Using Link Layer Discovery Protocol in Multivendor Networks

Link Layer Discovery Protocol (LLDP), standardized by the IEEE as part of 802.1ab, enables standardized discovery of nodes, which in turn facilitates future applications of standard management tools such as Simple Network Management Protocol (SNMP) in multivendor networks. Using standard management tools makes physical topology information available and helps network administrators detect and correct network malfunctions and inconsistencies in configuration.

The Cisco implementation of LLDP is based on the IEEE 802.1ab standard.

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- Restrictions for Using Link Layer Discovery Protocol in Multivendor Networks, on page 2
- Information About Using Link Layer Discovery Protocol in Multivendor Networks, on page 2
- How to Configure Link Layer Discovery Protocol in Multivendor Networks, on page 4
- Configuration Examples for Link Layer Discovery Protocol in Multivendor Networks, on page 12
- Additional References for Using Link Layer Discovery Protocol in Multivendor Networks, on page 14
- Feature Information for Link Layer Discovery Protocol in Multivendor Networks, on page 15

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Using Link Layer Discovery Protocol in Multivendor Networks

The Type-Length-Value (TLV) types must be 0 through 127.
Restrictions for Using Link Layer Discovery Protocol in Multivendor Networks

Use of LLDP is limited to 802.1 media types such as Ethernet, Token Ring, and FDDI networks.

Information About Using Link Layer Discovery Protocol in Multivendor Networks

IEEE 802.1ab LLDP

IEEE 802.1ab Link Layer Discovery Protocol (LLDP) is an optional link layer protocol for network topology discovery in multivendor networks. Discovery information includes device identifiers, port identifiers, versions, and other details. As a protocol that aids network management, LLDP provides accurate network mapping, inventory data, and network troubleshooting information.

LLDP is unidirectional, operating only in an advertising mode. LLDP does not solicit information or monitor state changes between LLDP nodes. LLDP periodically sends advertisements to a constrained multicast address. Devices supporting LLDP can send information about themselves while they receive and record information about their neighbors. Additionally, devices can choose to turn off the send or receive functions independently. Advertisements are sent out and received on every active and enabled interface, allowing any device in a network to learn about all devices to which it is connected. Applications that use this information include network topology discovery, inventory management, emergency services, VLAN assignment, and inline power supply.

Note

The figure below shows a high-level view of LLDP operating in a network node.
When you configure LLDP or Cisco Discovery Protocol location information on a per-port basis, remote devices can send Cisco medianet location information to the switch. For more information, see the *Using Cisco Discovery Protocol module*.

**TLV Elements**

Link Layer Discovery Protocol (LLDP) uses Type-Length-Values (TLVs) to exchange information between network and endpoint devices. TLV elements are embedded in communications protocol advertisements and used for encoding optional information. The size of the type and length fields is fixed at 2 bytes. The size of the value field is variable. The type is a numeric code that indicates the type of field that this part of the message represents, and the length is the size of the value field, in bytes. The value field contains the data for this part of the message.

By defining a network-policy profile TLV, you can create a profile for voice and voice signalling 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—Allows switches and phones to convey power information, such as how the device is powered on, power priority, and the power required by the device. Supports advertisement of fractional wattage power requirements, endpoint power priority, and endpoint and network connectivity-device power status. However, it does not support power negotiation between the endpoint and the network connectivity devices. When LLDP is enabled and a port is powered on, the power TLV determines the actual power requirement of the endpoint device, so that the system power budget can be adjusted. The switch 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 switch turns off power to the port, generates a syslog message, and updates the power budget.
A system power budget is the default power allocated to a device based on its device class. However, the total power sourced from a switch is finite, and power budgeting is done by the power module based on the number of ports already being served, total power that can be served, and number of new ports that are requesting.

**Note**

- Inventory management TLV—Allows an endpoint to send detailed inventory information about itself to the switch, 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 switch to the endpoint device. The location TLV can send the following 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), a phone number that routes an emergency call to the local public safety answering point (PSAP). The PSAP can call back the emergency caller using the same number.

**Benefits of LLDP**

- Follows IEEE 802.1ab standard.
- Enables interoperability among multivendor devices.
- Facilitates troubleshooting of enterprise networks and uses standard network management tools.
- Provides extension for applications such as VoIP.

**How to Configure Link Layer Discovery Protocol in Multivendor Networks**

**Enabling and Disabling LLDP Globally**

LLDP is disabled globally by default. This section describes the tasks for enabling and disabling LLDP globally.

**Enabling LLDP Globally**

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `lldp {hold time seconds | reinit delay | run | timer rate | tlv-select tlv}`
### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| 1.   | `enable`          | Enables privileged EXEC mode.  
|      | Example:          | • Enter your password if prompted. |
|      | Device> `enable`  |         |
| 2.   | `configure terminal` | Enters global configuration mode. |
|      | Example:          |         |
|      | Device# `configure terminal` | |
| 3.   | `lldp {hold time seconds | reinit delay | run | timer rate | tlv-select tlv}` | Enables LLDP globally. |
|      | Example:          |         |
|      | Device(config)# `lldp run` | |
| 4.   | `end`             | Returns to privileged EXEC mode. |
|      | Example:          |         |
|      | Device(config)# `end` | |

### Disabling LLDP Globally

#### SUMMARY STEPS

1. `enable`
2. `configure terminal`
3. `no lldp {hold time seconds | reinit delay | run | timer rate | tlv-select tlv}`
4. `end`

#### DETAILED STEPS

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
</table>
| 1.   | `enable`          | Enables privileged EXEC mode.  
|      | Example:          | • Enter your password if prompted. |
|      | Device> `enable`  |         |
| 2.   | `configure terminal` | Enters global configuration mode. |
|      | Example:          |         |
|      | Device# `configure terminal` | |

Using Link Layer Discovery Protocol in Multivendor Networks

Disabling LLDP Globally
Disabling and Enabling LLDP on a Supported Interface

LLDP is enabled by default on all supported interfaces. This section describes the tasks for disabling and enabling LLDP on a supported interface.

Disabling LLDP on a Supported Interface

**SUMMARY STEPS**

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **no lldp** *(tlv-select tlv | receive | transmit)*
5. **end**

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>enable</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>configure terminal</td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Specifies the interface type and number and enters interface configuration mode.</td>
</tr>
<tr>
<td>interface <em>type number</em></td>
<td></td>
</tr>
<tr>
<td>Example:</td>
<td></td>
</tr>
<tr>
<td>Device(config)# interface ethernet 0/1</td>
<td></td>
</tr>
</tbody>
</table>
Enabling LLDP on a Supported Interface

LLDP information can be transmitted and received only on an interface where LLDP is configured and enabled. Perform this task to enable LLDP.

**SUMMARY STEPS**

1. enable
2. configure terminal
3. interface type number
4. lldp {tlv-select tlv | receive | transmit}
5. end

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> interface type number</td>
<td>Specifies the interface type and number and enters interface configuration mode.</td>
</tr>
<tr>
<td>Example: Device(config)# interface ethernet 0/1</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> lldp {tlv-select tlv</td>
<td>receive</td>
</tr>
<tr>
<td>Example: Device(config-if)# lldp transmit</td>
<td></td>
</tr>
</tbody>
</table>
### Setting LLDP Packet Hold Time

Hold time is the duration that a receiving device should maintain LLDP neighbor information before aging it. Perform this task to define a hold time for an LLDP-enabled device.

**SUMMARY STEPS**

1. `enable`
2. `configure terminal`
3. `lldp holdtime seconds`
4. `end`

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td>Step 2 configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>Example: Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td>Step 3 lldp holdtime seconds</td>
<td>Specifies the hold time.</td>
</tr>
<tr>
<td>Example: Device(config)# lldp holdtime 100</td>
<td></td>
</tr>
<tr>
<td>Step 4 end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>Example: Device(config)# end</td>
<td></td>
</tr>
</tbody>
</table>

### Setting LLDP Packet Frequency

Perform this task to specify an interval at which the Cisco software sends LLDP updates to neighboring devices.
SUMMARY STEPS

1. enable
2. configure terminal
3. lldp timer rate
4. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td><em>Example:</em> Device&gt; enable</td>
<td></td>
</tr>
<tr>
<td><strong>Step 2</strong> configure terminal</td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td><em>Example:</em> Device# configure terminal</td>
<td></td>
</tr>
<tr>
<td><strong>Step 3</strong> lldp timer rate</td>
<td>Specifies the rate at which LLDP packets are sent every second.</td>
</tr>
<tr>
<td><em>Example:</em> Device(config)# lldp timer 75</td>
<td></td>
</tr>
<tr>
<td><strong>Step 4</strong> end</td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td><em>Example:</em> Device(config)# end</td>
<td></td>
</tr>
</tbody>
</table>

Monitoring and Maintaining LLDP in Multivendor Networks

Perform this task to monitor and maintain LLDP in multivendor networks. This task is optional, and Steps 2 and 3 can be performed in any sequence.

SUMMARY STEPS

1. enable
2. show lldp {entry | word | errors | interface [ethernet number] | neighbors [ethernet number | detail] | traffic}
3. clear lldp {counters | table}
4. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong> enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
</tbody>
</table>
Enabling and Disabling LLDP TLVs

LLDP TLV support is enabled by default if LLDP is enabled globally and locally on a supported interface. Specific TLVs, however, can be enabled and suppressed.

**Enabling LLDP TLVs**

**SUMMARY STEPS**

1. enable
2. configure terminal
3. interface type number
4. lldp {tlv-select tlv | receive | transmit}
5. lldp tlv-select tlv
6. end

**DETAILED STEPS**

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

| Step 2 show lldp  | Displays summarized and detailed LLDP information. |
| Example:          | Note When the show lldp neighbors command is issued, if the device ID has more than 20 characters, the ID is truncated to 20 characters in command output because of display constraints. |
| Device# show lldp entry * |

| Step 3 clear lldp | Resets LLDP traffic counters and tables to zero. |
| Example:          | |
| Device# clear lldp counters |

| Step 4 end       | Returns to user EXEC mode. |
| Example:         | |
| Device# end      |         |
Disabling LLDP TLVs

SUMMARY STEPS

1. enable
2. configure terminal
3. interface type number
4. no lldp {tlv-select tlv | receive | transmit}
5. no lldp tlv-select tlv
6. end

DETAILED STEPS

<table>
<thead>
<tr>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1 enable</td>
<td>Enables privileged EXEC mode.</td>
</tr>
<tr>
<td>Example:</td>
<td>• Enter your password if prompted.</td>
</tr>
<tr>
<td>Device&gt; enable</td>
<td></td>
</tr>
</tbody>
</table>

Step 2 configure terminal
Example:
Device# configure terminal

Step 3 interface type number
Example:
Device(config)# interface ethernet 0/1

Step 4 lldp {tlv-select tlv | receive | transmit}
Example:
Device(config-if)# lldp transmit

Step 5 lldp tlv-select tlv
Example:
Device(config-if)# lldp tlv-select system-description

Step 6 end
Example:
Device(config-if)# end
<table>
<thead>
<tr>
<th><strong>Command or Action</strong></th>
<th><strong>Purpose</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 2</strong></td>
<td>Enters global configuration mode.</td>
</tr>
<tr>
<td>configure terminal</td>
<td>Device# configure terminal</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Specifies the interface type and number on which to disable LLDP and enters interface configuration mode.</td>
</tr>
<tr>
<td>interface type number</td>
<td>Device(config)# interface ethernet 0/1</td>
</tr>
<tr>
<td><strong>Step 4</strong></td>
<td>Disables an LLDP TLV or LLDP packet reception on a supported interface.</td>
</tr>
<tr>
<td>no lldp {tlv-select tlv</td>
<td>Device(config-if)# no lldp receive</td>
</tr>
<tr>
<td></td>
<td>receive</td>
</tr>
<tr>
<td><strong>Step 5</strong></td>
<td>Disables a specific LLDP TLV on a supported interface.</td>
</tr>
<tr>
<td>no lldp tlv-select tlv</td>
<td>Device(config-if)# no lldp tlv-select system-description</td>
</tr>
<tr>
<td><strong>Step 6</strong></td>
<td>Returns to privileged EXEC mode.</td>
</tr>
<tr>
<td>end</td>
<td>Device(config-if)# end</td>
</tr>
</tbody>
</table>

### Configuration Examples for Link Layer Discovery Protocol in Multivendor Networks

#### Example: Configuring Voice VLAN

The following example shows how to configure voice VLAN and verify

```
Device1> enable
Device1# configure terminal
Device1(config)# interface GigabitEthernet0/1/7
Device1(config-if)# switchport voice vlan 10
Device1(config-if)# no ip address
Device1(config-if)# end
```

The following example displays the updated running configuration on Device 2. LLDP is enabled with hold time, timer, and TLV options configured.

```
Device1# show lldp neighbors detail

Local Intf: Gi0/1/7
Chassis id: 10.10.0.1
Port id: C8F9F9D61BC2:01
```
Port Description: SW PORT
System Name: SEPC8F9F9D61BC2

System Description:
Cisco IP Phone 7962G,V12, SCCP42.9-3-1ES27S

Time remaining: 127 seconds
System Capabilities: B,T
Enabled Capabilities: B,T
Management Addresses:
  IP: 10.10.0.1
Auto Negotiation - supported, enabled
Physical media capabilities:
  1000baseT(HD)
  1000baseX(FD)
  Symm, Asym Pause(FD)
  Symm Pause(FD)
Media Attachment Unit type: 16
Vlan ID: - not advertised

MED Information:

  MED Codes:
  (NP) Network Policy, (LI) Location Identification
  (PS) Power Source Entity, (PD) Power Device
  (IN) Inventory

  H/W revision: 12
  F/W revision: tnp62.8-3-1-21a.bin
  S/W revision: SCCP42.9-3-1ES27S
  Serial number: FCH1610A5S5
  Manufacturer: Cisco Systems, Inc.
  Model: CP-7962G
  Capabilities: NP, PD, IN
  Device type: Endpoint Class III
  Network Policy(Voice): VLAN 10, tagged, Layer-2 priority: 5, DSCP: 46
  Location - not advertised

The following example shows how to configure LLDP timer, hold time, and TLVs options on Device 2.

Device> enable
Device# configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Device(config)# lldp run
Device(config)# lldp holdtime 150
Device(config)# lldp timer 15
Device(config)# lldp tlv-select port-vlan
Device(config)# lldp tlv-select mac-phy-cfg
Device2(config)# interface ethernet 0/0
Device2(config-if)# lldp transmit
Device2(config-if)# end
00:08:32: %SYS-5-CONFIG_I: Configured from console by console

The following example shows that voice vlan has been configured on the IP phone.

Device1# show lldp traffic
LLDP traffic statistics:
  Total frames out: 20
  Total entries aged: 0
  Total frames in: 15
  Total frames received in error: 0
  Total frames discarded: 0
Total TLVs unrecognized: 0
Device1# show lldp neighbors
Capability codes:
    (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
    (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other
Device ID Local Intf Hold-time Capability Port ID
Device2 Et0/0 150 R Et0/0
Total entries displayed: 1
Device2# show lldp traffic
LLDP traffic statistics:
    Total frames out: 15
    Total entries aged: 0
    Total frames in: 17
    Total frames received in error: 0
    Total frames discarded: 2
    Total TLVs unrecognized: 0
Device2# show lldp neighbors
Capability codes:
    (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
    (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other
Device ID Local Intf Hold-time Capability Port ID
Device1 Et0/0 150 R Et0/0
Total entries displayed: 1

Additional References for Using Link Layer Discovery Protocol in Multivendor Networks

Related Documents

<table>
<thead>
<tr>
<th>Related Topic</th>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco IOS commands: master list of commands with complete command syntax, command mode, command history, defaults, usage guidelines, and examples</td>
<td>Cisco IOS Master Command List, All Releases</td>
</tr>
<tr>
<td>Carrier Ethernet commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples</td>
<td>Cisco IOS Carrier Ethernet Command Reference</td>
</tr>
<tr>
<td>LLDP</td>
<td>Link Layer Discovery Protocol</td>
</tr>
<tr>
<td>Per port location configurations</td>
<td>Per Port Location Configuration</td>
</tr>
</tbody>
</table>

Standards and RFCs

<table>
<thead>
<tr>
<th>Standards/RFCs</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE 802.1ab</td>
<td>Station and Media Access Control Connectivity Discovery</td>
</tr>
<tr>
<td>RFC 2922</td>
<td>Physical Topology MIB</td>
</tr>
</tbody>
</table>
MIBs

<table>
<thead>
<tr>
<th>MIB</th>
<th>MIBs Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTOPO MIB</td>
<td>To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: <a href="http://www.cisco.com/go/mibs">http://www.cisco.com/go/mibs</a></td>
</tr>
</tbody>
</table>

Technical Assistance

<table>
<thead>
<tr>
<th>Description</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.</td>
<td><a href="http://www.cisco.com/cisco/web/support/index.html">http://www.cisco.com/cisco/web/support/index.html</a></td>
</tr>
</tbody>
</table>

Feature Information for Link Layer Discovery Protocol in Multivendor Networks

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1: Feature Information for Using Link Layer Discovery Protocol in Multivendor Networks

<table>
<thead>
<tr>
<th>Feature Name</th>
<th>Releases</th>
<th>Feature Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE 802.1ab LLDP (Link Layer Discovery Protocol)</td>
<td>Cisco IOS XE Release 3.8S, Cisco IOS XE Release 3.9S</td>
<td>LLDP, standardized by the IEEE as part of 802.1ab, enables standardized discovery of nodes, which in turn facilitates future applications of standard management tools such as SNMP in multivendor networks. In Cisco IOS XE Release 3.9S, support was added for the Cisco 903 Series Aggregation Services Routers. The following commands were introduced or modified: clear lldp, lldp, and show lldp.</td>
</tr>
</tbody>
</table>