Configuring LLDP and LLDP-MED

Restrictions for LLDP

- If the interface is configured as a tunnel port, LLDP is automatically disabled.
- If you first configure a network-policy profile on an interface, you cannot apply the **switchport voice vlan** command on the interface. If the **switchport voice vlan** *vlan-id* is already configured on an interface, you can apply a network-policy profile on the interface. This way the interface has the voice or voice-signaling VLAN network-policy profile applied on the interface.
- You cannot configure static secure MAC addresses on an interface that has a network-policy profile.
- When Cisco Discovery Protocol and LLDP are both in use within the same switch, it is necessary to disable LLDP on interfaces where Cisco Discovery Protocol is in use for power negotiation. LLDP can be disabled at interface level with the commands **no lldp tlv-select power-management** or **no lldp transmit / no lldp receive**.

Information About LLDP and LLDP-MED

This section describes about LLDP and LLDP-MED.

LLDP

The Cisco Discovery Protocol (CDP) is a device discovery protocol that runs over Layer 2 (the data link layer) on all Cisco-manufactured devices (routers, bridges, access servers, switches, and controllers). CDP allows network management applications to automatically discover and learn about other Cisco devices connected to the network.

To support non-Cisco devices and to allow for interoperability between other devices, the device supports the IEEE 802.1AB Link Layer Discovery Protocol (LLDP). LLDP is a neighbor discovery protocol that is used

for network devices to advertise information about themselves to other devices on the network. This protocol runs over the data-link layer, which allows two systems running different network layer protocols to learn about each other.

LLDP Supported TLVs

LLDP supports a set of attributes that it uses to discover neighbor devices. These attributes contain type, length, and value descriptions and are referred to as TLVs. LLDP supported devices can use TLVs to receive and send information to their neighbors. This protocol can advertise details such as configuration information, device capabilities, and device identity.

The switch supports these basic management TLVs. These are mandatory LLDP TLVs.

- Port description TLV
- System name TLV
- System description TLV
- System capabilities TLV
- Management address TLV

These organizationally specific LLDP TLVs are also advertised to support LLDP-MED.

- Port VLAN ID TLV (IEEE 802.1 organizationally specific TLVs)
- MAC/PHY configuration/status TLV (IEEE 802.3 organizationally specific TLVs)

LLDP-MED

LLDP for Media Endpoint Devices (LLDP-MED) is an extension to LLDP that operates between endpoint devices such as IP phones and network devices. It specifically provides support for voice over IP (VoIP) applications and provides additional TLVs for capabilities discovery, network policy, Power over Ethernet, inventory management and location information. By default, all LLDP-MED TLVs are enabled.

LLDP-MED Supported TLVs

LLDP-MED supports these TLVs:

- LLDP-MED capabilities TLV

  Allows LLDP-MED endpoints to determine the capabilities that the connected device supports and has enabled.

- Network policy TLV

  Allows both network connectivity devices and endpoints to advertise VLAN configurations and associated Layer 2 and Layer 3 attributes for the specific application on that port. For example, the switch can notify a phone of the VLAN number that it should use. The phone can connect to any device, obtain its VLAN number, and then start communicating with the call control.

  By defining a network-policy profile TLV, you can create a profile for voice and voice-signaling by specifying the values for VLAN, class of service (CoS), differentiated services code point (DSCP), and tagging mode. These profile attributes are then maintained centrally on the switch and propagated to the phone.

- Power management TLV

  Enables advanced power management between LLDP-MED endpoint and network connectivity devices. Allows devices and phones to convey power information, such as how the device is powered, power priority, and how much power the device needs.

  LLDP-MED also supports an extended power TLV to advertise fine-grained power requirements, end-point power priority, and end-point and network connectivity-device power status. LLDP is enabled and power is applied to a port, the power TLV determines the actual power requirement of the endpoint device so that the system power budget can be adjusted accordingly. The device processes the requests and either grants or denies power based on the current power budget. If the request is granted, the switch updates the power budget. If the request is denied, the device turns off power to the port, generates a syslog message, and updates the power budget. If LLDP-MED is disabled or if the endpoint does not support the LLDP-MED power TLV, the initial allocation value is used throughout the duration of the connection.

  You can change power settings by entering the **power inline** {**auto** [**max** *max-wattage*] | **never** | **static** [**max** *max-wattage*] } interface configuration command. By default the PoE interface is in **auto** mode;

- Inventory management TLV

  Allows an endpoint to send detailed inventory information about itself to the device, including information hardware revision, firmware version, software version, serial number, manufacturer name, model name, and asset ID TLV.

- Location TLV

  Provides location information from the device to the endpoint device. The location TLV can send this information:

  - Civic location information

    Provides the civic address information and postal information. Examples of civic location information are street address, road name, and postal community name information.

  - ELIN location information

    Provides the location information of a caller. The location is determined by the Emergency location identifier number (ELIN), which is a phone number that routes an emergency call to the local public safety answering point (PSAP) and which the PSAP can use to call back the emergency caller.

  - Geographic location information

    Provides the geographical details of a switch location such as latitude, longitude, and altitude of a switch.

  - custom location

    Provides customized name and value of a switch location.

Default LLDP Configuration

Table 1: Default LLDP Configuration

Feature	Default Setting
LLDP global state	Enabled

Feature	Default Setting
LLDP holdtime (before discarding)	120 seconds
LLDP timer (packet update frequency)	30 seconds
LLDP reinitialization delay	2 seconds
LLDP tlv-select	Enabled
LLDP interface state	Enabled
LLDP receive	Enabled
LLDP transmit	Enabled
LLDP med-tlv-select	Enabled. When LLDP is globally enabled, LLDP-MED-TLV is also enabled.

How to Configure LLDP and LLDP-MED

This section provides the procedures to configure LLDP and LLDP-MED.

Enabling LLDP

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**lldp run** **Example:** `Device(config)# lldp run`	Enables LLDP globally on the device.
Step 4	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/1`	Specifies the interface on which you are enabling LLDP, and enters interface configuration mode.

	Command or Action	Purpose
Step 5	**lldp transmit** **Example:** `Device(config-if)# lldp transmit`	Enables the interface to send LLDP packets.
Step 6	**lldp receive** **Example:** `Device(config-if)# lldp receive`	Enables the interface to receive LLDP packets.
Step 7	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode, and returns to privileged EXEC mode.
Step 8	**show lldp** **Example:** `Device# show lldp`	Verifies the configuration.
Step 9	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring LLDP Characteristics

You can configure the frequency of LLDP updates, the amount of time to hold the information before discarding it, and the initialization delay time. You can also select the LLDP and LLDP-MED TLVs to send and receive.

Note Steps 3 through 6 are optional and can be performed in any order.

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**lldp holdtime** *seconds* **Example:** `Device(config)# lldp holdtime 120`	(Optional) Specifies the amount of time a receiving device should hold the information from your device before discarding it. The range is 0 to 65535 seconds; the default is 120 seconds.
Step 4	**lldp reinit** *delay* **Example:** `Device(config)# lldp reinit 2`	(Optional) Specifies the delay time in seconds for LLDP to initialize on an interface. The range is 2 to 5 seconds; the default is 2 seconds.
Step 5	**lldp timer** *rate* **Example:** `Device(config)# lldp timer 30`	(Optional) Sets the sending frequency of LLDP updates in seconds. The range is 5 to 65534 seconds; the default is 30 seconds.
Step 6	**lldp tlv-select** **Example:** `Device(config)# tlv-select`	(Optional) Specifies the LLDP TLVs to send or receive.
Step 7	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/1`	Specifies the interface on which you are enabling LLDP, and enters interface configuration mode.
Step 8	**lldp med-tlv-select** **Example:** `Device(config-if)# lldp med-tlv-select inventory management`	(Optional) Specifies the LLDP-MED TLVs to send or receive.
Step 9	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode, and returns to privileged EXEC mode.
Step 10	**show lldp** **Example:** `Device# show lldp`	Verifies the configuration.
Step 11	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring LLDP-MED TLVs

By default, the device only sends LLDP packets until it receives LLDP-MED packets from the end device. It then sends LLDP packets with MED TLVs, as well. When the LLDP-MED entry has been aged out, it again only sends LLDP packets.

By using the **lldp** interface configuration command, you can configure the interface not to send the TLVs listed in the following table.

Table 2: LLDP-MED TLVs

LLDP-MED TLV	Description
inventory-management	LLDP-MED inventory management TLV
location	LLDP-MED location TLV
network-policy	LLDP-MED network policy TLV
power-management	LLDP-MED power management TLV

Follow these steps to enable a TLV on an interface:

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/1`	Specifies the interface on which you are enabling LLDP, and enters interface configuration mode.
Step 4	**lldp med-tlv-select** **Example:** `Device(config-if)# lldp med-tlv-select inventory management`	Specifies the TLV to enable.
Step 5	**end** **Example:** `Device(config-if)# end`	Exits global configuration mode, and returns to privileged EXEC mode.

	Command or Action	Purpose
Step 6	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuring Network-Policy TLV

Procedure

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**network-policy profile** *profile number* **Example:** `Device(config)# network-policy profile 1`	Specifies the network-policy profile number, and enters network-policy configuration mode. The range is 1 to 4294967295.
Step 4	{**voice** | **voice-signaling**} **vlan** [*vlan-id* {**cos** *cvalue* | **dscp** *dvalue*}] | [[**dot1p** {**cos** *cvalue* | **dscp** *dvalue*}] | **none** | **untagged**] **Example:** `Device(config-network-policy)# voice vlan 100 cos 4`	Configures the policy attributes: • **voice**: Specifies the voice application type. • **voice-signaling**: Specifies the voice-signaling application type. • **vlan**: Specifies the native VLAN for voice traffic. • *vlan-id*: (Optional) Specifies the VLAN for voice traffic. The range is 1 to 4094. • **cos** *cvalue*: (Optional) Specifies the Layer 2 priority class of service (CoS) for the configured VLAN. The range is 0 to 7; the default is 5. • **dscp** *dvalue*: (Optional) Specifies the differentiated services code point (DSCP) value for the configured VLAN. The range is 0 to 63; the default is 46.

	Command or Action	Purpose
		• **dot1p**: (Optional) Configures the telephone to use IEEE 802.1p priority tagging and use VLAN 0 (the native VLAN). • **none**: (Optional) Do not instruct the IP telephone about the voice VLAN. The telephone uses the configuration from the telephone key pad. • **untagged**: (Optional) Configures the telephone to send untagged voice traffic. This is the default for the telephone.
Step 5	**exit** **Example:** `Device(config)# exit`	Returns to global configuration mode.
Step 6	**interface** *interface-id* **Example:** `Device(config)# interface gigabitethernet1/1`	Specifies the interface on which you are configuring a network-policy profile, and enters interface configuration mode.
Step 7	**network-policy** *profile number* **Example:** `Device(config-if)# network-policy 1`	Specifies the network-policy profile number.
Step 8	**lldp med-tlv-select network-policy** **Example:** `Device(config-if)# lldp med-tlv-select network-policy`	Specifies the network-policy TLV.
Step 9	**end** **Example:** `Device(config)# end`	Returns to privileged EXEC mode.
Step 10	**show network-policy profile** **Example:** `Device# show network-policy profile`	Verifies the configuration.
Step 11	**copy running-config startup-config** **Example:** `Device# copy running-config startup-config`	(Optional) Saves your entries in the configuration file.

Configuration Examples for LLDP and LLDP-MED

This section provides configuration examples for LLDP and LLDP-MED.

Examples: Configuring Network-Policy TLV

This example shows how to configure VLAN 100 for voice application with CoS and to enable the network-policy profile and network-policy TLV on an interface:

```
Device# configure terminal
Device(config)# network-policy 1
Device(config-network-policy)# voice vlan 100 cos 4
Device(config-network-policy)# exit
Device(config)# interface gigabitethernet1/1
Device(config-if)# network-policy profile 1
Device(config-if)# lldp med-tlv-select network-policy
```

This example shows how to configure the voice application type for the native VLAN with priority tagging:

```
Device-config-network-policy)# voice vlan dot1p cos 4
Device-config-network-policy)# voice vlan dot1p dscp 34
```

Monitoring and Maintaining LLDP and LLDP-MED

Use the following commands for monitoring and maintaining LLDP and LLDP-MED.

Command	Description
clear lldp counters	Resets the traffic counters to zero.
clear lldp table	Deletes the LLDP neighbor information table.
clear nmsp statistics	Clears the NMSP statistic counters.
show lldp	Displays global information, such as frequency of transmissions, the holdtime for packets being sent, and the delay time before LLDP initializes on an interface.
show lldp entry *entry-name*	Displays information about a specific neighbor. You can enter an asterisk (*) to display all neighbors, or you can enter the neighbor name.
show lldp interface [*interface-id*]	Displays information about interfaces with LLDP enabled. You can limit the display to a specific interface.

Command	Description
show lldp neighbors [*interface-id*] [**detail**]	Displays information about neighbors, including device type, interface type and number, holdtime settings, capabilities, and port ID. You can limit the display to neighbors of a specific interface or expand the display for more detailed information.
show lldp traffic	Displays LLDP counters, including the number of packets sent and received, number of packets discarded, and number of unrecognized TLVs.
show location admin-tag *string*	Displays the location information for the specified administrative tag or site.
show location civic-location identifier *id*	Displays the location information for a specific global civic location.
show location elin-location identifier *id*	Displays the location information for an emergency location
show network-policy profile	Displays the configured network-policy profiles.