MED?**

In the network topology, only the LLDP TLV defined in IEEE 802.1AB will be advertised until a valid LLDP-MED capability TLV is received.

The advantages of LLDP-MED are:

1. Deliver network policy for VLAN/QoS provision
2. Provide location identification for emergency call service
3. Reveal the inventory management information of the device
4. Notification for device move detection

LLDP-MED devices comprise two primary device types: Network Connectivity Devices and Endpoint Devices. In addition, Endpoint Devices are split into three defined sub-types or classes. Between the Network Connectivity Device and the Endpoint Device, LLDP-MED provides additional discovery capabilities such as network policy for media streaming and location identification of emergency call service. Due to LLDP-MED, the management of VoIP network topology is simplified.

### Network Connectivity Devices

An LLDP-MED Network Connectivity Device is a LAN access device such as a switch, router, or Wireless Access Point.

### Endpoint Devices

LLDP-MED Endpoint Devices are located at the IEEE 802 LAN network edge, and participate in IP communication services using the LLDP-MED PDU.

1. Class I Endpoint Device: Requires the base LLDP discovery services, however does not support IP media or acting as an end-user communication appliance. Such devices may include IP Communication Controllers.
2. Class II Endpoint Device: Has IP media capabilities however may or may not be associated with a particular end user. Capabilities include all of the capabilities defined for the previous Class I Endpoint Device. Example products expected to belong to this class include Media Gateways, Conference Bridges, Media Servers, etc.

3. Class III Endpoint Device: Acts as end-user communication appliances supporting IP media. Capabilities include all of the capabilities defined for the previous Class I Endpoint Device and Class II Endpoint Device.

# LLDP-MED Discovery Abilities

**Network Policy**

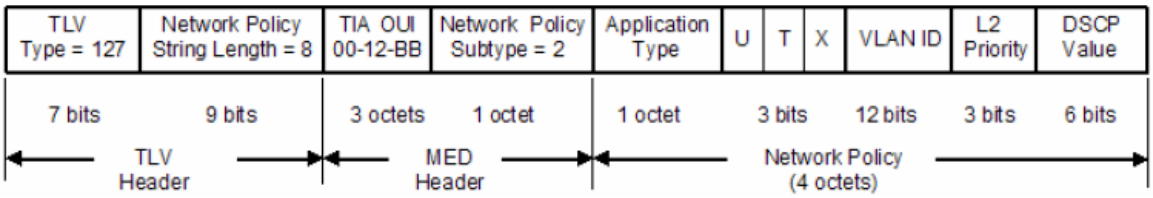
Network Policy discovery enables efficient discovery and diagnosis of mismatch issues with the VLAN configuration. Using Network Policy TLV, Layer 2 (VLAN ID and priority) and Layer 3 (DSCP value) attributes for a set of specific protocol applications on the port are advertised to the neighbors.

Improper network policy configurations are a very significant issue in VoIP environments that frequently result in voice quality degradation or loss of service. This TLV is only intended for use with applications that have specific 'real-time' network policy requirements, such as interactive voice or video services. The application type categories are as follows:

- Voice
  - Guest Voice
  - Softphone Voice
  - Video Conferencing
  - Streaming Video

Especially for unmanageable Endpoint devices, VLAN/QoS configurations cannot be configured by the device itself. Topology provision can be implemented by the Network Policy discovery from the Network Connectivity Device sent to the Endpoint Device.

**TLV Format:**




- This TLV allows both the Network Connectivity Devices and Endpoints to advertise VLAN configurations and associated Layer 2 and 3 attributes that

apply for a set of specific applications on that port.

- Every port on the Network Connectivity Device may advertise a unique set of network policies or different attributes for the same network policies.

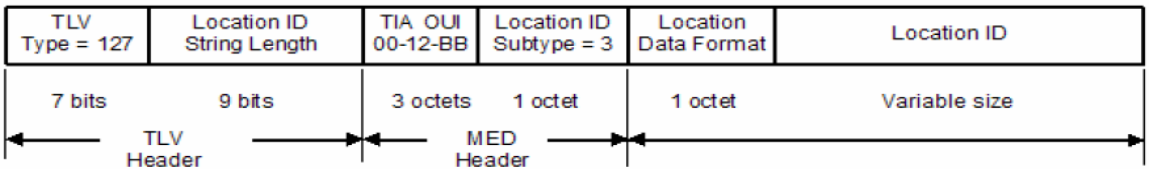
**Location Identification**

Emergency call service is important for VoIP applications. Endpoint devices can notify their location to the emergency call center when an emergency call is processed. If the Endpoint device can't define the location identifier by itself, LLDP-MED with Location Identification discovery can resolve this problem. Network Connectivity Devices transmit location identifiers to Endpoint Devices via Location Identifier TLV. Endpoint Devices can identify location via this TLV when it connects to a Network Connectivity Device. Furthermore, Location Identification discovery makes the location identification of mobile Endpoint Devices more flexible.

The location identifier data types specifically addressed in this revision of this Standard include:

1. **Civic Address LCI (Location Configuration Information)**
   Civic Address LCI identifies the location with country, state, street address, building name, etc.
2. **Coordinate-based LCI (RFC 3825)**
   Coordinate-based LCI identifies the location as the format of geographical coordinates; consist of latitude, longitude and altitude.
3. **Emergency Call Service ELIN number (NENA TID 07-501)**
   The Emergency Call Service ELIN identifier data format is defined to carry the ELIN number (10~25 numbers) for PSAP (public safety answering point) configuration.

**TLV Format:**



| Location data format type value | Data type provided | Location ID data length (octets) |
|---|---|---|
| 0 | Invalid | Invalid |
| 1 | Coordinate-based LCI | 16 |
| 2 | Civic Address LCI | 6 to 256 |
| 3 | ECS ELIN | 10 to 25 |
| 4 - 255 | Reserved for future expansion | Reserved |

**Endpoint Device Movement Detection**

Endpoint Movement Detection notification enables Network Connectivity devices to efficiently notify their associated management application(s) of VoIP device moves.

- A new remote device was connected
- A remote device was removed

**Notification triggered by port ID changes by Endpoint device associated with a remote MSAP identifier (Chassis ID+Port ID):**

- Advantage: Reduces the detection overhead and is more precise.
- However, this mechanism does not entirely eliminate the need of polling the Network Connectivity Devices. Because the notification is based on non-guaranteed delivery properties of UDP.

Before performing the LLDP lab, we need to setup admin-status <tx-only | rx-only | tx-rx >

# Scenario

Enable LLDP first and configure Network Policy and Location identifier on a specific port.
And then the switch will be able to advertise Network-policy TLV and Location TLV when the LLDP-MED capabilities TLV are received on this port.

**CLI:**

```
Switch(config)# lldp
Switch (config)# interface port-channel 1
Switch (config-interface)#lldp admin-status tx-rx
Switch (config-interface)# lldp org-specific-tlv med network-policy
Switch (config-interface)# lldp org-specific-tlv med location
Switch (config-interface)# lldp med topology-change-notification
Switch (config-interface)#lldp med network-policy voice tagged vlan 10 priority 0 dscp 0
Switch (config-interface)#lldp med location civic country TW city HSINCHU building ZYXEL
Switch (config-interface)#lldp med location elin 1234567890
Switch (config-interface)#lldp med location coordinate latitude north 50 longitude east 50 altitude meters 0.0 datum WGS84
```

**Verification:**

```
Copyright (c) 1994 - 2013 ZyXEL Communications Corp.
GS3700# show running-config
  Building configuration...

  Current configuration:

vlan 1
  name 1 ""
  normal ""
  fixed 1-52
  forbidden ""
  untagged 1-52
  ip address 192.168.1.20 255.255.255.0
exit
interface route-domain 192.168.1.20/24
exit
interface port-channel 1
  lldp admin-status tx-rx
  lldp org-specific-tlv med network-policy
  lldp org-specific-tlv med location
  lldp med topology-change-notification
  lldp med network-policy voice tagged vlan 10 priority 0 dscp 0
  lldp med location civic country TW city HSINCHU building ZYXEL
  lldp med location coordinate latitude north 50.0 longitude east 50.0 altitude meters 0.0 datum WGS84
  lldp med location elin 1234567890
exit
ip address 192.168.0.1 255.255.255.0
snmp-server trap-destination 192.168.1.188
snmp-server trap-destination 192.168.1.188 enable traps interface  lldp
lldp
GS3700#
```

```
Copyright (c) 1994 - 2013 ZyXEL Communications Corp.
GS3700# show lldp info local interface port-channel 1
LLDP Local Device Information Detail:
        Local Port:          1
Port ID Subtype: local-assigned
        Port ID:          0
Port Description:
Extended TLV Info 802.1 OUI (hex value) = 00-80-c2
-Port VLAN ID
                    -ID:     1
Extended TLV Info 802.3 OUI (hex value) = 00-12-0f
-MAC PHY Configuration & Status
          -AN Supported:     Y
            -AN Enabled:     Y
        -AN Advertised Capability:  10baseT 10baseTFD 100baseTX 100baseTXFD 1000baseTFD
         -Oper MAU type: 30
-Link Aggregation
            -Capability:     Y
                -Status:     N
              -Port ID:     0
-Max Frame Size
            -Frame Size:  1518
Extended TLV Info LLDP-MED OUI (hex value) = 00-12-bb
-Capabilities
              Network Policy: Y
                    Location: Y
        Extend Power via MDI PSE: N
        Extend Power via MDI PD: N
        Inventory Management: N
   -Device Type: Network Connectivity
-Network Policy
                 voice: VLAN ID 10, tagged, L2-priority 0, DSCP 0
-Location
           ELIN Number: 1234567890
        Coordinate-base LCI: latitute north 50.0 longitute east 50.0 altitute meter 0.0 datum WGS84
             Civic LCI: country TW city HSINCHU building ZYXEL
-------------------------------------------------
```