

Configuration Guide

LLDP and LLDP-MED

This configuration guide will aid in the setup of the Link-Layer Discovery Protocol (LLDP) and LLDP-Media Endpoint Discovery (LLDP-MED) for ADTRAN Operating System (AOS) products. An overview of LLDP and LLDP-MED general concepts combined with detailed command descriptions for example networks provide step-by-step assistance for configuration. The troubleshooting section outlines proper use of **show** and **debug** commands to verify that LLDP and LLDP-MED have been configured properly on the AOS product(s).

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LLDP Overview

AOS devices have the ability to advertise information about themselves to other devices on the local network through the use of a vendor-neutral Layer 2 protocol called LLDP. This protocol is outlined in the IEEE standard 802.1AB. AOS products not only advertise network management information, but also receive network management information from adjacent neighbors on the same IEEE 802 local area network (LAN). The information is transmitted via LLDP frames to all adjacent devices using a special multicast media access control (MAC) address that has been reserved for LLDP implementations. Received network management information is stored in a local database on each individual device. Since LLDP support in AOS adheres to the IEEE 802.1AB standard, AOS devices should be able to discover non-ADTRAN devices that also adhere to this standard.

LLDP can be used to propagate stacking specific parameters among AOS devices connected in a stacking environment. This functionality is achieved through the use of an optional type length value (TLV) that has been implemented in AOS. Only AOS products that support stacking will respond to the stacking TLV carried in the LLDP frame. When an AOS device receives an LLDP frame containing updated stack master information, the device will propagate the information by transmitting LLDP frames containing the update to all neighboring devices. For more information on the configuration of switch stacking in AOS, refer to the *Switch Stacking in AOS Quick Configuration Guide* available on ADTRAN's Support Community (<https://supportforums.adtran.com>).

Each LLDP frame (see *Figure 1*) contains a Link-Layer Discovery Protocol Data Unit (LLDPDU). The destination address of an LLDP frame is the reserved LLDP multicast MAC address: 01:80:C2:00:00:0E.

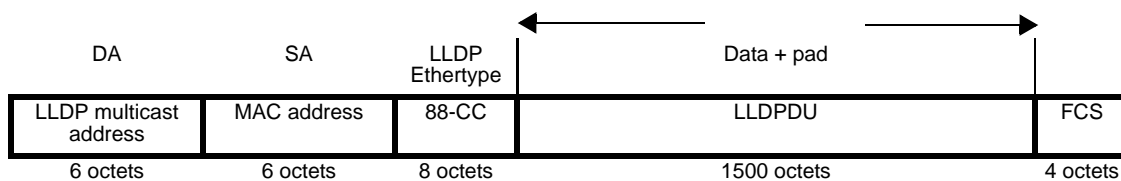
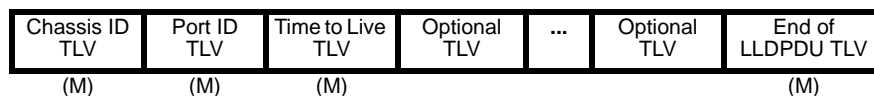


Figure 1. IEEE 802.3 LLDP Frame Format

LLDP frames are transmitted to all adjacent devices under the following conditions:

- Spanning tree has resolved the network topology.
- A frame will be sent every 30 seconds by default. The minimum amount of time between successive packets is 2 seconds by default.
- The port state changes (e.g., link state, changes in Spanning Tree Protocol (STP) state, administrative status change).

The LLDPDU (see *Figure 2*) contains a sequence of short, variable length, TLV information elements. IEEE 802.1AB defines four mandatory TLVs that must be implemented: chassis ID, port ID, time to live (TTL), and end of LLDPDU.



M - Mandatory TLV (required for all LLDPDUs)

Figure 2. LLDPDU Format

Additional TLVs can be optionally added based on the needs of the equipment manufacturer. AOS devices support the basic management TLV set as defined by 802.1. This set includes TLVs for port description, system name, system description, system capabilities, and management address. In addition, AOS devices also support the MAC/PHY configuration/status TLV as defined in the IEEE 802.3 organization specific TLV set. The MAC/PHY TLV identifies the speed/duplex capability, current speed/duplex, and whether the current settings are the result of auto-negotiation or a manual setting of the sending device.

LLDP-MED Overview

LLDP-MED is an extension to the base LLDP protocol that provides support for needs specific to Voice over Internet Protocol (VoIP). The extension is defined by standards developed through the Telecommunications Industry Association (TIA) and published as ANSI/TIA-1057. LLDP-MED simplifies the deployment of VoIP-related products into IEEE 802-based LAN environments. Since the protocol is a published standard, LLDP-MED support enables VoIP products from multiple vendors to interoperate with each other on the local network.

The TLVs associated with the LLDP-MED standard expand upon the existing capabilities offered by LLDP. These TLVs help to simplify the management of a VoIP network. AOS devices currently support two LLDP-MED TLVs:

- LLDP-MED capabilities TLV
- Network policy TLV

The LLDP-MED capabilities TLV allows AOS devices that support LLDP-MED to discover other devices on the local network that support LLDP-MED. The NetVanta products that support LLDP-MED will advertise themselves as a network connectivity device with support for LLDP-MED capabilities TLV and network policy TLV.

The network policy TLV streamlines troubleshooting by facilitating efficient discovery and diagnosis of port-level mismatch issues pertaining to virtual local area network (VLAN) configuration and associated Layer 2 and Layer 3 attributes. The following is a list of the attributes that are advertised in the network policy TLV:

- Layer 2 VLAN ID
- Layer 2 priority class of service (CoS) value
- Layer 3 differentiated services code point (DSCP) value

The attribute values specified in the network policy are assigned to an application type. AOS devices support four different application types: voice, guest voice, soft phone voice, and voice signaling. Each application type can be assigned different attribute values based on the priority of that application on the LAN. For example, a voice application would typically be assigned higher priority CoS and DSCP values than a guest voice application.

Hardware and Software Requirements and Limitations

LLDP capability was introduced in AOS 8.01.00 and is supported on all NetVanta hardware platforms.

Stacking TLVs were introduced in AOS 8.01.00 and are supported on all AOS-based switch products.

LLDP-MED and the MAC/PHY configuration/status TLVs were introduced in AOS 17.02.00 and are supported on all AOS-based switch products.

CLI Configuration

LLDP

LLDP is supported on a number of interfaces in the AOS product. By default, all of these interfaces are configured to send and receive LLDP packets. Generally, the default settings for LLDP are left in place. However, each individual interface in the AOS device may be configured to send only specified LLDP packets and/or to receive all or no LLDP packets. In addition, intervals, delays, and the TTL multiplier associated with LLDP can be adjusted from the Global Configuration mode.

Global-Level LLDP Commands

Several commands are available in the Global Configuration mode that allow control over LLDP timers. A complete list of LLDP commands available in this mode is available using the question mark command line interface (CLI) shortcut:

```
(config)#lldp ?
```

Syntax:

```
lldp med-fast-start-interval <value>
```

```
lldp minimum-transmit-interval <value>
```

```
lldp reinitialization-delay <value>
```

```
lldp transmit-interval <value>
```

```
lldp ttl-multiplier <value>
```

med-fast-start-interval <value> specifies the fast start transmit interval (in seconds) that LLDP-MED TLVs are sent once every second, allowing rapid automatic configuration of LLDP-MED capable endpoints at startup. Range is **1** to **10** seconds. Default value is **4** seconds.

minimum-transmit-interval <value> defines the minimum amount of time (in seconds) between the successive transmission of LLDP frames. Configuration changes in an AOS device will trigger the transmission of LLDP frames to provide updates to neighboring devices. The minimum transmit interval prevents excessive transmission of LLDP frames when multiple updates are occurring in a relatively short period of time. Range is **1** to **8192** seconds. Default value is **2** seconds.

reinitialization-delay <value> defines the minimum amount of time (in seconds) to delay after LLDP is enabled on a port before allowing transmission of additional LLDP frames on that port. Range is **1** to **10** seconds. Default value is **2** seconds.

transmit-interval <value> defines the delay (in seconds) between LLDP frame transmission attempts during normal operation. Range is **5** to **32768** seconds. Default value is **30** seconds.

ttl-multiplier <value> defines the multiplier to be applied to the transmit interval to compute the TTL for data sent in an LLDP frame (refer to the equation below). Range is **2** to **10**. Default value is **4**.

The data received via an LLDP frame is retained in the management information base (MIB) of the receiving device for a specified amount of time. This amount of time is called TTL and the value is stipulated within the LLDP frame. The formula for calculating the TTL that is transmitted in the LLDP frame is:

$$\text{TTL} = (\text{transmit-interval}) \times (\text{ttl-multiplier})$$

The following example sets the LLDP transmit interval to **15** seconds and the TTL multiplier to **2** for all LLDP frames transmitted from the unit. The resulting TTL is 30 seconds.

```
(config)#lldp transmit-interval 15
```

```
(config)#lldp ttl-multiplier 2
```

Interface-Level LLDP Commands

Each interface that supports LLDP can be individually configured to include only specified information in outbound LLDP packets. Individual interfaces can also be configured to receive all or no LLDP packets. Except where noted, the interface-level LLDP commands can be configured on the following interfaces:

- Demand
- Ethernet
- Frame Relay subinterface
- HDLC
- Port channel
- Point-to-Point Protocol (PPP)
- Generic router encapsulation (GRE) tunnel
- Switchport



For illustrative purposes, switchport interface 0/1 (swx 0/1) will be used to represent interface-level commands throughout this guide.

LLDP Receive

Use the **lldp receive** command to allow LLDP packets to be received on this interface. This command is enabled by default. Use the **no** form of this command to prevent LLDP packets from being received on the interface.

The following example configures switchport interface 0/1 to reject all LLDP packets:

```
(config-sw-x 0/1)#no lldp receive
```

LLDP Send

Use the **lldp send** command to configure an interface to transmit all LLDP frames or to control optional types of information transmitted by the interface. Use the **no** form of these commands to prevent certain information from being transmitted by the interface.

Syntax:

```
lldp send 802.3-info mac-phy-config  
lldp send med-info network-policy  
lldp send management-address  
lldp send port-description  
lldp send system-capabilities  
lldp send system-description  
lldp send system-name  
lldp send-and-receive
```

802.3-info mac-phy-config enables transmission of the capability and settings of the duplex and speed on this interface. Also, transmits whether the settings are a result of auto-negotiation or manual configuration. This TLV is only supported on switchport interfaces and NetVanta 1524ST Gigabit Ethernet interfaces.

med-info network-policy enables transmission of LLDP-MED network policy information on the interface. These TLVs are only supported on switchport interfaces and NetVanta 1524ST Gigabit Ethernet interfaces.

management-address enables transmission of management address information on the interface.

port-description enables transmission of port description information on the interface.

system-capabilities enables transmission of this device's system capabilities on the interface.

system-description enables transmission of this device's system description on the interface.

system-name enables transmission of this device's system name on the interface.

send-and-receive configures the interface to both transmit and receive LLDP packets.

By default, all interfaces that support LLDP except routed Ethernet are configured to transmit and receive LLDP packets. LLDP is disabled by default on routed Ethernet interfaces.

Individual LLDP information can be enabled or disabled using the various forms of the **lldp send** command. The following example uses the **lldp send-and-receive** command to enable transmission and reception of all LLDP frames on switchport interface 0/1. The **no lldp send port-description** command is then issued to prevent the transmission of port description information in the outbound LLDP frames.

```
(config-sw 0/1)#lldp send-and-receive  
(config-sw 0/1)#no lldp send port-description
```



*The **802.3-info mac-phy-config** command enables detection of speed/duplex and network policy mismatches between the interface and the endpoint. Encountered mismatches will generate console messages in the command line interface (CLI) and warning statements in the web-based graphical user interface (GUI).*

LLDP-MED

Since LLDP-MED is designed to support specific needs of VoIP applications, an AOS device will not send any LLDP-MED TLVs unless it discovers an LLDP-MED capable endpoint (e.g., IP phones, PCs, etc.) on an interface. Once an LLDP-MED capable endpoint is detected, LLDP-MED TLVs containing network policy information are sent to the LLDP-MED capable endpoint devices once per second for the duration of the LLDP-MED fast start interval. These endpoints will automatically configure based on information received in the network policy, simplifying setup and configuration.



The MAC/PHY Configuration/Status TLV and LLDP-MED TLVs will not be transmitted on a port that is part of a channel group.

The following steps are recommended for LLDP-MED operation in AOS:

1. Verify that the LLDP-MED fast start interval is set to the desired value.
2. Configure a network policy (or policies) on the switchport interface that is connected to an LLDP-MED capable endpoint.
3. Verify that the LLDP-MED TLVs are enabled on the interface.
4. Save the configuration to memory.



The network policy is typically configured on switchport interfaces in AOS devices that support LLDP-MED. An exception is the NetVanta 1524ST, where network policies are configured on Gigabit Ethernet interfaces.

The following sections detail each of the steps listed above with an explanation and the required syntax for configuration.

Step 1: Verify that the LLDP-MED fast start interval is set to the desired value

LLDP-MED TLVs are sent once every second for the period of the fast start interval, which allows rapid auto-configuration of the LLDP-MED capable endpoints at startup. When the fast start interval is over, normal transmission of LLDP frames resumes as defined by the LLDP transmit interval (refer to [Global-Level LLDP Commands](#) on page 4). The default value for the LLDP-MED fast start interval is 4 seconds. Enter the following command from the Global Configuration mode to change the duration of the LLDP-MED fast start interval:

```
(config)#lldp med-fast-start-interval <value>
```

<value> Specifies the fast start transmit interval (in seconds) that LLDP-MED TLVs will be transmitted once every second. Valid range is **1** to **10** seconds.

Step 2: Configure a network policy (or policies) on the switchport interface that is connected to an LLDP-MED capable endpoint

At least one network policy should be configured on a switchport interface that is connected to an LLDP-MED capable endpoint. Depending on the type and use of VoIP equipment attached to the switchport interface, multiple network policies may need to be configured on the same interface. The network policy specifies the application type (**voice**, **guest-voice**, **voice-signalling**, **softphone**), VLAN, CoS, and DSCP priorities that will be advertised to the LLDP-MED capable endpoint that is attached to the switchport interface.

Enter the following command from the switchport interface to configure a network policy for an LLDP-MED capable endpoint:

```
(config-sw 0/1)#switchport [voice | guest-voice | voice-signalling | softphone] vlan <vlan id> [cos <value>] [dscp <value>]
```

voice is used by dedicated IP phone handsets and other similar devices supporting interactive voice services.

guest-voice is used to define a limited feature set of voice services for guest users.

voice-signalling is used to define a separate policy for the command and control signaling that supports voice and guest voice applications.

softphone is used by softphone applications that operate on devices, such as PCs or laptop computers.

vlan <vlan id> specifies the VLAN ID assigned to the application specified in this command. Range is **1** to **4094**.

cos <value> (optional) specifies the CoS value assigned to the application specified in this command. Range is **0** to **7**. Default CoS values are: voice (**5**); voice-signalling (**3**); guest-voice (**0**); softphone (**0**).

dscp <value> (optional) specifies the (DSCP value assigned to the application specified in this command. Range is **0** to **63**. Default DSCP values are: voice (**46**); voice-signalling (**26**); guest-voice (**0**); softphone (**0**).



If the VLAN specified in this command does not yet exist, it will be created in AOS when the command is issued.

Step 3: Verify that the LLDP-MED TLVs are enabled on the interface



The LLDP-MED TLVs are enabled by default. If this command has been disabled previously, then it must be re-enabled for LLDP-MED to function properly.

Enter the following command to enable the transmission of the LLDP-MED TLVs:

```
(config-swxx 0/1)#lldp send med-info network-policy
```



If the network policy on the switchport interface has not been configured properly for the application, then the interface will not transmit any LLDP-MED TLVs, even if they are enabled.

Step 4: Save the configuration to memory

Enter the following commands to save the configuration to memory: (config-swxx 0/1)#do copy run start

or

```
(config-swxx 0/1)#do write memory
```

GUI Configuration

The GUI is an especially useful tool for those who are less familiar with CLI configuration. AOS products ship with a user-friendly GUI that can be used to perform many basic management and configuration functions on the AOS product. Certain advanced options can be configured using the GUI as well.

Accessing the GUI

1. Connect to the GUI by opening a new page in your Internet browser and entering the unit's IP address in the address field in the following form: **http://<ip address>**, for example:




2. At the prompt, enter your user name and password and select **OK**.



*The default user name is **admin**, and the default password is **password**.*

Once a successful connection to the GUI has been established, the main menu appears.



While navigating the GUI you will notice question mark  symbols that indicate additional information is available. Simply place your cursor over the symbol to view the additional information.



Upon completion of the desired settings for LLDP and/or LLDP-MED, select **Apply** to apply the changes to the configuration. Save the configuration to memory by selecting **Save** in the upper right-hand corner of the menu.

LLDP and LLDP-MED Timers

To configure the LLDP-related timers, navigate to **System > LLDP** to display the **LLDP Setup** menu. Select the **Basic Setup** tab to view or modify the following timers: **Transmit Interval**, **Minimum Transmit Interval**, **TTL Multiplier**, and **Fast-Start Interval**.



Please refer to the [Global-Level LLDP Commands](#) on page 4 of this document for detailed information on LLDP timers. Additional information on the LLDP-MED fast start interval is found under [LLDP-MED](#) on page 7.

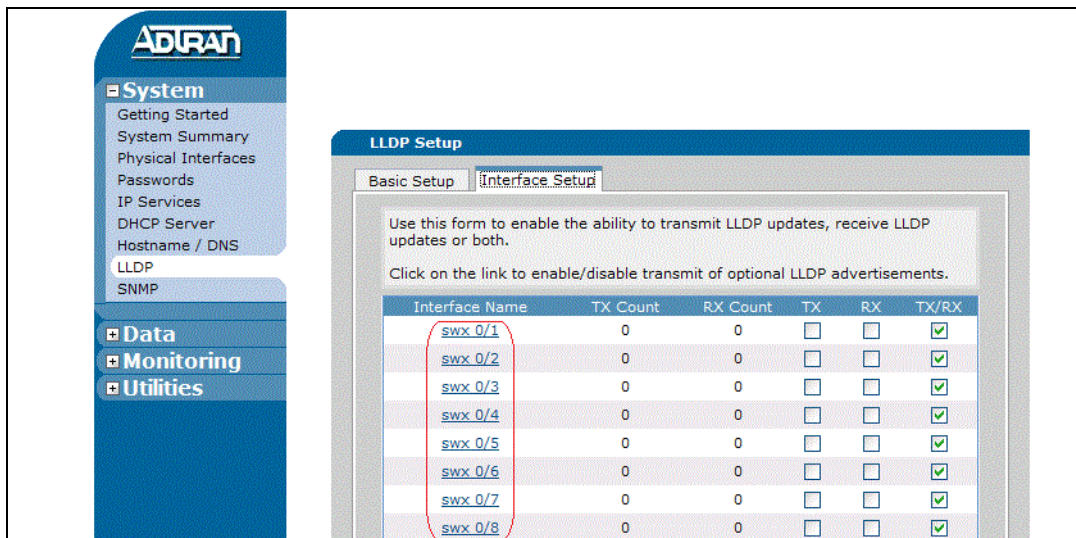
The screenshot displays the ADTRAN configuration interface. On the left is a navigation menu with categories: System, Data, Monitoring, and Utilities. The 'System' category is expanded, showing options like Getting Started, System Summary, Physical Interfaces, Passwords, IP Services, DHCP Server, Hostname / DNS, LLDP, and SNMP. The main content area is titled 'LLDP Setup' and has two tabs: 'Basic Setup' (selected) and 'Interface Setup'. Below the tabs, a text box explains that the parameters modify how often LLDP packets are sent out. There are four configuration fields: 'Transmit Interval' (0 hours, 0 min, 30 sec), 'Minimum Transmit Interval' (0 hours, 0 min, 2 sec), 'TTL Multiplier' (4), and 'Fast-Start Interval' (4). Each field has a 'Reset' button and an 'Apply' button. Below the configuration fields is a section titled 'LLDP Neighbors' with a text box stating 'This is a list of neighbors learned through LLDP.' Below this is a table with columns: Name, Platform, Local Interface, and Unit Access. The table contains one entry: 'Switch 1224', 'NetVanta 1224', 'swx 0/24'. The 'Name' cell is circled in red. To the right of the table are 'Browse' and 'Telnet' buttons.

A list of all LLDP neighbors learned through LLDP is displayed at the bottom of the page. Select the blue hyperlinked name of any unit in the list to view details about a specific neighbor. It is also possible to access the GUI or Telnet to these neighbors.

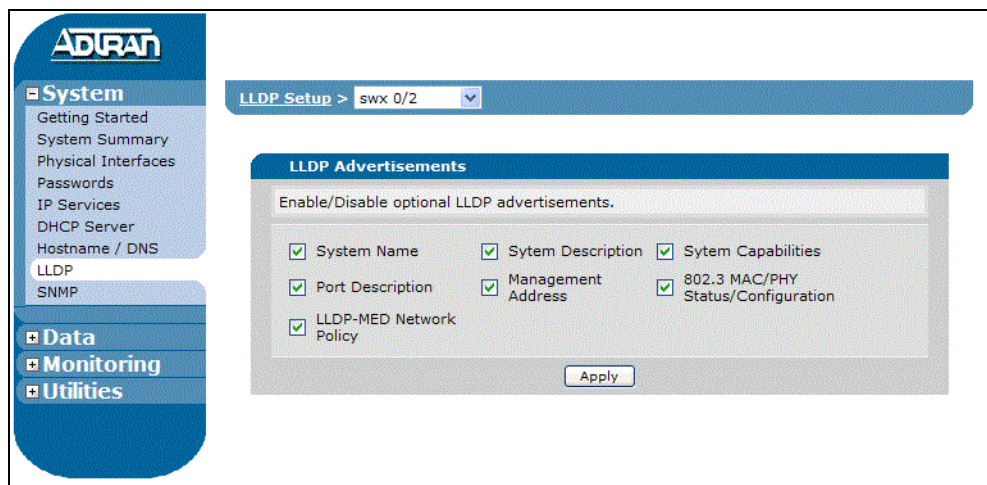
LLDP Advertisements

To configure LLDP advertisement preferences for switchport interfaces, select the **Interface Setup** tab on the **LLDP Setup** menu. Individual switchport interfaces can be configured to either transmit (**TX**), receive (**RX**), or transmit and receive (**TX/RX**) LLDP frames by placing a check mark in the box in the appropriate column beside the interface. By default, all interfaces are configured to transmit and receive LLDP frames.

Enable/disable the transmission of specific LLDP advertisements on individual switchport interfaces by selecting the blue hyperlinked name of the port you want to configure.



The **LLDP Advertisements** menu allows a system administrator to customize the information transmitted in an LLDP frame on a specific switchport interface. Enable an advertisement by placing a check mark in the box next to the name.



Setting the LLDP-MED Network Policy on a Switchport

To display the **Switch Ports Configuration** menu, navigate to **Data > Ports**. Configure individual switchport interface options by selecting the blue hyperlinked name of the port you want to configure.

The screenshot shows the ADTRAN GUI's 'Switch Ports Configuration' page. The left sidebar contains a navigation menu with categories like System, Data, Router / Bridge, Firewall, Wireless, and VPN. Under 'Data', 'Ports' is selected. The main content area has a title 'Switch Ports Configuration' and a sub-header 'Make changes to one or more port's settings and click Apply. Click on the name of the port to configure additional port settings and view port statistics.' Below this is a table with columns: Port, Edge Port Mode, Membership, Speed/Duplex, Status, and STP. The table lists ports from swx 0/1 to swx 0/16. A red box highlights the 'swx 0/1' port name in the first row.

Select the **VLAN Application** tab on the **Port Information** menu. The LLDP-MED network policy settings are configured here. Select the desired **Application** from the drop-down menu: **Voice**, **Guest-Voice**, **Voice-Signaling**, or **Softphone**. Next, choose the **VLAN ID** to use for the application.



*If a VLAN ID has not been previously established for the selected application, then a new one must be added before network policy configuration can continue. New VLANs are created on the **VLAN Configuration** menu (a convenient hyperlink to this menu is located on each **Port Information** the menu under the **VLAN Application** tab).*

Enter the **CoS** and **DSCP** values to be assigned to the application. If no values are entered, the default values will be assigned (refer to [Step 2: Configure a network policy \(or policies\) on the switchport interface that is connected to an LLDP-MED capable endpoint](#) on page 8 for default values). Select **Apply** to create the network policy.

Existing application policies appear in the summarized table at the bottom of the menu. This table provides a quick glance at the types of application policies configured and their corresponding **VLAN ID**, **CoS**, and **DSCP** values.

Port Information for swx 0/2

Customize the characteristics of an individual Ethernet port on the switch.

Configuration | **VLAN Application**

Use this form to configure VLAN application(s) and its policies for the port. If this port is enabled to advertise LLDP-MED information, the policies you have configured will be used in the advertisements.

Note: Only one policy can be configured for an application.

Application: Select an application.


VLAN ID: VLAN ID to use for the application. (1-4094) To create VLANs, please click [here](#).

CoS: Class of Service to use for the application. (0-7)

DSCP: DiffServ code to use for the application. (0-63)

Delete application policies.

Application	VLAN ID	CoS	DSCP
Voice	200	4	36

 **NOTE** Ensure the LLDP-MED network policy TLVs are enabled on the **LLDP Advertisements** menu. Refer to [LLDP Advertisements](#) on page 11.

Example Configurations

The following example scenarios are designed to enhance understanding of LLDP-MED configuration on AOS products.

Example 1: Multiple IP Phones Using the Same Network Policy

Two IP phones are connected to switchports 0/2 and 0/3, respectively, on an ADTRAN Power over Ethernet (PoE) Multiservice Access Router. The phones are LLDP-MED capable and will automatically configure themselves with the network policy settings that have been programmed on their respective switchport interfaces. Even though the same network policy will be assigned to both phones, the policy must be configured on each individual switchport interface. The LLDP-MED fast start interval is to be left at the default value of 4 seconds.

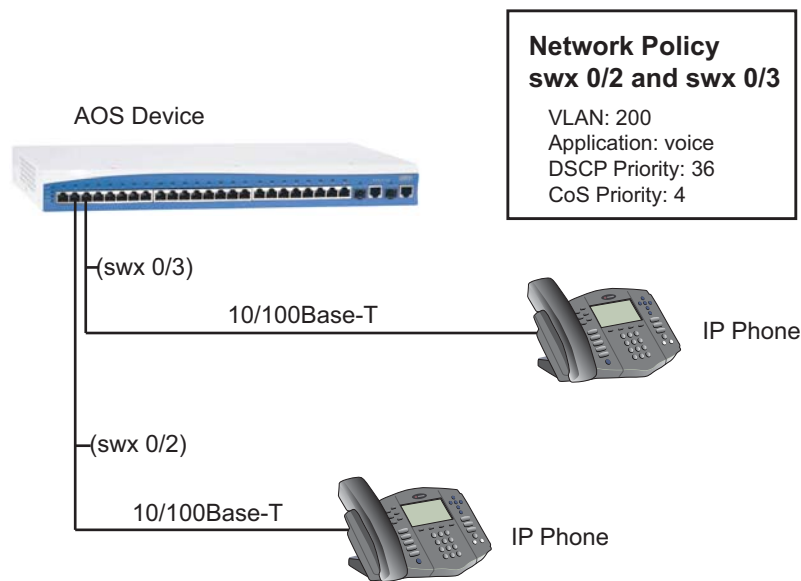


Figure 3. Multiple IP Phones Using the Same Network Policy

The following commands are entered to establish the LLDP-MED network policies for Example 1:

```
(config)#interface switchport 0/2
(config-sw x 0/2)#switchport voice vlan 200 dscp 36 cos 4
(config-sw x 0/2)#interface switchport 0/3
(config-sw x 0/3)#switchport voice vlan 200 dscp 36 cos 4
(config-sw x 0/3)#do copy run start
```



The LLDP-MED TLVs are enabled by default. If these TLVs have been disabled previously, then they must be re-enabled for LLDP-MED to function properly.

Example 2: Multiple IP Phones Using Multiple Network Policies

Two IP phones are connected to switchports 0/2 and 0/3, respectively, on an ADTRAN PoE Multiservice Access Router. The phones are LLDP-MED capable and will automatically configure themselves with the network policy settings that have been programmed on their respective switchport interfaces. A different voice network policy will be assigned to each phone. In addition, a guest voice network policy will be assigned to the phone on switchport interface 0/3. The LLDP-MED fast start interval is to be increased to a value of 6 seconds.

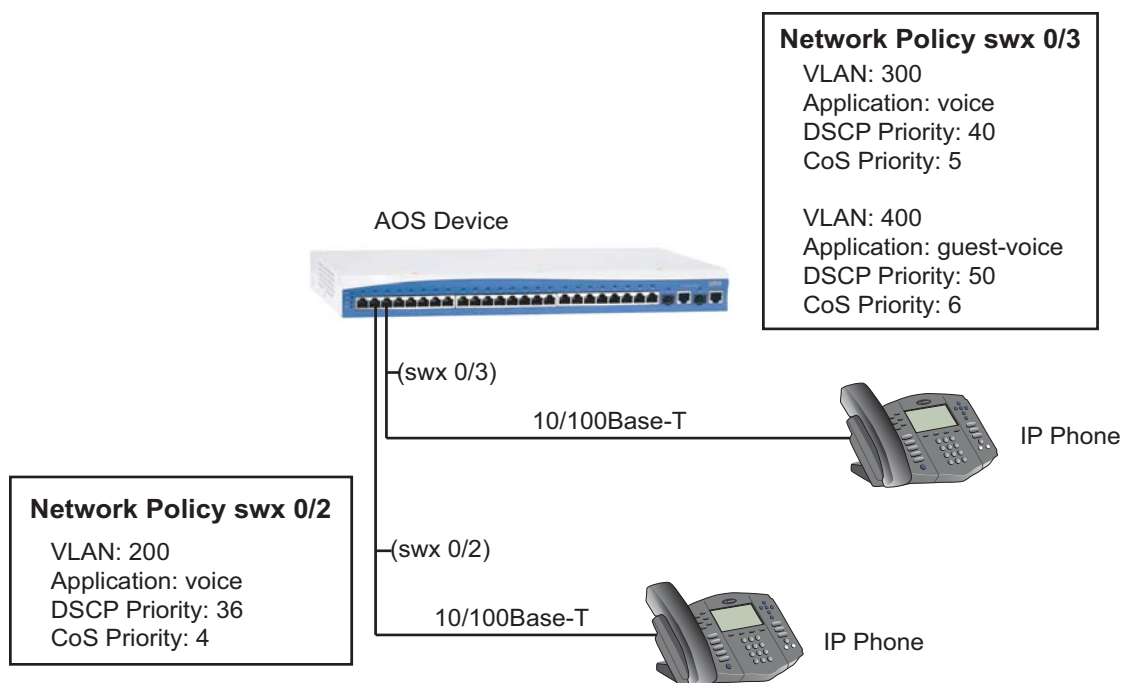


Figure 4. Multiple IP Phones Using Multiple Network Policies

The following commands are entered to establish the LLDP-MED network policies for Example 2:

```
(config)#lldp med-fast-start-interval 6
(config)#interface switchport 0/2
(config-sw 0/2)#switchport voice vlan 200 dscp 36 cos 4
(config-sw 0/2)#interface switchport 0/3
(config-sw 0/3)#switchport voice vlan 300 dscp 40 cos 5
(config-sw 0/3)#switchport guest-voice vlan 400 dscp 50 cos 6
(config-sw 0/3)#do copy run start
```



The LLDP-MED TLVs are enabled by default. If these TLVs have been disabled previously, then they must be re-enabled for LLDP-MED to function properly.

Command Summary

The following table summarizes commands that can be used to configure LLDP from the Global Configuration mode in an AOS device.

Table 1. Global-Level LLDP Commands

Command	Description
lldp minimum-transmit-interval <value>	Defines the minimum amount of time between the successive transmission of LLDP frames. Range is 1 to 8192 seconds.
lldp reinitialization-delay <value>	Defines the minimum amount of time to delay after LLDP is enabled on a port before allowing transmission of additional LLDP frames on that port. Range is 1 to 10 seconds.
lldp transmit-interval <value>	Defines the delay between LLDP frame transmission attempts during normal operation. Range is 5 to 32758 seconds.
lldp ttl-multiplier <value>	Defines the multiplier to be applied to the transmit interval to compute the time to live for outbound LLDP frames. Range is 2 to 10 .

The following table summarizes commands that can be used to configure LLDP on a specific interface. Refer to [Interface-Level LLDP Commands](#) on page 5 for a listing of interfaces that support LLDP.

Table 2. Interface-Level LLDP Commands

Command	Description
lldp receive	Allows LLDP packets to be received on the interface. Use the no form of this command to prevent LLDP packets from being received on the interface.
lldp send 802.3-info mac-phy-config	Enables transmission of the capability and settings of the duplex and speed on the interface.
lldp send med-info network-policy	Enables transmission of LLDP-MED network policy information on the interface.
lldp send management-address	Enables transmission of management address information on the interface.
lldp send port-description	Enables transmission of port description on the interface.
lldp send system-capabilities	Enables transmission of this device's system capabilities on the interface.
lldp send system-description	Enables transmission of this device's system description on the interface.

Table 2. Interface-Level LLDP Commands (Continued)

Command	Description
lldp send system-name	Enables transmission of this device's system name on the interface.
lldp send-and-receive	Configures the interface to both transmit and receive LLDP packets.

The following table summarizes the recommended configuration steps to configure LLDP-MED on an AOS product.

Table 3. LLDP-MED Configuration Steps

Step	Command	Description
Step 1	<code>(config)#lldp med-fast-start-interval <value></code>	Verify that the LLDP-MED fast start interval is set to the desired value. Range is 1 to 10 seconds. Default value is 4 seconds.
Step 2	<code>(config-sw 0/1)#switchport [voice guest-voice voice-signaling softphone] vlan <vlan id> [cos <value>] [dscp <value>]</code>	Configure a network policy (or policies) on the switchport interface that is connected to an LLDP-MED capable endpoint.
Step 3	<code>(config-sw 0/1)#lldp send med-info network-policy</code>	Verify that the LLDP-MED TLVs are enabled on the interface. LLDP-MED TLVs are enabled by default.
Step 4	<code>(config-sw 0/1)#do copy run start</code>	Save the configuration to memory.

Troubleshooting

There are several different tools available to assist with troubleshooting LLDP and LLDP-MED.

State Messages and Warnings

State messages are displayed on the console whenever there is a speed or duplex mismatch between the AOS device and an LLDP neighbor. The output follows the format below:

```
[time stamp] LLDP LLDP: Speed Duplex mis-match on [interface]. Speed/Duplex: "[speed/duplex of local interface]" Neighbor Speed/Duplex: "[speed/duplex of neighbor interface]"
```

The following example state message shows that a duplex mismatch exists between local switchport interface 0/2 and the neighboring endpoint. The local interface is set for full-duplex, while the neighbor interface is set for half-duplex:

```
2008.01.27 18:07:54 LLDP LLDP: Speed Duplex mis-match on swx 0/2. Speed/Duplex: "100M/full-duplex" Neighbor Speed/Duplex: "100M/half-duplex"
```



The most common cause of duplex mismatches is improper configuration of auto-negotiation. If one end of an Ethernet link is configured to auto-negotiate duplex, but the other end has had its duplex manually forced to full-duplex, there will be a mismatch. The manually configured endpoint will use full-duplex, but the negotiated endpoint will assume half-duplex.

Warning messages are displayed on the **Troubleshooting** menu in the GUI. Navigate to **Utilities > Troubleshooting** to display the **Troubleshooting** menu. LLDP warnings will appear under the **Physical Interfaces** category. There are two warnings displayed in the illustration below:

- There is a duplex mismatch between switchport interface 0/1 and the Mitel 5224 DM endpoint. The switchport interface is set to full-duplex, while the Mitel 5224 DM is set to half-duplex.
- There is a mismatch between the voice signaling policy configured for switchport interface 0/1 and the Mitel 5224 DM endpoint. The voice signaling application is configured for VLAN 100 on the switchport interface and VLAN 10 on the Mitel 5224 DM. The configured VLAN for the policy should match on both ends.

The screenshot shows the ADTRAN GUI's Troubleshooting menu. The left sidebar contains a navigation tree with categories: System, Data, Monitoring, and Utilities. Under Utilities, there are sub-items for System, Troubleshooting, Language, Two-way Ping, Reboot Unit, Telnet To Unit, and Connectivity. The 'Collapse Menus' option is checked. The main content area is titled 'Troubleshooting' and contains a legend: 'Red - Error' and 'Orange - Warning'. Below the legend are several expandable sections: System Health, Physical Interfaces (checked), Layer 2 Protocols, Routing, and Firewall. The Physical Interfaces section is expanded, showing two warnings in red text:

- There is a speed/duplex mismatch on port swx 0/1 with URL 5000@10.22.41.52,MITEL 5224 DM.
Local: 100M Full Duplex
Neighbor: 100M Half Duplex
- Voice signaling policy mismatch with URL 5000@10.22.41.52,MITEL 5224 DM on swx 0/1.
Local VLAN / CoS / DSCP: 100 / 3 / 26 (tagged)
Neighbor VLAN / CoS / DSCP: 10 / 3 / 26 (tagged)

Show, Debug, and Clear Command Summary

Several different commands can be issued from Enable mode in the CLI to assist in troubleshooting. The following tables contain the AOS troubleshooting commands that can be implemented specifically for LLDP/LLDP-MED.

Table 4. LLDP and LLDP-MED Show Commands

Command	Description
show lldp	Displays the current LLDP transmit interval and transmitted TTL.
show lldp device <name>	Displays neighbor information about an adjacent device on the same IEEE 802 LAN.
show lldp interface <interface>	Displays LLDP statistics for all interfaces on this device. If an interface is specified, only statistics for that interface will be displayed.
show lldp neighbors [detail]	Displays basic information about all adjacent LLDP neighbor devices. Use the optional detail keyword to view detailed information about all LLDP neighbor devices.
show lldp neighbors interface <interface> [detail]	Displays basic information about LLDP neighbor devices connected to a specified interface. Use the optional detail keyword to view detailed information about LLDP neighbor devices connected to a specified interface.
show lldp neighbors med	Displays a summary of all neighbor devices that support LLDP-MED.
show lldp neighbors realtime	Displays basic information about all LLDP neighbors via full-screen output in real time.
show lldp neighbors statistics	Displays information about changes in this device's neighbor table (e.g., neighbors inserted, deleted, dropped, or aged out).

Table 5. LLDP and LLDP-MED Debug and Clear Commands

Command	Description
debug lldp [verbose]	Displays real time LLDP messages that are transmitted and received by the device. Use the optional verbose keyword to display extensive information.
debug lldp [tx rx] [verbose]	Displays real time LLDP messages that are either transmitted or received from this device. Use the optional verbose keyword to display extensive transmit or receive information.

Table 5. LLDP and LLDP-MED Debug and Clear Commands (*Continued*)

Command	Description
clear lldp counters [interface] <interface>	Clears all LLDP counters on all interfaces. Specify an interface to clear the counters only on the specified interface.
clear lldp neighbors	Clears all LLDP neighbors.

Show Commands

The **show** commands are used to display configuration, neighbor information, and statistical data for LLDP and LLDP-MED. Specifying interfaces (where applicable) when issuing a **show** command reduces the amount of information displayed and allows a system administrator to view precise information quickly and easily.



*The output of all **show** commands can be limited by appending the following modifiers to the end of the command: | **begin** <text>, | **exclude** <text>, and | **include** <text>. The **include** modifier limits output to lines that contain the specified text, the **exclude** modifier excludes any lines with the specified text, and the **begin** modifier displays the first line of output with the specified text and all lines thereafter. For specific instructions and examples regarding these modifiers, refer to the Enable Mode Command Set introduction in the [AOS Command Reference Guide](#) available on ADTRAN's Support Community (<https://supportforums.adtran.com>).*

show lldp

Use the **show lldp** command to display very basic timer information for LLDP. This information includes the LLDP transmit interval and the transmitted TTL. The transmitted TTL is calculated by multiplying the transmit interval by the TTL multiplier. The output below shows that the transmit interval is set to 30 seconds, and the TTL specified in the LLDP frame is 120 seconds. For more information, refer to the command **tll-multiplier** on [page 5](#).

#show lldp

Global LLDP information:
 Sending LLDP packets every 30 seconds
 Sending TTL of 120 seconds

show lldp device

Use the **show lldp device** command to display neighbor information about a specific adjacent device on the same IEEE 802 LAN. Specify the neighbor device by its system name.



If more than one neighbor exists with the same system name, then all neighbors with that system name will be displayed.

The following example shows specific information about a neighbor for the system name **ROUTER**:

#show lldp device ROUTER

```
Chassis ID: 00:A0:C8:02:DD:2A (MAC Address)
  System Name: ROUTER
  Device Port: eth 0/1 (Locally Assigned)
  Holdtime: 30
  Platform: NetVanta 3305
  Software: Version: 08.00.22.sw1.D, Date: Mon Nov 01 10:28:55 2004
  Capabilities: Bridge, Router
  Enabled Capabilities: Router
  Local Port: eth 0/3
  Management Addresses:
  Address Type: IP version 4, Address: 10.23.10.10
  Interface Type: Interface Index, Interface Id: 2
```

show lldp interface

Use the **show lldp interface** command to display LLDP statistics for all interfaces on this device. These statistics include: packet input/output, input and TLV errors, packets discarded, and neighbor ageouts. Reduce the amount of statistics displayed in the output by specifying an interface.

#show lldp interface switchport 0/1

```
swx 0/1 (TX/RX)
  189 packets input
  0 input errors
  0 TLV errors, 0 TLVs Discarded
  0 packets discarded
  96 packets output
  0 neighbor ageouts
```

show lldp neighbors

Use the **show lldp neighbors** command to display a summary of information about all LLDP neighbors connected to this device. This information includes:

- System name
- Port ID
- TTL
- Capability
- Platform
- Local interface to which the neighbor is connected
- Inventory information if transmitted by the endpoint (when using the **detail** keyword)

#show lldp neighbors

Capability Codes: R - Router, B - Bridge, H - Host, D - DOCSIS Device,
W - WLAN Access Point, r - Repeater, T - Telephone

System Name	Port ID	TTL	Cap.	Platform	Local Int
Router	eth 0/1	91	---R---	NetVanta 3200	swx 0/1
Switch	giga-eth 0/10	100	--B----	NetVanta 1524	swx 0/1
URL 5000@10.22.41.	08:00:0F:2C:AB	105	--B--T--		swx 0/2

Reduce the amount of information by only displaying neighbors on a specific interface.

#show lldp neighbors interface switchport 0/2

System Name	Port ID	TTL	Cap.	Platform	Local Int
URL 5000@10.22.41.	08:00:0F:2C:AB	96	--B--T--		swx 0/2

Add the optional **detail** keyword to either version of the command to display extensive details about the LLDP neighbor(s). The following example output displays detailed information about the Mitel 5224 DM endpoint connected to switchport interface 0/2:

#show lldp neighbors interface switchport 0/2 detail

```
Chassis ID: 10.23.130.2 (Network Address)
System Name: URL 5000@10.22.41.52,MITEL 5224 DM
Device Port: 08:00:0F:2C:AB:97 (MAC Address)
TTL: 105
Platform: URL 5000@10.22.41.52
Software: MITEL 5224 DM,h/w rev 1,ASIC rev 1,f/w Boot 02.03.02.01,f/w Main 07.01.00.04
Capabilities: Bridge, Telephone
Enabled Capabilities: Bridge, Telephone
Local Port: swx 0/1
Management Addresses:
  Address Type: IP version 4, Address: 10.23.130.2
  Interface Type: Unknown, Interface Id: 0
Auto-negotiation: enabled
Speed/duplex: 100baseTXHD
LLDP-MED Enabled Capabilities:
  Capabilities, Network Policy, ExtendedPD
LLDP-MED Network Policy:
  Application - Voice
  Cos/DSCP - 5/46
  VLAN ID - 10 (tagged)
  Application - Voice Signaling
  Cos/DSCP - 3/26
  VLAN ID - 10 (tagged)
```

show lldp neighbors med

Use the **show lldp neighbors med** command to display a summary of neighbor devices that support LLDP-MED.

#show lldp neighbors med


Capability Codes: R - Router, B - Bridge, H - Host, D - DOCSIS Device,
W - WLAN Access Point, r - Repeater, T - Telephone

System Name	Port ID	TTL	Cap.	Platform	Local Int
URL 5000@10.22.41	08:00:0F:2C:AB	96	--B--T--		swx 0/2

show lldp neighbors realtime

Use the **show lldp neighbors realtime** command to display basic information about all LLDP neighbors via full-screen output in real time. The information is displayed in a table that looks similar to the output of the **show lldp neighbors** command. However, the TTL values are changing as they repeatedly count down and then reset when an LLDP frame is received.

#show lldp neighbors realtime



NOTE Information is continuously updated on the console until you either freeze the data (by pressing the **F** key) or exit **realtime** mode (by pressing **Ctrl-C**). If there is not enough room on the screen for all available data, the information will truncate at the bottom of the screen. In order to maximize the amount of data displayed, increase the terminal length (using the terminal length command; refer to the command **terminal length** <number> in the *AOS Command Reference Guide* available on ADTRAN's Support Community (<https://supportforums.adtran.com>)).

show lldp neighbors statistics

Use the **show lldp neighbors statistics** command to display statistical information about changes in this device's neighbor table. The following is a breakdown of information displayed in the output:

- System Last Change Time** Shows the time at which the most recent change occurred in the neighbor table.
- Inserts** Shows the number of times neighbors have been added to the table.
- Deletes** Shows how many times neighbors have been deleted from the table because an interface was shut down.
- Drops** Shows how many times the insertion of a new neighbor into the table failed because the table was full.
- Ageouts** Shows how many times neighbors have been removed from the table because no new updates were received from that neighbor before its time to live timer expired.

#show lldp neighbors statistics

System Last Change Time	Inserts	Deletes	Drops	Ageouts
01-27-2008 19:32:00	6	2	0	1

Debug Commands

The **debug** commands are used to provide insight into the operation of LLDP and LLDP-MED. Debug messages can be numerous, making it a tedious task to sort through all of the information displayed. The more specific the **debug** command, the easier it will be to pinpoint pertinent data.



*Some **debug** commands will produce data that will quickly fill up the screen. Due to continuous scrolling of incoming debug messages, it may become difficult to execute the **no** form of the **debug** command to turn debug messages off. A shortcut command can be issued to turn all debug messages off. This command is **#undebbug all** or **#u all** for short.*



Turning on a large amount of debug information can adversely affect the performance of your unit.

debug lldp

The **debug lldp** command displays both transmitted (Tx) and received (Rx) frame messages related to LLDP. Reduce the amount of information displayed by specifying only transmitted or received LLDP messages:

#debug lldp

or

#debug lldp [rx | tx]

Consider the following sample output:

#debug lldp

LLDP: **swx 0/1: RX** LLDPDU from **00:A0:C8:15:B6:21** len = 258

2008.01.27 23:50:52

LLDP: Neighbor Port ID: **giga-eth 0/10** on 2008.01.27 23:50:52

LLDP: **swx 0/2: RX** LLDPDU from **08:00:0F:2C:AB:97** len = 355

2008.01.27 23:50:54

LLDP: Neighbor Port ID: **08:00:0F:2C:AB:97** on 2008.01.27 23:50:54

LLDP: swx 0/2: TX LLDPDU on 2008.01.27 23:50:58

LLDP: Next Update for swx 0/2 in 30 seconds

2008.01.27 23:50:58

LLDP: swx 0/1: TX LLDPDU on 2008.01.27 23:51:00

```
LLDP: Next Update for swx 0/1 in 30 seconds
2008.01.27 23:51:00
```

```
LLDP: swx 0/1: RX LLDPDU from 00:A0:C8:0B:65:E0 len = 182
2008.01.27 23:51:11
LLDP: Neighbor Port ID: eth 0/1 on 2008.01.27 23:51:11
```

The output contains LLDP information for switchport interfaces 0/1 and 0/2 (extra line breaks have been added to aid the explanations that follow).

The first group of messages indicate that an LLDPDU was received on switchport interface 0/1 for a device with MAC address **00:A0:C8:15:B6:21** on January 27, 2008 at 23:50:52. The **Neighbor Port ID** for this neighbor device is **giga-eth 0/10**.

The second group of messages indicate that an LLDPDU was received on switchport interface 0/2 for a device with MAC address **08:00:0F:2C:AB:97** on January 27, 2008 at 23:50:54. The **Neighbor Port ID** for this neighbor device is **08:00:0F:2C:AB:97**, the same as its MAC address.

The fifth group of messages indicate that an LLDPDU was received on switchport interface 0/1 for a device with MAC address **00:A0:C8:0B:65:E0** on January 27, 2008 at 23:51:11. The **Neighbor Port ID** for this neighbor device is **eth 0/1**.

The information provided in the sample output indicates that there are two LLDP neighbors connected to switchport interface 0/1 (00:A0:C8:15:B6:21 and 00:A0:C8:0B:65:E0) and one LLDP neighbor connected to switchport interface 0/2 (08:00:0F:2C:AB:97). LLDP updates are being transmitted and received on both switchport interface 0/1 and 0/2.

debug lldp verbose

The **debug lldp verbose** command displays extensive LLDP and LLDP-MED related information in addition to both transmitted (Tx) and received (Rx) LLDP frame messages. Reduce the amount of information displayed by narrowing the command to display only transmitted or received LLDP messages:

```
#debug lldp
```

or

```
#debug lldp [rx | tx] verbose
```

The following output was captured on a NetVanta 1335 PoE switch and displays both the Tx and Rx verbose information for the neighboring LLDP device on switchport interface 0/2 (the output has been split in half to aid in the explanations that follow):

```
#debug lldp verbose
```

```
LLDP: swx 0/2: RX LLDPDU from 08:00:0F:2C:AB:97 len = 355
2008.01.28 01:08:54
LLDP: Chassis ID (Network Address) "10.23.130.2"
2008.01.28 01:08:54
LLDP: Port ID (MAC Address) "08:00:0F:2C:AB:97"
2008.01.28 01:08:54
LLDP: Neighbor Port ID: 08:00:0F:2C:AB:97 on 2008.01.28 01:08:54
LLDP: TTL 120
2008.01.28 01:08:54
LLDP: Port Description "LAN port"
```

```

2008.01.28 01:08:54
LLDP: System Name "URL 5000@10.22.41.52,MITEL 5224 DM"
2008.01.28 01:08:54
LLDP: System Description "URL 5000@10.22.41.52,MITEL 5224 DM,h/w rev 1,ASIC rev 1,f/w Boot
    02.03.02.01,f/w Main 07.01.00.04"
2008.01.28 01:08:54
LLDP: System Capabilities:
    Bridge, Telephone
Enabled System Capabilities:
    Bridge, Telephone
2008.01.28 01:08:54
LLDP: Management Address:
    Type: "IP version 4" Address: "10.23.130.2"
    Interface Type: "Unknown" Id: 0
    OID: ""
2008.01.28 01:08:54
LLDP: Negotiation Status: "enabled"
LLDP: Speed/Duplex: "10M/half-duplex"
2008.01.28 01:08:54
LLDP: LLDP-MED Capabilities:
    Other, Repeater, Router
2008.01.28 01:08:54
LLDP: Application/VLAN ID/CoS/DSCP:          Voice/10/5/46 (tagged)
LLDP: Application/VLAN ID/CoS/DSCP:          Voice Signaling/100/3/26 (tagged)
-----

```

The first part of the captured output (see output above) displays verbose LLDP information that has been **received** on switchport interface 0/2. The system name of the device connected to the interface is **URL 5000@10.22.41.52,MITEL 5224 DM**. Therefore, one can conclude that the neighboring device is a Mitel 5224 DM. The Mitel's system capabilities are **bridge** and **telephone**. Both of these capabilities have been enabled on the Mitel unit. The LLDP negotiation status is enabled and the speed/duplex settings for the Mitel 5224 DM are **10Mbps/half-duplex**. The speed/duplex setting on the Mitel must match the speed/duplex setting on the NetVanta 1335 PoE. One way to verify a match is to compare this information to that of the NetVanta 1335 PoE in the output below. The advertised LLDP-MED capabilities for the Mitel 5224 DM are **other, repeater, and router**. Two network policies have been configured on the Mitel unit: **voice** and **voice signaling**. These policies should match the network policies that are transmitted from the NetVanta 1335 PoE (see output below).

```

LLDP: swx 0/2: TX LLDPDU on 2008.01.28 01:08:58
LLDP: Chassis ID (MAC Address) "00:A0:C8:00:12:E4"
2008.01.28 01:08:58
LLDP: Port ID (Locally Assigned) "swx 0/2"
2008.01.28 01:08:58
LLDP: TTL 120
2008.01.28 01:08:58
LLDP: System Description "NetVanta 1335 PoE W/AP"
2008.01.28 01:08:58
LLDP: Port Description "swx 0/2: Fast Ethernet (BCM56xx v228)"
2008.01.28 01:08:58
LLDP: System Name "Switch"

```

2008.01.28 01:08:58

LLDP: System Description "NetVanta 1335 PoE W/AP, Version: 17.02.00.22.E, Date:Mon Jan 07 01:29:47 2008"

2008.01.28 01:08:58

LLDP: System Capabilities:

Bridge, Router

Enabled System Capabilities:

Bridge, Router

2008.01.28 01:08:58

LLDP: Management Address:

Type: "802 media" Address: "00:A0:C8:00:12:E6"

Interface Type: "Interface Index" Id: 2

OID: "1.3.6.1.2.1.2.2.1.1.2"

2008.01.28 01:08:58

LLDP: Negotiation Status: "enabled"

LLDP: Speed/Duplex: "10M/half-duplex"

2008.01.28 01:08:58

LLDP: LLDP-MED Capabilities:

LLDP-MED Capabilities, Network Policy

LLDP: Application/VLAN ID/CoS/DSCP: Voice/10/5/46 (tagged)

LLDP: Application/VLAN ID/CoS/DSCP: Voice Signaling/100/3/26 (tagged)

2008.01.28 01:08:58

LLDP: Next Update for swx 0/2 in 30 seconds

2008.01.28 01:08:58

The second part of the captured output (see output above) displays verbose LLDP information that has been **transmitted** on switchport interface 0/2. The NetVanta 1335 PoE system capabilities are **bridge** and **router**. Both of these capabilities have been enabled on the NetVanta unit. The LLDP negotiation status is enabled and the speed/duplex settings for the NetVanta 1335 PoE are **10Mbps/half-duplex**, which matches the settings transmitted by the Mitel unit. Two network policies have been configured on the NetVanta 1335 PoE: **voice** and **voice signaling**. Comparing these policies to the ones that were transmitted by the Mitel unit, it is confirmed that the policies match.