

## Example: Setting Up VoIP with 802.1X and LLDP-MED on an EX-series Switch

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You can configure voice over IP (VoIP) on an EX-series switch to support IP telephones. VoIP is a protocol used for the transmission of voice through packet-switched networks. VoIP transmits voice calls using a network connection instead of an analog phone line. The Link Layer Discovery Protocol-Media Endpoint Discovery (LLDP-MED) protocol forwards VoIP parameters from the switch to the phone. You also configure 802.1X authentication to allow the telephone access to the LAN. Authentication is done through a backend RADIUS server.

This example describes how to configure VoIP on an EX-series switch to support an Avaya IP phone, as well as the LLDP-MED protocol and 802.1X authentication:

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### Requirements

This example uses the following hardware and software components:

- JUNOS Release 9.1 or later for EX-series switches
- One EX 4200 switch acting as an authenticator port access entity (PAE). The interfaces on the authenticator PAE form a control gate that blocks all traffic to and from supplicants until they are authenticated.
- An Avaya 9620 IP telephone that supports LLDP-MED and 802.1X

Before you configure VoIP, be sure you have:

- Installed your EX-series switch. See *Installing and Connecting an EX 3200 or EX 4200 Switch*.
- Performed the initial switch configuration. See *Connecting and Configuring an EX-series Switch (J-Web Procedure)*.
- Performed basic bridging and VLAN configuration on the switch. See *Example: Setting Up Basic Bridging and a VLAN for an EX-series Switch*.
- Configured the RADIUS server for 802.1X authentication and set up the access profile. See *Example: Connecting a RADIUS Server for 802.1X to an EX-series Switch*.
- Configured interface **ge-0/0/2** for Power over Ethernet (PoE). For information about configuring PoE, see *Configuring PoE (CLI Procedure)*.



**NOTE:** The PoE configuration is not necessary if the VoIP supplicant is using a power adapter.

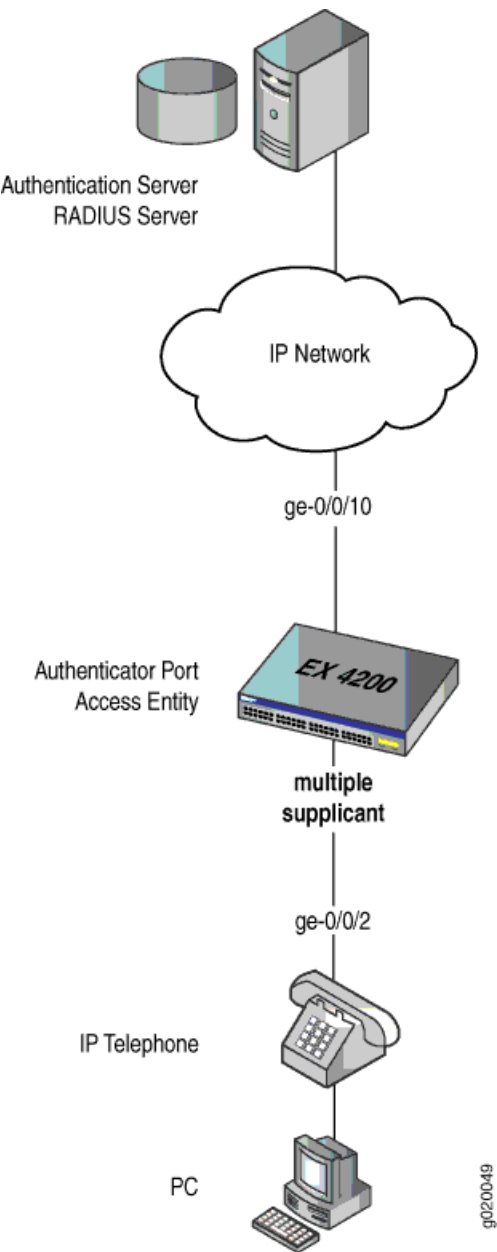
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## **Overview and Topology**

Instead of using a regular telephone, you connect an IP telephone directly to the switch. An IP phone has all the hardware and software needed to handle VoIP. You also can power an IP telephone by connecting it to one of the Power over Ethernet (PoE) interfaces on the switch.

In this example, the access interface **ge-0/0/2** on the EX 4200 switch is connected to an Avaya 9620 IP telephone. Avaya phones have a built-in bridge that allows you to connect a desktop PC to the phone, so the desktop and phone in a single office require only one interface on the switch. The EX-series switch is connected to a RADIUS server on interface **ge-0/0/10** (see Figure 1).

**Figure 1: VoIP Topology**



In this example, you configure VoIP parameters and specify the forwarding class `assured-forward` for voice traffic to provide the highest quality of service.

Table 1 describes the components used in this VoIP configuration example.

**Table 1: Components of the VoIP Configuration Topology**

Property	Settings
Switch hardware	EX 4200 switch

**Table 1: Components of the VoIP Configuration Topology** *(continued)*

VLAN names	data-vlan voice-vlan
Connection to Avaya phone—with integrated hub, to connect phone and desktop PC to a single interface (requires PoE)	ge-0/0/2
One RADIUS server	Provides backend database connected to the switch through interface ge-0/0/10.

As well as configuring a VoIP for interface **ge-0/0/2**, you configure:

- 802.1X authentication. Authentication is set to **multiple** supplicant to support more than one supplicant's access to the LAN through interface **ge-0/0/2**.
- LLDP-MED protocol information. The switch uses LLDP-MED to forward VoIP parameters to the phone. Using LLDP-MED ensures that voice traffic gets tagged and prioritized with the correct values at the source itself. For example, 802.1p class of service and 802.1Q tag information can be sent to the IP telephone.



**NOTE:** A PoE configuration is not necessary if an IP telephone is using a power adapter.

## Configuration

To configure VoIP, LLDP-MED, and 802.1X authentication:

**CLI Quick Configuration** To quickly configure VoIP, LLDP-MED, and 802.1X, copy the following commands and paste them into the switch terminal window:

```
[edit]
set vlans data-vlan vlan-id 77
set vlans voice-vlan vlan-id 99
set vlans data-vlan interface ge-0/0/2.0
set interfaces ge-0/0/2 unit 0 family ethernet-switching vlan members data-vlan
set interfaces ge-0/0/2 unit 0 family ethernet-switching port-mode access
set ethernet-switching-options voip interface ge-0/0/2.0 vlan voice-vlan
set ethernet-switching-options voip interface ge-0/0/2.0 forwarding-class
assured-forwarding
set protocols lldp-med interface ge-0/0/2.0
set protocols dot1x authenticator interface ge-0/0/2.0 supplicant multiple
```

**Step-by-Step Procedure** To configure VoIP with LLDP-MED and 802.1X:

1. Configure the VLANs for voice and data:

```
[edit vlans]
user@switch# set data-vlan vlan-id 77
user@switch# set voice-vlan vlan-id 99
```

2. Associate the VLAN data-vlan with the interface:

```
[edit vlans]
user@switch# set data-vlan interface ge-0/0/2.0
```

3. Configure the interface as an access interface, configure support for Ethernet switching, and add the data-vlan VLAN:

```
[edit interfaces]
user@switch# set ge-0/0/2 unit 0 family ethernet-switching vlan members
data-vlan
user@switch# set ge-0/0/2 unit 0 family ethernet-switching port-mode
access
```

4. Configure VoIP on the interface and specify the assured-forwarding forwarding class to provide the most dependable class of service:

```
[edit ethernet-switching-options]
user@switch# set voip interface ge-0/0/2.0 vlan voice-vlan
user@switch# set voip interface ge-0/0/2.0 forwarding-class
assured-forwarding
```

5. Configure LLDP-MED protocol support:

```
[edit protocols]
user@switch# set lldp-med interface ge-0/0/2.0
```

6. To authenticate an IP phone and a PC connected to the IP phone on the interface, configure 802.1X authentication support and specify multiple supplicant mode:



**NOTE:** If you do not want to authenticate any device, skip the 802.1X configuration on this interface.

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```
[edit protocols]
user@switch# set dot1x authenticator interface ge-0/0/2.0 supplicant
multiple
```

**Results** Display the results of the configuration:

```
[edit]
```

```

user@switch# show configuration
interfaces {
  ge-0/0/2 {
    unit 0 {
      family ethernet-switching {
        port-mode access;
        vlan {
          members data-vlan;
        }
      }
    }
  }
}
protocols {
  lldp-med {
    interface ge-0/0/2.0;
  }
  dot1x {
    authenticator {
      interface {
        ge-0/0/2.0 {
          supplicant multiple;
        }
      }
    }
  }
}
vlangs {
  data-vlan {
    vlan-id 77;
    interface {
      ge-0/0/2.0;
    }
  }
  voice-vlan {
    vlan-id 99;
  }
}
ethernet-switching options {
  voip {
    interface ge-0/0/2.0 {
      vlan voice-vlan;
      forwarding-class assured-forwarding;
    }
  }
}
}

```

## Verification

To confirm that the configuration is working properly, perform these tasks:

- Verifying LLDP-MED Configuration on page 7
- Verifying 802.1X Authentication for IP Phone and Desktop PC on page 7
- Verifying the VLAN Association with the Interface on page 8

## Verifying LLDP-MED Configuration

**Purpose** Verify that LLDP-MED is enabled on the interface.

**Action** user@switch> show lldp detail

```
LLDP : Enabled
Advertisement interval : 30 Second(s)
Transmit delay : 2 Second(s)
Hold timer : 2 Second(s)
Config Trap Interval : 300 Second(s)
Connection Hold timer : 60 Second(s)

LLDP MED : Enabled
MED fast start count : 3 Packet(s)
```

Interface	LLDP	LLDP-MED	Neighbor count
all	Enabled	-	0
ge-0/0/2.0	-	Enabled	0

Interface	VLAN-id	VLAN-name
ge-0/0/0.0	0	default
ge-0/0/1.0	0	employee-vlan
ge-0/0/2.0	0	data-vlan
ge-0/0/2.0	99	voice-vlan
ge-0/0/3.0	0	employee-vlan
ge-0/0/8.0	0	employee-vlan
ge-0/0/10.0	0	default
ge-0/0/11.0	20	employee-vlan
ge-0/0/11.0	0	__juniper-vlan_internal__
ge-0/0/23.0	0	default

LLDP basic TLVs supported:

Chassis identifier, Port identifier, Port description, System name, System description, System capabilities, Management address.

LLDP 802 TLVs supported:

Power via MDI, Link aggregation, Maximum frame size, Port VLAN tag, Port VLAN name.

LLDP MED TLVs supported:

LLDP MED capabilities, Network policy, Endpoint location, Extended power Via MDI.

**Meaning** The show lldp detail output shows that both LLDP and LLDP-MED are configured on the ge-0/0/2.0 interface. The end of the output shows the list of supported LLDP basic TLVs, 802.3 TLVs, and LLDP-MED TLVs that are supported.

## Verifying 802.1X Authentication for IP Phone and Desktop PC

**Purpose** Display the 802.1X configuration to confirm that the VoIP interface has access to the LAN.

**Action** user@switch> show dot1x interface ge/0/0/2.0 detail

```

ge-0/0/2.0
  Role: Authenticator
  Administrative state: Auto
  Supplicant mode: Multiple
  Number of retries: 3
  Quiet period: 60 seconds
  Transmit period: 30 seconds
  Reauthentication: Enabled Reauthentication interval: 3600 seconds
  Supplicant timeout: 30 seconds
  Supplicant timeout: 30 seconds
  Server timeout: 30 seconds
  Maximum EAPOL requests: 2
  Number of connected supplicants: 1
    Supplicant: abc, 00:00:00:00:22:22
    Operational state: Authenticated
    Reauthentication due in 3588 seconds

```

**Meaning** The field `Role` shows that the `ge-0/0/2.0` interface is in the authenticator state. The `Supplicant` field shows that the interface is configured in multiple supplicant mode, permitting multiple supplicants to be authenticated on this interface. The MAC addresses of the supplicants currently connected are displayed at the bottom of the output.

## Verifying the VLAN Association with the Interface

**Purpose** Display the interface state and VLAN membership.

**Action** `user@switch> show ethernet-switching interfaces`  
 Ethernet-switching table: 0 entries, 0 learned

```

user@switch> show ethernet-switching interfaces
Interface  State  VLAN members  Blocking
ge-0/0/0.0  down  default       unblocked
ge-0/0/1.0  down  employee-vlan unblocked
ge-0/0/5.0  down  employee-vlan unblocked
ge-0/0/3.0  down  employee-vlan unblocked
ge-0/0/8.0  down  employee-vlan unblocked
ge-0/0/10.0 down  default       unblocked
ge-0/0/11.0 down  employee-vlan unblocked
ge-0/0/23.0 down  default       unblocked
ge-0/0/2.0  up    voice-vlan    unblocked
              data-vlan    unblocked

```

**Meaning** The field `VLAN members` shows that the `ge-0/0/2.0` interface supports both the `data-vlan` VLAN and `voice-vlan` VLAN. The `State` field shows that the interface is up.

- Related Topics**
- Example: Connecting a RADIUS Server for 802.1X to an EX-series Switch
  - Example: Setting Up 802.1X for Single Supplicant or Multiple Supplicant Configurations on an EX-series Switch
  - Defining CoS Forwarding Classes (CLI Procedure)
  - Defining CoS Forwarding Classes (J-Web Procedure)
  - Configuring LLDP-MED (CLI Procedure)