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CISCO NETWORKING ACADEMY PROGRAM

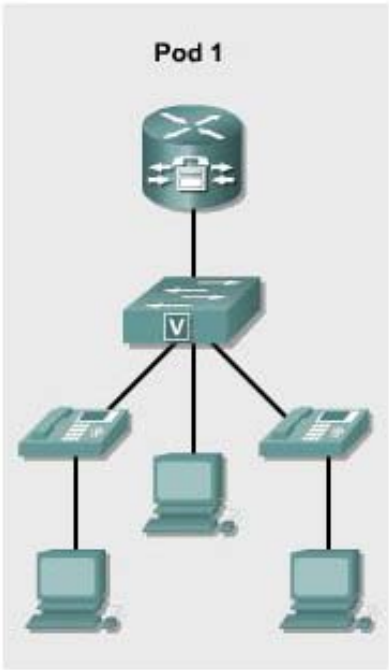


IP Telephony v1.0

Student Lab Manual

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Lab 2.1.1a Basic Setup for the CME Router with Switch Module



Objectives

- Configure a Cisco router in preparation for CallManager Express (CME)
- Configure a switch in preparation for CME

Equipment Requirements

- Cisco CallManager Express (CME) capable router with switch module
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP phones

In this lab, the ACME.com Company has decided to deploy CallManager Express in the enterprise. First, the router portion (including the switch module) of CallManager Express must be configured. The routers and switch module should be configured using the information found in IP Telephony Table 1.

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Step 1 Assign a Pod Number

a. Ask the instructor to assign a pod number to the lab group.

What pod number was the group assigned? _____

Step 2 Erasing Configuration and VLANs from the Router

a. The router with a four port switch module stores VLAN information in Flash memory. To ensure the router does not have a previous configuration, connect a console cable to the router and power on the router.

b. Erase the switch VLAN database and startup-configuration file by using the **delete flash:vlan.dat**, **erase startup-config**, and **reload** commands.

```
Router# delete flash:vlan.dat
Router# erase startup-config
Router# reload
```

Step 3 Basic CME Router Configuration

a. On the router, enter privilege mode and then configuration mode.

b. Change the hostname of the router. Use the command **hostname CMERouter*X***, where ***X*** is the pod number assigned to the group. Throughout the rest of the lab, use IP Telephony Table 1 parameters based on the pod number assigned.

```
Router(config)# hostname CMERouterX
```

c. Set the enable secret password to **cisco**. (Do not deviate from this password.)

d. Use the command **no ip domain-lookup** to disable name resolution since there is no DNS server in the classroom lab.

```
CMERouterX(config)# no ip domain-lookup
```

e. Note that router commands are IOS and model specific. Examples given in this lab are the most common configurations seen. However, the command may vary slightly. For example, on a 1760 router the VTY lines are 0 through 15 instead of 0 through 4. Configure all the router VTY lines with parameters similar to the following:

```
CMERouterX(config)# line vty 0 4
CMERouterX(config-line)# password cisco
CMERouterX(config-line)# login
CMERouterX(config-line)# logging synchronous
```

f. Configure the console port parameters.

```
CMERouterX(config)# line console 0
CMERouterX(config-line)# password cisco
CMERouterX(config-line)# login
CMERouterX(config-line)# logging synchronous
```

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g. Create two VLANs—one for the voice VLAN and one for the data VLAN. VLAN 1, the management VLAN, is already created. Note that the ***X*** shown in the command is the pod number.

```
CMERouterX# vlan database
CMERouterX(vlan)# vlan X0 name Data state active
CMERouterX(vlan)# vlan X5 name Voice state active
```

h. Go into the configuration mode for the management VLAN by entering global configuration mode and typing the command **interface vlan 1**. The management VLAN is the VLAN used to remotely manage network devices such as routers and switches.

```
CMERouterX(config)# interface vlan 1
```

i. Configure the management VLAN interface with an IP address appropriate for the management VLAN. From the interface configuration mode, enter the IP address for the management VLAN based on the information found in IP Telephony Table 1. Use the command **ip address 10.X.0.1 255.255.255.0** command (where ***X*** is the pod number).

```
CMERouterX(config-if)# ip address 10.X.0.1 255.255.255.0
```

j. Go into the configuration mode for the data VLAN by entering global configuration mode and entering the command **interface vlan X0** (where ***X*** is the pod number). For example, if the group was assigned to Pod 1, the command would be as follows: **interface vlan 10**

```
CMERouterX(config)# interface vlan X0
```

k. Configure the data VLAN interface with an appropriate IP address. From the interface configuration mode, enter the IP address for the data VLAN based on the information found in IP Telephony Table 1. Use the command **ip address 10.X0.0.1 255.255.255.0** command (where ***X*** is the pod number).

```
CMERouterX(config-if)# ip address 10.X0.0.1 255.255.255.0
```

m. If a host was configured on the same data VLAN, what would be the host default gateway IP address? _____

n. Go into the configuration mode for the voice VLAN by entering the global configuration mode and entering the command **interface vlan X5** (where ***X*** is the pod number).

```
CMERouterX(config)# interface vlan X5
```

o. Configure the voice VLAN with the appropriate IP address. Enter the IP address for the voice VLAN based on the information found in IP Telephony Table 1. Use the **ip address 10.X5.0.1 255.255.255.0** command (where ***X*** is the pod number).

```
CMERouterX(config-if)# ip address 10.X5.0.1 255.255.255.0
```

p. Bring EACH of the created VLAN interfaces to a useable condition.

```
CMERouterX(config)# interface vlan x
CMERouterX(config-if)# no shutdown
```

q. Configure the EIGRP routing protocol by using the **router eigrp 100** command to start an EIGRP process with an autonomous system number of 100. Then enter the command **network 10.0.0.0**, which enables and advertises EIGRP updates on all 10.0.0.0-configured interfaces.

```
CMERouterX(config)# router eigrp 100
CMERouterX (config-router)# network 10.0.0.0
```

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Step 4 Configure the Router Switch Ports

a. Verify the slot into which the router switch four port module inserts by (1) viewing the router and (2) using the **show diag** command. Look for the words 4 Port FE Switch.

```
CMERouterX# show diag
```

b. Based on the previous step, into what slot does the switch module insert? _____

c. Use the **show ip interface brief** command to verify the slot and the format used for the interface. For example in a 2811 ISR, the four ports list as FastEthernet 0/0/0, 0/0/1, 0/0/2, and 0/0/3.

d. Write the format in which the four ports list. _____

e. Ports 0 and 1 of the switch module will be used to connect the IP phones. These ports must be configured as trunk modes, must have the trunking protocol configured, must identify the native VLAN, and must identify the voice VLAN.

Note that the *slot*/*port-adapter*/*port* parameter that is typed depends on the router slot into which the four port module inserts.

The **native** keyword defines this VLAN as the one that is not tagged with VLAN information when a frame (from VLAN ***X***0) crosses the trunk between the IP phone and the switch. This allows the PC that connects to the IP phone to be on a different subnet than the IP phone and still receive an IP address from a DHCP server. If a warning message appears, ignore it. If this command does not work, the proper router is not being used.

IMPORTANT: Note that the following commands must be done on both port 0 and port 1. An alternative to the **interface fastethernet** command is **interface range fastethernet *slot/port-adapter/port*** command.

```
CMERouterX(config)# interface fastethernet slot/port-adapter/port
CMERouterX(config-if)# switchport trunk encapsulation dot1q
CMERouterX(config-if)# switchport trunk native vlan X0 (where X is
the pod number)
CMERouterX(config-if)# switchport mode trunk
CMERouterX(config-if)# switchport voice vlan X5 (where X is the pod
number)
CMERouterX(config-if)# no shutdown
```

f. What is the purpose of the **dot1q** parameter used in the previous step? _____

_____

Step 5 Verify VLAN Configuration

a. From privileged mode on the router, issue the **show ip interface brief** command and verify that VLAN1, X0, and X5 (where X is the pod number) have IP addresses and that their status is up and up.

```
CMERouterX# show ip interface brief
```

b. Are all three VLAN interfaces up and up and have the proper IP address? If not, troubleshoot as necessary. _____

If the interfaces are not there, do not have an IP address or the correct IP address, or if their status is not up and up, do not proceed until appropriate troubleshooting has been performed.

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c. From privileged mode verify the port is properly configured as a trunk port by using the **show interfaces *slot/port-adapter/port* switchport** command (where *interface-id* is the switch port used to connect to the router).

```
CMERouterX# show interfaces fastethernet slot/port-adapter/port
      switchport
```

d. What is the status of the switch port (shown as *switchport* in the command output)?
_____

e. What is the status of the Administrative Mode? _____

f. What is the status of the Operational Mode? _____

g. What is the Operational Trunking Encapsulation that has been configured? _____

h. What VLANs are trunked by default? _____

i. The **show interfaces trunk** command can be used to verify trunk operations.

```
CMERouterX# show interfaces trunk
```

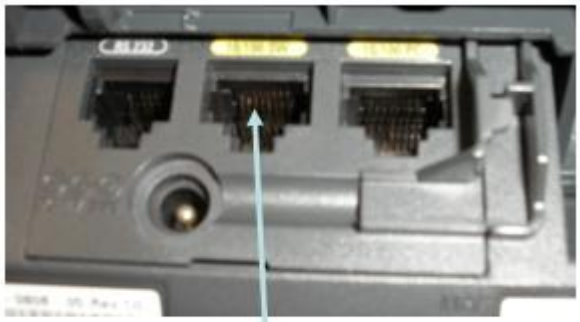
j. Based on the command output, what port(s) have trunking enabled?
_____

k. Based on the command output, what VLAN is the native VLAN? (**Note:** The native VLAN is the VLAN that does not tag a frame from this VLAN as it traverses the trunk with VLAN information. It is also the VLAN that continues to cross the link between the router and the switch if the trunk ever fails for any reason.) _____

l. Based on the command output, what VLANs are allowed on the trunk? _____

m. Based on the command output, what VLANs are participating in spanning tree and are in the forwarding state? _____

n. Connect a Cisco IP phone using a straight-through cable to the switch port 0. The port on the bottom of the IP phone is labeled 10/100. Note that the IP phone will not work until CallManager Express has been configured.



o. Using a second straight-through cable, connect the second phone to switch port 1 on the router.

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Step 6 Save the Router Configuration

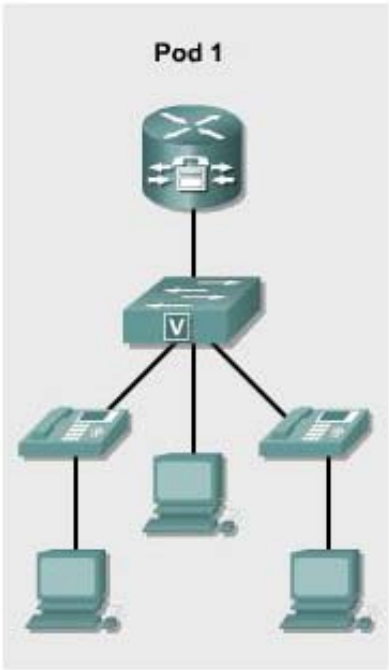
a. Save the router configuration by typing the following command:

```
CMERouterX# copy running-config startup-config
```

Note: Save the router configuration to a text file as well. These configurations will be required in future labs.

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Lab 2.1.1b Basic Setup for the CME Router and Switch



Objectives

- Configure a Cisco router in preparation for CallManager Express (CME)
- Identify the DHCP configuration commands
- Configure a switch in preparation for CME

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Inline Power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed

In this lab, the ACME.com Company has decided to deploy CallManager Express in the enterprise. First, the router portion of CallManager Express must be configured. The routers and switches should be configured using the information found in IP Telephony Table 1.

Step 1 Assign a Pod Number

a. Ask the instructor to assign a pod number to the lab group.

What pod number was the group assigned? _____

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Step 2 Basic CME Router Configuration

a. Connect to the console port of a Cisco CallManager Express router and power it on. If the router has a configuration already on it, erase the router and reload it.

b. Enter privilege mode, and then configuration mode.

c. Change the hostname of the router. Use the command **hostname CMERouter*X***, where ***X*** is the pod number assigned to the group. Throughout the rest of the lab, use IP Telephony Table 1 parameters based on the pod number assigned.

```
Router(config)# hostname CMERouterX
```

d. Set the enable secret password to **cisco**. (Do not deviate from this password.)

e. Use the command **no ip domain-lookup** to disable name resolution since there is no DNS server in the classroom lab.

```
CMERouterX(config)# no ip domain-lookup
```

f. Note that router commands are IOS and model specific. Examples given in this lab are the most common configurations seen. However, the command man vary slightly. For example, on a 1760 router the VTY lines are 0 through 15 instead of 0 through 4. Configure all the router VTY lines with parameters similar to the following:

```
CMERouterX(config)# line vty 0 4
CMERouterX(config-line)# password cisco
CMERouterX(config-line)# login
CMERouterX(config-line)# logging synchronous
```

g. Configure the console port parameters.

```
CMERouterX(config)# line console 0
CMERouterX(config-line)# password cisco
CMERouterX(config-line)# login
CMERouterX(config-line)# logging synchronous
```

h. Create a subinterface for the management VLAN by entering global configuration mode, and typing the command **interface fastethernet 0/0.1**. The management VLAN is the VLAN used to remotely manage network devices such as routers and switches.

Note: Depending on the model and physical configuration of the router, the interface could be a FastEthernet port or a Gigabit Ethernet port. Also, the router may have a different physical interface number (i.e., FastEthernet 0 or GigabitEthernet 2/0). If unsure about which interface is installed, verify the name of the Ethernet ports on the router by using the **show running-config** or **show ip interface brief** command.

```
CMERouterX(config)# interface fastethernet 0/0.1
```

What types of Ethernet interface(s) are on the router? _____

i. Configure the subinterface for trunking by entering the command **encapsulation dot1q 1**. The 1 is the management VLAN number. The command instructs the router to use this subinterface for VLAN 1. If a warning message appears, ignore it. If this command does not work, the proper router is not being used.

```
CMERouterX(config-subif)# encapsulation dot1q 1
```

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j. Configure the management VLAN subinterface with an IP address appropriate for the management VLAN. From the subinterface configuration mode, enter the IP address for the management VLAN based on the information found in IP Telephony Table 1. Use the command **ip address 10.X.0.1 255.255.255.0** command (where ***X*** is the pod number).

```
CMERouterX(config-subif)# ip address 10.X.0.1 255.255.255.0
```

If a switch was configured with an IP address on the same management VLAN, what would be the default gateway IP address configured on the switch? _____

k. Create a subinterface for the data VLAN by entering the global configuration mode and entering the command **interface fastethernet 0/0.X0** (where ***X*** is the pod number). For example, if the group was assigned to Pod 1, the command would be as follows: **interface fastethernet 0/0.10**

```
CMERouterX(config)# interface fastethernet 0/0.X0
```

l. Configure the subinterface for trunking by entering the command **encapsulation dot1q X0** (where *X* is the pod number) **native**. The **native** keyword defines this VLAN as the one that is not tagged with VLAN information when a frame (from VLAN ***X***0) crosses the trunk between the router and the switch. This allows the PC that connects to the IP phone to be on a different subnet than the IP phone and still receive an IP address from a DHCP server. If a warning message appears, ignore it. If this command does not work, the proper router is not being used.

```
CMERouterX(config-subif)# encapsulation dot1q X0 native
```

What is the purpose of the **dot1q** portion of the command?

_____

m. Configure the data VLAN subinterface with an IP address appropriate for the data VLAN. From the subinterface configuration mode, enter the IP address for the data VLAN based on the information found in IP Telephony Table 1. Use the command **ip address 10.X0.0.1 255.255.255.0** command (where ***X*** is the pod number).

```
CMERouterX(config-subif)# ip address 10.X0.0.1 255.255.255.0
```

If a host was configured on the same data VLAN, what would be the host default gateway IP address? _____

n. Create a subinterface for the voice VLAN by entering the global configuration mode, and entering the command **interface fastethernet 0/0.X5** (where ***X*** is the pod number).

```
CMERouterX(config-subif)# interface fastethernet 0/0.X5
```

o. Configure the subinterface for trunking by entering the command **encapsulation dot1q X5** (where ***X*** is the pod number).

```
CMERouterX(config-subif)# encapsulation dot1q X5
```

p. Configure the voice VLAN subinterface with an IP address appropriate for the voice VLAN. Enter the IP address for the voice VLAN based on the information found in IP Telephony Table 1. Use the **ip address 10.X5.0.1 255.255.255.0** command (where ***X*** is the pod number).

```
CMERouterX(config-subif)# ip address 10.X5.0.1 255.255.255.0
```

q. Bring the Ethernet interface to a useable condition.

```
CMERouterX(config)# interface fastethernet 0/0
CMERouterX(config-if)# no shutdown
```


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r. Configure the EIGRP routing protocol by using the **router eigrp 100** command to start an EIGRP process with an autonomous system number of 100. Then enter the command **network 10.0.0.0**, which enables and advertises EIGRP updates on all 10.0.0.0-configured interfaces.

```
CMERouterX(config)# router eigrp 100
CMERouterX (config-router)# network 10.0.0.0
```

s. Connect a straight-through cable between the Ethernet port on the router and port 1 on the switch.

t. Verify connectivity by viewing the interfaces on the router.

```
CMERouterX# show ip interface brief
```

u. Is the Ethernet interface in a functional state?_____

If not, troubleshoot and resolve the problem. Do not proceed until the interface is up and up.

What is the status of the Status and Protocol states for the main Ethernet interface (not the subinterfaces)? _____

v. Save the router configuration.

Step 3 Erasing the CME Switch

Note: The configuration output used in the lab is produced from a 2950 switch. Any other switch or IOS may produce different output. The following steps are to be executed on each model of switch unless specifically instructed otherwise.

a. Connect a console cable to the switch and power on the switch.

b. Erase the switch VLAN database and startup-configuration file by using the **delete flash:vlan.dat**, **erase startup-config**, and **reload** commands.

```
Switch# delete flash:vlan.dat
Delete filename [vlan.dat]? [Enter]
Delete flash:vlan.dat? [confirm] [Enter]
Switch# erase startup-config
Switch(config)# reload
```

Step 4 Examine the current switch configuration

a. Examine the running configuration file:

```
Switch# show running-config
```

b. How many Ethernet or Fast Ethernet interfaces does the switch have? _____

c. What is the range of values shown for the VTY lines? _____

d. Examine the current contents of NVRAM as follows:

```
Switch# show startup-config
%% Non-volatile configuration memory is not present
```

Note that on some switches, the message does not appear.

e. If the switch gave the error message response, why does it appear?

_____

_____

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Step 5 Assign a name to the switch

a. Enter privilege mode and then configuration mode. Use the **hostname CMESwitch*X*** command (where ***X*** is the pod number) to name the switch. Throughout the rest of the lab, use IP Telephony Table 1 parameters based on the pod number assigned.

```
Switch# configure terminal
Switch(config)# hostname CMESwitchX
```

Step 6 Examine the current running configuration

a. From privileged mode, exam the current configuration that follows to verify that there is no configuration except for the hostname:

```
CMESwitchX# show running-config
```

b. Are there any passwords set on the console or VTY lines? _____

c. What does the configuration show as the hostname of this switch? _____

Step 7 Set access passwords

Enter line configuration mode for the console port. Set the password on the console port to **cisco**. Configure the VTY lines with the password of **cisco**.

```
CMESwitchX# configure terminal
CMESwitchX(config)# line console 0
CMESwitchX(config-line)# password cisco
CMESwitchX(config-line)# login
CMESwitchX(config-line)# line vty 0 15
CMESwitchX(config-line)# password cisco
CMESwitchX(config-line)# login
```

Step 8 Set the command mode password

a. Set the **enable secret** password to **cisco**.

```
CMESwitchX(config)# enable secret cisco
```

b. Which password takes precedence, the enable password or enable secret password?

_____

Step 9 Configure Layer 3 access to the switch

a. Set the IP address of the switch to 10.***X***.0.4/24 (where ***X*** is the pod number). **Note:** This is done on the internal virtual interface VLAN 1.

```
CMESwitchX(config)# interface vlan 1
CMESwitchX(config-if)# ip address 10.X.0.4 255.255.255.0
CMESwitchX(config-if)# description Management VLAN
```

b. What is the purpose of the management VLAN? _____

_____

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c. Set the default gateway for the switch to **10.X.0.1** (where ***X*** is the pod number).

```
CMESwitchX(config)# ip default-gateway 10.X.0.1
```

d. What is the purpose of putting a default gateway on a switch? (Be specific.)

_____

_____

Step 10 Verify and activate the management VLANs settings

a. Verify the interface settings on VLAN 1 as follows:

```
CMESwitchX# show interfaces vlan 1
```

b. What is the bandwidth on this interface? _____

c. What are the VLAN states: VLAN1 is _____, line protocol is _____.

d. What is the queuing strategy being used? _____

e. Enable the virtual interface using the **no shutdown** command.

```
CMESwitchX(config)# interface vlan 1
CMESwitchX(config-if)# no shutdown
```

Step 11 Save the configuration

a. The basic configuration of the switch has just been completed. Backup the running configuration file to NVRAM.

Note: This will ensure that the changes made will not be lost if the system is rebooted or loses power.

```
CMESwitchX# copy running-config startup-config
```

Step 12 Configure the switch port as a trunk port

a. From global configuration mode, access switch interface port 1 that connects to the router.

```
CMESwitchX(config)# interface fastethernet 0/1
```

b. From interface configuration mode, set the switch to use the IEEE 802.1Q trunking protocol.

Note: If this command does not work on the switch, the switch only supports the 802.1Q trunking protocol and does not have to be programmed with this command. The next step may have to be completed before this step if an older switch is being used.

```
CMESwitchX(config-if)# switchport trunk encapsulation dot1q
```

c. From interface configuration mode, set the switch to trunking mode.

```
CMESwitchX(config-if)# switchport mode trunk
```

d. The native VLAN is the one VLAN that does not have the VLAN information tagged onto the frame as it travels across the trunk. From interface configuration mode, specify which VLAN is the native VLAN (where ***X*** is the pod number).

```
CMESwitchX(config-if)# switchport trunk native vlan X0
```


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e. Besides trunking, what are the other modes for which a switch port can be configured?
_____

f. From enable mode verify the port is properly configured as a trunk port by using the **show interface *interface-id* switchport** command (where *interface-id* is the switch port used to connect to the router).

```
CMESwitchX# show interfaces fastethernet 0/1 switchport
```

g. What is the status of the switch port (shown as *switchport* in the command output)?
_____

h. What is the status of the Administrative Mode? _____

i. What is the status of the Operational Mode? _____

j. What is the Operational Trunking Encapsulation that has been configured? _____

k. What VLANs are trunked by default? _____

l. Some switches have another command that can be used to verify trunking operations—**show interfaces trunk**.

```
CMESwitchX# show interfaces trunk
```

m. If the **show interfaces trunk** command is available, what port(s) have trunking enabled?
_____

n. If the **show interfaces trunk** command is available, what VLAN is the native VLAN? (**Note:** The native VLAN is the VLAN that does not tag a frame from this VLAN as it traverses the trunk with VLAN information. It is also the VLAN that continues to cross the link between the router and the switch if the trunk ever fails for any reason.) _____

o. If the **show interfaces trunk** command is available, what VLANs are allowed on the trunk based on the output from this command? _____

p. If the **show interfaces trunk** command is available, what VLANs are participating in spanning tree and are in the forwarding state? _____

Step 13 Test connectivity across the trunk

a. From enable mode on the switch, ping the router IP address for VLAN1 (the management VLAN). Refer to IP Telephony Table 1 for this address. (***X*** in the command below refers to the pod number.)

```
CMESwitchX# ping 10.X.0.1
```

b. Was the ping successful from the switch? _____
If the ping was unsuccessful, do not proceed until appropriate troubleshooting has been performed and the ping is successful. Note that on some models of routers and switches the speed and duplex must be manually configured on both ports.

c. Ping the router IP address for the voice VLAN and the data VLAN. Refer to IP Telephony Table 1 for IP addresses, if necessary. All pings should be successful when the trunk is working correctly. Troubleshoot as necessary.

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Step 14 Create VLANs on the switch

a. Manually create the data and voice VLANs in the VLAN database. The ***X*** in the VLAN number is the pod number.

```
CMESwitchX# vlan database
CMESwitchX(vlan)# vlan X0
CMESwitchX(vlan)# vlan X5
CMESwitchX(vlan)# exit
```

Step 15 Configure switch ports for IP phones

a. Cable the two IP phones to switch ports 4 and 6 using straight-through cables.

b. Configure the two IP phone ports to use the IEEE 802.1Q trunking protocol using the **switchport trunk encapsulation dot1q** command. This command is executed from interface configuration mode.

Note that the next step may have to be completed before this step if an older switch is being used.

Configure each switch port for the trunking encapsulation mode.

```
CMESwitchX(config)# interface fastethernet 0/4 (and 6)
CMESwitchX(config-if)# switchport trunk encapsulation dot1q
```

c. Configure the two IP phone ports to be trunk ports with the **switchport mode trunk** command. This command is executed from interface configuration mode.

```
CMESwitchX(config)# interface fastethernet 0/4 (and 6)
CMESwitchX(config-if)# switchport mode trunk
```

d. For the ports that connect to the IP phones, the switch must be configured so that 802.1Q knows which VLAN contains voice traffic. This is done with the **switchport voice vlan** command. The voice VLAN is X5, where *X* is the pod number. Refer to IP Telephony Table 1 for the IP addressing scheme.

```
CMESwitchX(config)# interface fastethernet 0/4 (and 6)
CMESwitchX(config-if)# switchport voice vlan X5
```

e. The IP phone has a port used to connect a PC. The PC can (and should) be on a separate VLAN from the IP phone. The IP phone connects to the switch via a trunk port. A trunk port can carry multiple VLAN information. In order for the phone to operate on a different VLAN from the phone, the **switchport trunk native vlan X0** (where ***X*** is the pod number) command must be used. The native VLAN is the VLAN that does not get tagged with VLAN information as frames from this VLAN traverse the trunk. The native VLAN must be the same as the data VLAN for this to work.

This command is done in interface configuration mode. The interface to use is the switch interface to which one of the IP phones connects (the one that has a PC connected to the PC port on the back of the IP phone). The ***X*** in the **switchport** command refers to the pod number.

```
CMESwitchX(config)# interface fastethernet 0/4 (and 6)
CMESwitchX(config-if)# switchport trunk native vlan X0
```

The IP phones will not register at this point because Call Manager Express has not been configured on the router yet.

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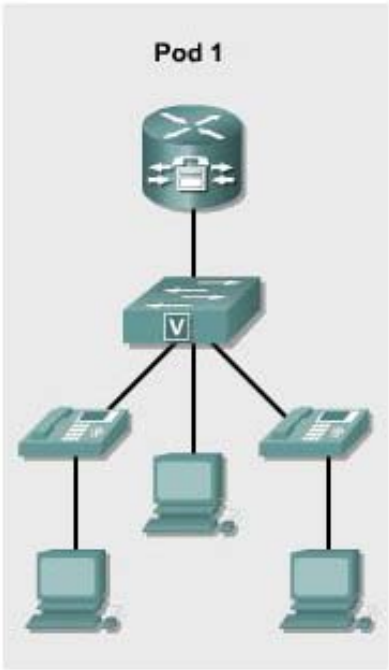
f. Save the switch configuration by typing the following command:

```
CMESwitchX# copy running-config startup-config
```

Note: Save the router and switch configurations to a text file as well. These configurations will be required in future labs.

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Lab 2.1.2 Installing Cisco CME Software



Objective

- Install Cisco CallManager Express (CME) software on the router

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Cisco router IOS version that supports CallManager Express
- Workstation with Ethernet 0/100 NIC installed
- TFTP server application
- Access to Table 1 IP Telephony IP Addressing Scheme and VLAN Assignment document

In this lab the ACME.com Company has configured the router with a basic configuration, but the version of IOS on the router does not support CallManager Express features. The version of IOS will need to be updated. The router should already be configured. Redo Lab 2.1.1 if necessary.

Note: This lab may not be necessary if the IPVoice IOS is already installed. Use the **show flash:** command on the router and see if the words IPVOICE appear in the name of the IOS image. This is one quick indication that can be used to determine if this lab is necessary.

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Step 1 Configure the TFTP server

Note: If the router has multiple Ethernet interfaces use the lowest numbered interface. For example, if there are two Ethernet interface, 0 and 1, then 0 should be used.

a. Ensure the computer that has the TFTP server application loaded on it is connected to the Ethernet port of the router. Be sure that the computer has an appropriate IP address and default gateway assigned. See the IP Telephony Table 1 for IP addressing assignment. An example IP address is 10.1.0.5 and default gateway of 10.1.0.1, where the 1 in the second octet is equal to the pod number and the number in the fourth octet is 2, 3 or any number between 5 and 254.

b. Ensure that the appropriate router IOS file that supports CallManager Express is placed in the default folder for the TFTP server application. Obtain this file from the instructor.

c. Open the TFTP server application.

d. Console to the router. From the router ping the TFTP server. Do not proceed unless the ping is successful. Troubleshoot as necessary.

e. What address is assigned to the TFTP server? _____

Step 2 Update and Install Cisco CallManager Express IOS

a. From enable mode, copy the IOS image from the TFTP server to the router. The prompts may vary depending on the model and IOS.

```
CMERouterX# copy tftp: flash:
Source filename? [Enter the IOS filename. It is best to copy and
past the filename into this section.]
Address or name of remote host? [Enter the address assigned to the
TFTP server. See step 1e.]
Destination filename? [The filename should be the same as what was
placed in the source filename and Enter can be pressed.]
```

When and if prompted to overwrite enter **y** for yes.

(*Address or name of remote host* is the IP address of the TFTP server. *Source filename* is the filename of the Voice IOS located on the TFTP server. *Destination filename* is the same name as Source filename. Contact the instructor to obtain the correct router IOS that supports IP Telephony.)

An example of the process follows:

```
CMERouter1# copy tftp flash:
Address or name of remote host? 10.10.0.12
Source filename? c2800nm-ipvoice-mz.123-11.T3.bin
Destination filename? c2800nm-ipvoice-mz.123-11.T3.bin
Accessing tftp://10.10.0.12/ c2800nm-ipvoice-mz.123-11.T3.bin...
```

b. Was the TFTP transfer successful? _____

If not, troubleshoot until the transfer is successful. Do not proceed without a successful transfer.

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c. Use the **show flash** command to verify that the IOS file is present in flash memory.

```
CMERouterX# show flash

For example:
-#- --length-- -----date/time------ path
1     24119024 Mar 24 2005 22:17:00 +00:00 c2800nm-ipvoice-mz.123-
11.T3.bin
32143304 bytes available (24119024 bytes used)
```

d. The following are the steps to load new system IOS image:

```
CMERouterX# configure terminal
CMERouterX(config)# boot system flash new_system_image_filename
CMERouterX(config)# exit
CMERouterX# copy running-config startup-config
CMERouterX# reload
```

When prompted to save the system configuration, enter **no**.
When prompted to confirm the reload, enter **y**.

e. Verify the system image file (IOS Image) is the correct one by using the **show flash** or **show version** command. The system image file should match the filename used in step 2a.

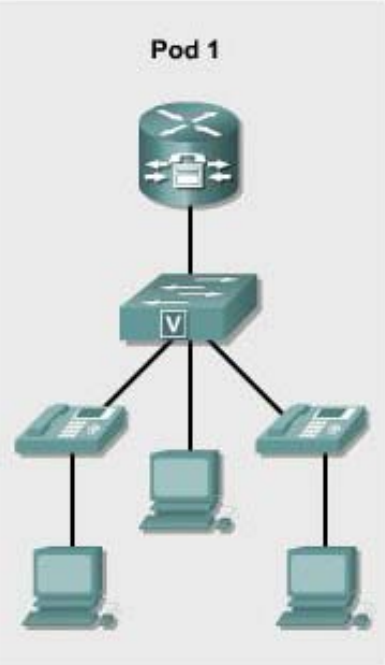
```
CMERouterX# show version

      For example:
      Cisco IOS Software, 2800 Software (C2800NM-IPVOICE-M), Version
      12.3(11)T3, RELEASE SOFTWARE (fc4)
      Technical Support: http://www.cisco.com/techsupport
      Copyright (c) 1986-2005 by Cisco Systems, Inc.
      Compiled Wed 26-Jan-05 02:49 by pwade
      ROM: System Bootstrap, Version 12.3(8r)T7, RELEASE SOFTWARE
      (fc1)
      CMERouter1 uptime is 11 minutes
      System returned to ROM by power-on
      System image file is "flash:c2800nm-ipvoice-mz.123-11.T3.bin"
      Cisco 2821 (revision 53.51) with 249856K/12288K bytes of
      memory.
      Processor board ID FHK0847F0QH
      4 FastEthernet interfaces
      2 Gigabit Ethernet interfaces
      2 Serial(sync/async) interfaces
      DRAM configuration is 64 bits wide with parity enabled.
      239K bytes of non-volatile configuration memory.
      62720K bytes of ATA CompactFlash (Read/Write)
      Configuration register is 0x2102
```

f. Is the image on the router correct? _____
If not, troubleshoot as necessary until this image is on the router.

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Lab 2.1.3 Connecting the IP Phone to a Switch



Objective

- Connect an IP phone to a switch and provide power to it

Equipment Requirements

- Inline power capable switch or non-inline power switch with power injectors
- Two Cisco IP phones

This lab relies on labs 2.1.1 being successfully completed and loaded.

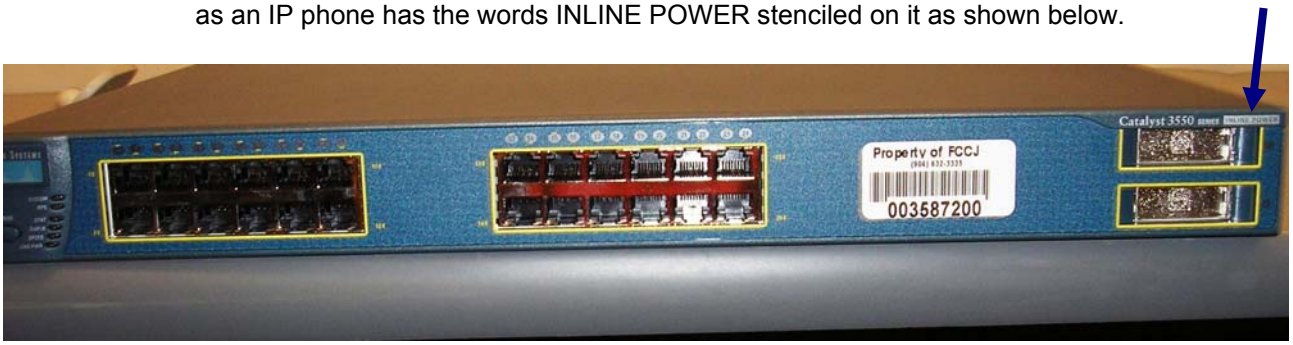
In this lab the ACME.com Company wishes to implement IP telephony. In order to do so, the phones must receive power in order to work.

- Cable the two IP phones to a switch
- Provide power to the phones using one or both methods

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Step 1 Understanding the two types of switches

a. There are two types of switches that can be used with Cisco IP phones: (1) an inline power switch and (2) a non-inline power switch. A switch that can provide power to another device such as an IP phone has the words INLINE POWER stenciled on it as shown below.



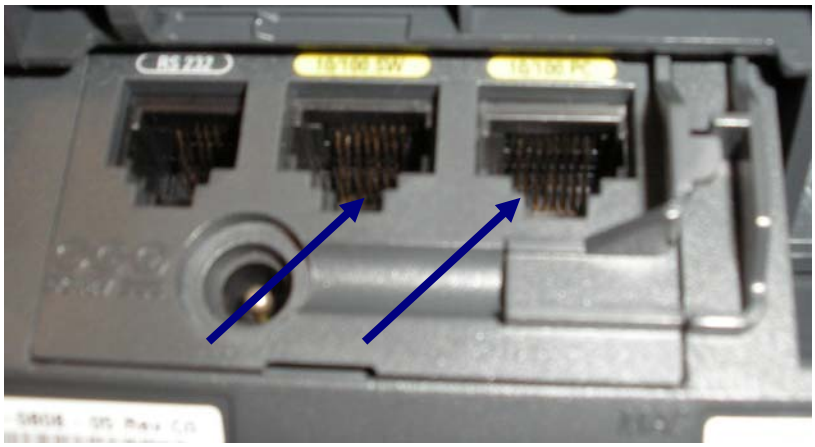
A non-inline power switch does not have the words INLINE POWER stenciled on it. An example of this type of switch is the 2950. The 2950 cannot provide power to other devices such as the Cisco IP phone.

b. Use the Cisco web site to determine if any model of 29xx switch can provide inline power. Record the results. _____

Step 2 Cabling the IP phone to an inline power switch

Note: If an inline power switch is not available, skip to Step 3.

a. Locate the two RJ-45 ports on the back of the IP phone.



b. What are the names of the two RJ-45 ports? _____

c. Connect a power cord to the switch that is to provide the inline power. The switch should power on.

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d. Connect a straight-through Ethernet cable from the 10/100 SW port on the IP phone to any 100 MB port on the inline power switch.



e. What indication is shown that the phone is receiving power? _____

_____

Step 3 Cabling the IP phone to a non-inline power switch

a. Connect power to the non-inline power switch.

b. In order to connect a Cisco IP phone to a non-inline power switch, a power injector is needed. Look at the power injector and notice the two RJ-45 jacks on one end of the power injector.



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The port on the left labeled 10/100BaseTX to Device is used to connect to the IP phone (via a straight-through cable).The port on the right labeled 10/100BaseTX to Network is used to connect to a non-inline power switch such as a 2950 switch (via a straight-through cable).

c. Connect a straight-through cable from the left power injector port labeled 10/100BaseTX To Device to the IP phone port labeled 10/100 SW.

d. Connect a second straight-through cable from the right power injector port labeled 10/100BaseTX To Network to any non-inline power switch port.

e. At the opposite end of the power injector module there is a cable that goes to the power supply adapter. The opposite end of the power supply adapter requires an AC power cord.



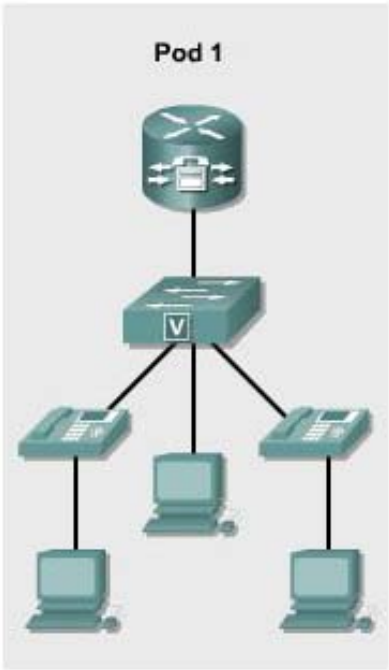
Plug an AC power cord into the AC adapter. Plug the other end of the AC power cord into an AC wall outlet.

f. What indication is shown on the phone that power has been applied?

_____
_____

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Lab 2.1.4 Resetting a 7900 Series Cisco IP Phone to Factory Defaults



Objective

- Erase the current configuration from an IP phone

Equipment Requirements

- Cisco IP Phone 79xx series
- Inline power capable switch or non-inline power switch with power injectors

In this lab, the ACME.com Company has decided to deploy CallManager Express (CME) in the enterprise. First, the IP phones must be reset. They were used in a test lab by the network support staff and currently have various configurations. This process should be used when configuring any IP phone that could have been previously configured.

Step 1 Provide power to the switch

a. Cable the Cisco IP phone to an inline power switch using a straight-through cable OR cable the phone (with a straight-through cable) to a power module that connects to a non-inline power switch.

b. Power on the switch.

c. Which method of providing power to the IP phone was chosen? _____

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d. What is an advantage of using an in-line power switch? _____

_____

Step 2 Reset the Cisco IP phone

a. On the IP phone press the following keys to unlock the Network Configuration menu: ****#**. **Note:** No feedback will be given on the screen.

b. Press the **Settings** button on the phone. If the phone buttons are unlabelled, it is the button that has a checkmark on the button.

c. Press the number **3** on the keypad to select the Network Configuration option.

d. Using the arrow keys scroll up and down to see the network configuration options. How many options are available? _____

e. Either scroll to the number 33 options or press the number **33** on the keypad. The Erase Configuration option should now be displayed on the IP phone.

Note: A key to whether or not this works properly is that the symbol of an unlocked lock is beside the words Network Configuration. If the symbol is a lock press the following keys: ****#**.

f. Press the button located under the **Yes** option.

g. Press the button located under the **Save** option.

What message appears on the IP phone screen? _____

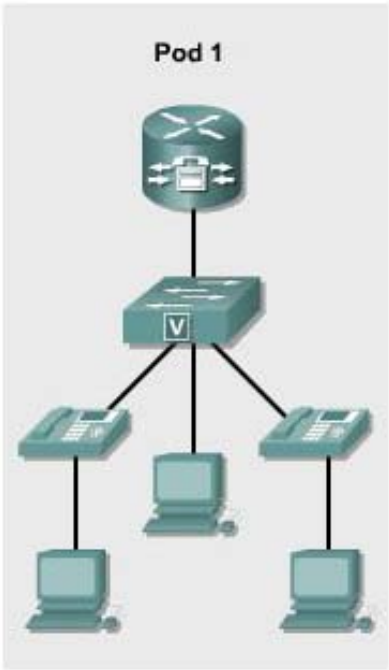
h. Press the button that corresponds to **Cancel**.

i. Press the **Save** option.

j. What message appears on the IP phone screen? _____

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Lab 3.1.1 CME Automated Phone Setup



Objectives

- Identify the basic steps to automatically configure Cisco CallManager Express (CME)
- Configure two dual-line phones
- Verify the IP phones register and calls can be placed between two IP phones

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Inline power capable switch or non-in-line power switch with power injectors
- Workstation with FastEthernet 10/100 NIC installed
- Two Cisco IP phones
- Access to Table 1 IP Telephony IP Addressing and VLAN Assignment document
- Access to Table 2 IP Telephony Dial Plan Assignment document

In this lab the ACME.com Company has decided to use the setup utility to configure the Cisco CallManager Express router and phones. This lab relies on the labs 2.1.1, 2.1.2, and 2.1.3 being successfully completed. The lab uses information from Table 2 IP Telephony Dial Plan.

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Step 1 Configure Cisco IP Telephony Express using the Automated Method

a. From privilege exec (EXEC) mode on the router, use the **show running-config** command and view the current configuration. Save or print a copy of the current configuration to compare with changes later in this lab.

```
CMERouterX# show running-config
```

b. From global configuration mode, enter the command

```
CMERouterX(config)# telephony-service setup
```

Note: If a mistake is made in the setup program, the mistake can be remedied at the end of the utility.

c. When prompted with the choice to setup the DHCP service, type **y**, and press Enter.

d. The IP network of the DHCP pool for voice devices is **10.X5.0.0** (where X is the pod number). Refer to IP Telephony Table 1 for the DHCP pool information. This command allows the IP phone to get an IP address from a DHCP pool that will be created on the router.

What pod number is assigned? _____

e. The subnet mask for the DHCP network is **255.255.255.0** for all pods.

f. The TFTP server IP address will be the Cisco CallManager Express router with an IP address of **10.X5.0.1** (where ***X*** is the pod number). Option 150 is an optional DHCP option which allows the IP telephony device to obtain configuration information (files) from the TFTP server.

g. The default router for the pool will also be **10.X5.0.1** (where ***X*** is the pod number).

h. Answer **yes** to the question regarding starting the telephony service setup.

i. For the source IP address, enter **10.X5.0.1** (where ***X*** is the pod number).

j. Accept the default port of 2000 by pressing the **Enter** key. Skinny will be discussed in a later lab.

k. When asked how many phones to configure, respond with **4**. Note that even though only two phones are being configured, selecting 4 will allow up to four IP phones to be configured at this time. This value can be changed from the command prompt if necessary.

l. When asked whether dual-lines are desired, answer **y**, and press Enter.

Dual-line IP phones have one voice port with two channels to handle two independent calls. This capability enables call waiting, call transfer, and conference functions on a phone-line button. In dual-line mode, each IP phone and its associated line button can support one or two calls. Selection of one of two calls on the same line is made using the Navigation button located below the phone display.

m. Select the language that is desired on the phone. (The default of English may be accepted by simply pressing the Enter key.)

n. Select the country for call progress tones. (If in the United States, the default may be used by just pressing the Enter key.)

In−band call progress tones (for example, ringback and busy tones) and announcements (for example, "The number you have dialed is no longer in service") are required to successfully signal voice calls. Call progress tones can be generated by the originating, terminating or intermediate devices.

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o. Refer to the Table 2 IP Telephony Dial Plan (back of lab manual) to find the appropriate first extension number. Use the first column in the table to locate the pod being used. The second column lists extension numbers. From the second column pick the first number in the range listed for the pod being used. For example, if Pod 1 is being used then the first extension number is 5000.

p. When asked if DID (Direct-Inward-Dialing) is used, answer **y**, and press Enter.

DID is a local phone company service that provides a block of phone numbers used to call into a company's PBX system. With DID, individual phone numbers can be assigned to each person or PC without having to have a physical line into the PBX for each person's connection.

q. When asked for the full E.164 number, enter the value from IP Telephony Table 2 that is specific for the pod. For example, if Pod 1 was being used the E.164 DID number would be 5105555000.

A fully qualified E.164 number contains a country code (issued by the ITU), area code (sometimes known as a STD code), and the local telephone number. Since the country has been selected already, it is just the area code and the phone number.

What E.164 number is being used on this router? _____

r. When asked if forwarding to voicemail (voice message service) is desired, enter **y**, and press Enter.

s. Enter the extension number for voicemail based on the pod number assigned. The extension numbers for voicemail can be seen in the IP Telephone Table 2.

What voicemail extension is being used? _____

t. Press the **Enter** key to accept the default of 18 seconds for Call Forward timeout.

u. When asked if any of the information is to be changed, select *yes* to change an option, or *no* to use the current settings and to exit out of the utility. If no mistakes were made in the previous steps enter **n**, press Enter, and proceed to the Step1v. If any mistakes were made enter **y**, press Enter, and go back to Step 1c.

v. Watch the console output to see if the phones register. Output similar to the following should be seen on the terminal window. Note that this may take several minutes.

```
Mar 2 23:57:09.080: %IPPHONE-6-REGISTER: ephone-1 :SEP000F2470F92E
IP:10.15.0.11 Socket:1 DeviceType:Phone has registered.
```

Note: The power to the phone may need to be removed and reapplied in order to get the phone to re-request an IP address and register with Call Manager Express.

Step 2 Confirm Correct Setup of CME

a. Place a call between the two IP phones. Pick up the handset on one phone and enter the number of the second IP phone. Once a connection has been made, reverse the process. Make a call from the second IP phone to the first one. Calls can also be placed by entering the number of the other IP phone and pressing the speaker button on the bottom right of the phone. Note that the speaker button could be pressed first and then the number being dialed.

b. If the phones do connect to one another, perform troubleshoot as necessary. Reset the phone using steps from a previous exercise if necessary.

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Step 3 Review Changes to the Running Configuration

a. From privilege exec (EXEC) mode, enter the **show running-config** command and view the changes made in the configuration. Pay particular attention to the telephony-service section. Compare this configuration with the configuration saved prior to this lab.

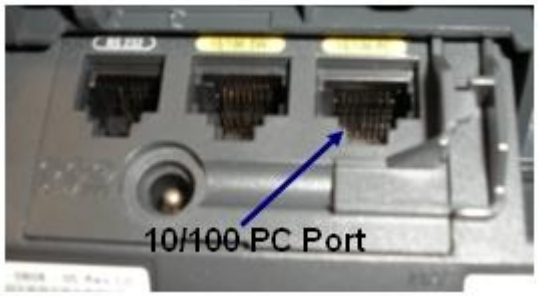
```
CMERouterX# show running-config
```

b. Write the commands that changed, and the commands that were created as a result of the automatic telephony-service configuration utility used in this lab. Use additional paper if needed._____

_____
_____
_____
_____

Step 4 Connect a PC to the IP phone port

a. Connect a PC using a straight-through cable to the port labeled 10/100 PC on the bottom of the IP phone.



b. Configure the PC to receive an IP address from a DHCP server.

c. From privileged mode on the router, create a DHCP pool for the data VLAN (the PC). The ***X*** in the **network** and **default-router** commands represents the pod number.

```
CMERouterX(config)# ip dhcp pool DATA
CMERouterX(dhcp-config)# network 10.X0.0.0 255.255.255.0
CMERouterX(dhcp-config)# default-router 10.X0.0.1
```

d. In the DHCP pool just created reserve the first 10 IP addresses for networking devices. The ***X*** in the **ip dhcp excluded-address** command represents the pod number.

```
CMERouterX(config)# ip dhcp excluded-address 10.X0.0.1 10.X0.0.10
```

e. Renew the IP address on the PC. It may be necessary to use the commands **ipconfig /release** and **ipconfig /renew** if the PC had already gotten an address in the excluded-address range.

f. Did the PC receive an IP address? If yes, what address did it receive? If no, troubleshoot as necessary.

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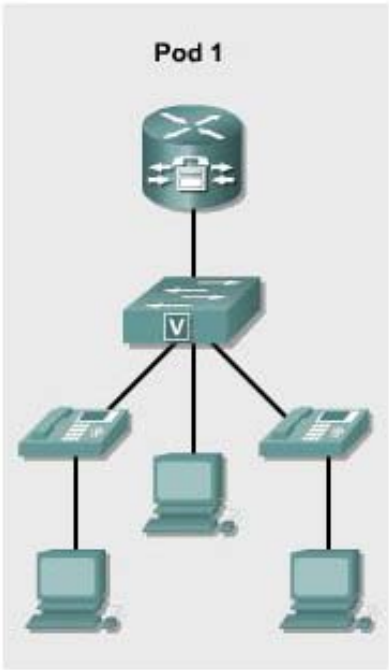
Step 5 Reload Router

a. Do **NOT** save the router configuration. However, it is recommended that you copy the current configuration to a text file that can be used later.

b. Reload the router so that a manual configuration can be completed in the next task. Do **NOT** save the changes.

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Lab 3.1.2 CME Manual Phone Setup



Objective

- Configure IP Phones using the manual configuration process

Equipment Requirements

- Cisco CallManager Express (CME) capable router with specific files for IP phone (basic CME .tar file)
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- One Cisco IP phone

In this lab the ACME.com Company has decided to use the manual setup process to configure the Cisco CallManager Express router and phones. Use IOS commands to achieve the following goals:

- Manually configure the IP phones with an extension and connect them to the network
- Assign a name to the IP phones

This lab relies on labs 2.1.1, 2.1.2, and 2.1.3 being successfully completed. The lab uses information referenced in IP Telephony Table 1 and IP Telephony Table 2.

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Step 1 Verify if the Telephony Service is Running

a. If necessary, put the basic configuration from 3.1.1 on the router and switch.

b. Ensure that **NO** phones are connected to the switch at this time.

c. Access the Cisco CallManager Express router and use the **show running-config | begin tele** command to verify that the telephony service has not been configured. The **begin tele** parameter will search the running configuration for the first instance of the letter combination of tele, which is really meant to be telephony-service. If no telephony-service is configured nothing will be displayed and the CMERouterX prompt will be seen again. If a configuration exists, use the **no telephony-service** command to erase any existing configuration.

```
CMERouterX# show running-config | begin tele
CMERouterX(config)# no telephony-service
```

Step 2 Configure DHCP for the IP Phones

a. Enter **ip dhcp exclude-address 10.X5.0.1 10.X5.0.10** (where ***X*** is the pod number) to disallow certain addresses from a DHCP pool that is about to be created in the next step.

```
CMERouterX(config)# ip dhcp excluded-address 10.X5.0.1 10.X5.0.10
```

b. Enter the command **ip dhcp pool CMEVoiceX** (where ***X*** is the pod number) to name the DHCP pool and begin configuration of the parameters that will be served to remote devices.

```
CMERouterX(config)# ip dhcp pool CMEVoiceX
```

c. Use the **network 10.X5.0.0 255.255.255.0** command to set up the range of addresses that will be used.

```
CMERouterX(dhcp-config)# network 10.X5.0.0 255.255.255.0
```

d. Enter the **default-router 10.X5.0.1** (where ***X*** is the pod number) to assign a default gateway to the IP phone.

```
CMERouterX(dhcp-config)# default-router 10.X5.0.1
```

e. With CallManager Express, the IP phones receive their initial configuration information and phone firmware from the TFTP server associated with the CME router. The phones usually get the IP address of their TFTP server using the DHCP **option 150** command. When using CME, the TFTP server address obtained by the phone should point to the CME router IP address.

Enter **option 150 ip 10.X5.0.1** to assign the TFTP server address as the CME router. The Cisco IP phone downloads the image configuration files from this address (the router). The configuration files will be located on the voice-capable router.

```
CMERouterX(dhcp-config)# option 150 ip 10.X5.0.1
```

Step 3 Verify and Configure Firmware

a. From privileged mode, use the **show flash:** command to verify the IP phone firmware files that are present. The firmware files for a 7960 and 7940 will start with “P003.” For example, P00303020214.bin. Do not continue to Step 4 until the IP phone firmware files are present in flash.

For a 28x1 router: If these files are not there, there is a file that the instructor must obtain from

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the Cisco site that starts with the letters “cme-basic” and has a file extension of “.tar”. An example of the filename is cme-basic-123-11T.tar.

Note: The .tar file must match the IOS version on the CME router.

The file must be extracted and uploaded to the router Flash memory from a TFTP server. Copy the .tar file into the appropriate TFTP server folder. From privileged mode, use the **archive tar /xtract tftp://*tftp_server_ip_address*/*.tar_filename* flash:**. An example of this command is as follows: **archive tar /xtract tftp://10.3.0.33/cme-basic-123-11T.tar flash:**.

For a 1760 router (on an older IOS): If these files are not there, the instructor must download the IOS zip file and the Pxxx files are part of the zip file. For this model of router and this IOS, upload any and all files that start with P003 from the downloaded file to the router Flash memory using a TFTP server. An example of this command is **copy tftp:P00303020214.bin flash:**.

b. In the space provided, write down the firmware files present in flash memory that relate to IP phones (the P003 files).

```
CMERouterX# show flash:
```

_____

_____

Step 4 Basic Phone Configuration

a. From global configuration mode, use the **tftp-server flash:P003*XXXX*.XXX** command to allow the firmware files to be accessed through the TFTP server service running on the router. An example of this command is as follows: **tftp-server flash:P00303020214.bin**

```
CMERouterX(config)# tftp-server flash:P003XXXXXXXX.XXX
```

Note: The filename typed after the **flash:** parameter is case-sensitive.

Repeat this command for all “P003” firmware files present in Flash memory.

b. From global configuration mode, enter telephony service mode.

```
CMERouterX(config)# telephony-service
```

c. To see the maximum allowable number of ephones (another name for IP phones) that this system can use enter the command **max-ephones ?**.

d. In the space provided, write the maximum number of phones supported by the current router:

```
CMERouterX(config-telephony)# max-ephones ?
```

_____

e. Set the maximum number of IP phones to two, as this will be sufficient for the classroom lab.

```
CMERouterX(config-telephony)# max-ephones 2
```

The **max-dn** command specifies the maximum number of directory numbers or virtual voice ports supported by the router. The maximum number is IOS and platform-dependent. The default number is zero.

To see the maximum allowable number of directory numbers that this system can use enter the command **max-dn ?**.

```
CMERouterX(config-telephony)# max-dn ?
```


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f. In the space provided, write the maximum number of directory numbers supported by the router and IOS being used:

```
CMERouterX(config-telephony)# max-dn ?
```

_____

g. Use the **max-dn** command to configure the maximum number of directory numbers to 20, as this will be sufficient for the classroom lab.

```
CMERouterX(config-telephony)# max-dn 20
```

h. The **load** command updates the Cisco IOS Telephony Services (Cisco ITS) configuration file for a specific type of IP phone to add the name of the correct firmware file that the phone should load. This filename also provides the version number for the phone firmware that is in the file. Cisco IP phones update themselves with new phone firmware whenever they are initially started or reloaded. When a phone is started or rebooted, the phone reads the configuration file to determine the name of the firmware file it should load and then looks for that firmware file on a TFTP server.

Note: A separate **load** command is needed for each type of phone (although the 7940 and 7960 phones have the same firmware and share the **7960-7940** keyword).

Another keyword used with this command is the name of the firmware file. With the **load** command, do not specify the file extension.

Specify the firmware version and associate it with a model of phone by entering the command **load *model firmware_filename_without_extension***. An example of this command when using a 7940 and/or 7960 IP phone model is **load 7960-7940 P00303020214**.

Note: The tar filename used with the **load** command is entered *without* the filename extension (such as .bin). Also, the filename is not case-sensitive with this command. Before using the **load** command, view the model numbers available by typing **load ?**.

```
CMERouterX(config-telephony)# load ?
```

```
CMERouterX(config-telephony)# load model filename
```

Was the 7960-7940 model number used as part of the command? If not, why not? _____

_____

i. The IP phone will attempt to transfer a configuration file that it needs called XmlDefault.cnf.xml. This file is automatically generated by the CME router through the use of the **ip source-address** command and is placed in router memory. The XmlDefault.cnf.xml file contains the IP address that the phones used to register for service. The phones use the SCCP (Skinny Client Control Protocol) to do this. SCCP is commonly referred to as simply Skinny or the Skinny protocol.

Enter the **ip source-address** command to define the address and port number where the Cisco CallManager Express router is listening for registrations (Skinny messages). This address should correspond to a valid CME router IP address. Note the ***X*** in the command is the pod number.

```
CMERouterX(config-telephony)# ip source-address 10.X5.0.1 port 2000
```

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j. Use the **create cnf-files** command to build XML configuration files that will be used by the phones during the boot process.

```
CMERouterX(config-telephony)# create cnf-files
```

k. What message(s) did the router display when the **create cnf-files** command was entered?

_____

_____

l. The **keepalive** command sets the time interval (in seconds) between messages that are sent from the phone to the CME router. The default is 30 seconds, which is normally adequate. If the default is set to too large a value, it is possible that notification will be delayed when a system goes down.

m. What is the maximum number of seconds that can be set using the **keepalive** command and how long is this in hours?

_____

n. Set the keepalive interval to 10 seconds.

```
CMERouterX(config-telephony)# keepalive 10
```

o. Use the **show running-config | begin tele** command to view the results of the manual configuration.

```
CMERouterX# show running-config | begin tele
```

p. Ephone-dn stands for Ethernet phone directory number. It represents a line that connects a voice channel to a phone so that calls can be made. An ephone-dn has one or more extensions or phone numbers associated with it to allow calls to be made. An ephone-dn is similar to a phone line. Each ephone has a number to identify it during the configuration process.

The **ephone-dn** command creates one virtual voice port and one or more dial peers. This command automates the process of associating dial peers. The number of ephone-dns that are created corresponds to the number of simultaneous calls that can be made because each ephone-dn represents one virtual voice port in the router. This means that if you want more than one call to the same number to be answered simultaneously, multiple ephone-dns (virtual voice ports) are needed.

There are two types of ephone-dns: single-line and dual-line. On the most basic level, the single-line option has one phone number associated to it. A dual-line can have one or two numbers associated with it. The single-line option should be used when phone buttons have a one-to-one correspondence to the regular phone lines that come into a CME system. The dual-line option allows making two call connections at the same time using one phone line button.

Ensure no IP phones are plugged into the switch.

From global configuration command, type **ephone-dn 1 ?**

q. What two options are available? _____

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r. Add an ephone-dn for the first line appearance on the first phone in the pod by entering the **ephone-dn 1 dual-line** command. The **dual-line** parameter defines the type of ephone-dn is being created.

```
CMERouterX(config)# ephone-dn 1 dual-line
```

In ephone-dn mode enter the **number X000** command (where X is the pod number).

```
CMERouterX(config-ephone-dn)# number X000
```

s. Enter a name that will be associated with this DN by entering the **name *firstname lastname*** command. Either make up a name or use a student's name. Example **name Ray Hampton**.

```
CMERouterX(config-ephone-dn)# name firstname lastname
```

Exit e-phone-dn configuration mode by typing **exit**.

t. From global configuration mode, enter the command **ephone 1** to enter ephone configuration mode for the first phone in the pod.

```
CMERouterX(config)# ephone 1
```

u. The MAC address of the IP phone will be needed in the next step. The MAC address is on a sticker on the bottom of the phone. The sticker is normally located in the center. Upon close inspection, the letters MAC are stenciled directly to the left of the white sticker that contains the MAC address. In the space provided, write down the MAC of the first IP phone.

_____



v. Assign the MAC address to ephone 1 with the **mac-address *H.H.H*** (where H is the four hexadecimal characters). Note that the periods must be inserted between each set of four characters, and the letters are not case-sensitive. An example entry is **mac-address 0013.c43b.4999**.

```
CMERouterX(config-ephone)# mac-address H.H.H
```


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w. The **button** command is used to define properties to the buttons located to the right of the IP phone's LCD. The **button** command has a number that follows it with the number 1 representing the top button on the IP phone. The number is followed by a separator character that specifies phone characteristics. For example, the colon separator assigns the phone a normal ring, a single pulse for internal calls and a double pulse for external calls.

```
CMERouterX(config-ephone)# button 1:1
```

Step 5 Verify Phone Registration

a. From privileged mode, enter the **debug ephone register** command.

```
CMERouterX# debug ephone register
```

b. Plug in the IP phone with MAC address configured previously.

c. View the ephone registration debugging output. This may take a few moments. Verify that the phone has registered and the proper DN appears with the line.

d. Once the phone has registered, what is the last line of the **debug** output?

_____

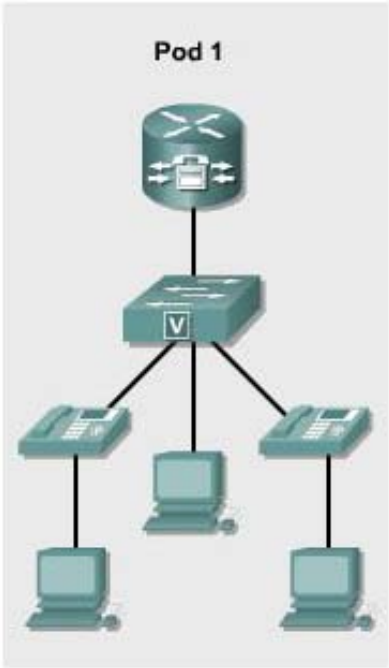
e. Enter **undebug all** to turn off all debugging.

```
CMERouterX(config)# undebug all
```

f. Save the router configuration. It will be used to complete the next lab.

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Lab 3.1.3 CME Partially Automated Phone Setup



Objective

- Configure an IP phone using the partially automated process

Equipment Requirements

- Cisco CallManager Express (CME) capable router with .tar configuration files already extracted
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP Phones (one of which was configured in Lab 3.1.2 lab)

In this lab the ACME.com Company has decided to use the partially automated setup to configure the Cisco CallManager Express router and phones. Use IOS commands to achieve the following goals

- Configure the second IP phone through the use of the auto assign command
- Attach the second IP phone to the network

NOTE: This lab relies on lab 3.1.2 being successfully completed. Redo lab 3.1.2 if necessary to configure one IP phone before starting this lab.

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Step 1 Add a Second IP Phone by using the Auto Assign Method

a. Ensure the second IP phone is not connected to the switch. Add a second ephone-dn by using the **ephone-dn 2 dual-line** command.

```
CMERouterX(config)# ephone-dn 2 dual-line
```

b. Use the **number X001** command to add a DN (where X is the pod number).

```
CMERouterX(config-ephone-dn)# number X001
```

c. Enter telephony service mode by entering the **telephony-service** command from global configuration mode.

```
CMERouterX(config)# telephony-service
```

d. The **auto assign** command is used to partially automate the IP phone configuration process. The **auto assign** command specifies a range of ephone-dn numbers to assign newly discovered IP phones. This method is used when there are multiple phones to install and each phone has a unique extension number.

A phone type can be specified so that all 7940 IP phone models receive an extension in a particular range and all 7960 models receive an extension in a different range of numbers.

View the models supported by the **auto assign** command by typing the following command:

```
CMERouterX(config-telephony)# auto assign 2 to 2 type ?
```

e. How many IP phone models are listed? _____

f. For this lab, the basic concept of automatic number assignment is being demonstrated, so simply enter the command **auto assign 2 to 2** from telephony-service configuration mode.

Step 2 Connect an IP Phone

a. From privileged mode, enter the **debug ephone pak** command, which allows ephone packets to be displayed.

b. Connect the second IP phone to the appropriate switch port that has been configured for IP Telephony. Verify the switch configuration if necessary.

c. View the ephone pak debugging output. This may take a few moments. Once the phone has registered, what is the last line of the **debug** output?

_____

d. Verify that both phones are registered and configured by typing the **show ephone** command.

e. What indication is shown in the output to prove that both phones are configured properly?

_____

f. From one of the IP phones, press the lower right button that has a speaker icon. A dial tone sounds.

g. After approximately 10 seconds of no input, what sound emits from the phone?

_____

h. Is this the sound you normally hear on an analog phone when the phone is taken off the hook and a number has not been dialed? _____

i. Press the lower right button again to cancel the speaker function.

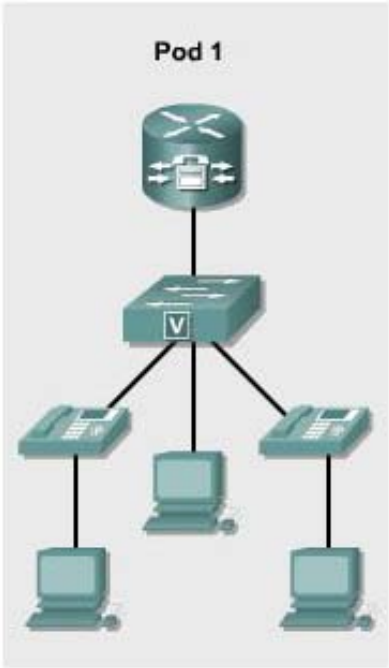
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j. Lift the handset of the first IP phone and dial the other IP phone by pressing the four digit identifier of the second phone. This number is located in the upper right display of the second phone.

k. If the second IP phone rings, save your configuration by using the **copy running-config startup-config**. If unsuccessful, troubleshoot as necessary.

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Lab 4.1.1 Configuring a FXS Port



Objective

- Configure a router FXS port for an analog phone

Equipment Requirements

- Cisco CallManager Express (CME) capable router with a FXS port
- Inline power capable switch or non-inline power switch with power injectors
- One analog phone with RJ-11 cable
- One IP phone

In this lab the ACME.com Company wants to be able to reuse an analog phone for emergency calls. The analog phone plugs into the router FXS port. A similar configuration could be done for an analog fax machine or another analog device.

- Configure the router for FXS capability

This lab relies on labs 2.1.1, 2.1.2, and 3.1.1 being successfully completed and loaded.

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Step 1 Verify FXS interface

a. Power on the router and switch.

b. Connect the IP phones. Test them by calling from one phone to another.

c. Use the **show hardware** privileged mode command to verify a FXS interface is installed in a router.

d. How many FXS interfaces are installed based on the command output? _____

e. Look at the router and notice how the slots where WICs are installed are numbered. On a 2800 series router the slots are numbered to the side of the cards. On a 1760 or 2600 series router, the slots are numbered below the WIC slot.

f. What slot is the FXS card installed into the router? _____

g. Use the **show voice port summary** command to see a brief summary of the voice ports installed on a router. The Ports column shows the slot that the FXS WIC is installed in the router. The Ports column shows the WIC in a *slot*/*subunit*/*port* format.

h. How are numbers shown for the FXS WIC in the Ports column of the command output?

_____

i. Use the **show voice port *slot*/*subunit*/*port*** command to see detailed information about the FXS card. For example, if the FXS WIC lists as 0/3/0 and 0/3/1 in the Ports column, the command would be **show voice port 0/3/0** or **show voice port 0/3/1**.

j. What is the Operation State of the voice port? _____

k. What is the Administrative State of the voice port? _____

l. Use the **show running-config | begin voice-port** command to see the section of the configuration that deals with the voice ports. Notice that the syntax following **voice-port** is the same as the previous **show** commands.

m. Using the **show running-config** command, can you determine whether the voice card is a FXS or FXO card? _____

Step 2 Connect Analog Phone

a. Connect an analog phone to FXS **port 0** on the router using a phone cable. The FXS ports are labeled with a 0 or a 1. Reference the photo below.



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b. Access global configuration mode on the router and configure the FXS port for connectivity. The first step is to configure a dial-peer for POTS connectivity.

```
CMERouterX(config)# dial-peer voice 1 pots
```

c. The **destination-pattern *number*** command defines the phone number that can be used to reach the analog phone. Use Table 2 Router FXS Port 0 column to locate a number that corresponds to the appropriate pod. (For example, Pod 3 would use the command: **destination-pattern 5555088**.) Note that the **destination-pattern** command can be used in other, more flexible scenarios.

```
CMERouterX(config-dial-peer)# destination-pattern number
```

d. The **port *X*/*X*/0** command associates a dial peer with a specific voice port. Another way of looking at this is that when someone dials the number listed in the **destination-pattern** command, the call is routed to the voice port referenced in this command. The first ***X*** is the slot, the second ***X*** is the voice interface subunit, and the 0 is the port number. This slot, subunit, and port numbers are the same numbers researched in previous questions.

```
CMERouterX(config-dial-peer)# port X/X/X
```

e. Save the router configuration.

f. From the analog phone dial the four digits extension of either IP phones. The IP phone should ring. Troubleshoot if necessary until the IP phone rings.

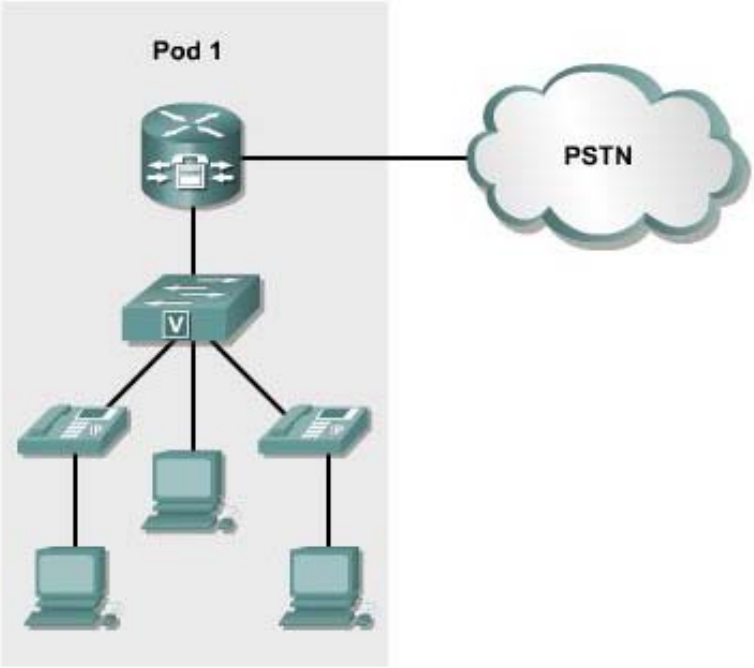
g. What number shows on the IP phone when the analog phone rings? _____

h. From the IP phone, dial the seven digits for the analog phone. This number is the number that showed on the IP phone display in the previous step.

i. Does the analog phone ring? If not, troubleshoot as necessary. _____

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Lab 4.1.2 Configuring a FXO Port



Objective

- Configure a router FXO port for an analog phone

Equipment Requirements

- Cisco CallManager Express (CME) capable router with a FXO port
- Inline power capable switch or non-inline power switch with power injectors
- Adtran
- Two IP phones
- Two analog phones

This lab relies on labs 2.1.1, 2.1.2, 3.1.1, and 4.1.1 being successfully completed and loaded.

In this lab the ACME.com Company has configured the IP phones and now wishes to configure the analog connection to the PSTN. This lab will allow an outbound call only.

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Step 1 Configure the FXO Port

a. Connect a RJ-11 phone cable from the lowest numbered FXO port on the router to a port on the Adtran Octal FXS card.

b. What port on the Adtran was used to connect the FX0 router port? _____

c. What slot does the FXO card use on the router? _____

d. Use the **show running-config | begin voice-p** command to verify the slot number and the format of the slot number.

e. Write the format shown in the **show running-config** command output of the FXO port 0. _____

f. From global configuration mode, use the command **voice-port *slot/subunit/port*** to enter the configuration for the FXO port. The ***slot/subunit/port*** is the numbers representing the FXO card shown in the **show running-config** command. An example of this command is **voice-port 0/2/0**

```
CMERouterX(config)# voice-port slot/subunit/port
```

g. Enter the **ring number 2** command to set the FXO port to answer after two rings. The default number of rings is one ring. Normally the default is fine so that incoming calls are answered quickly. If other equipment that can be used to answer incoming calls (such as a fax machine), the **ring number** value might want to be set to a higher value to give the equipment sufficient time to respond. In that case, the FXO interface would answer the call if the other equipment did not answer the incoming call within the configured number of rings.

This command is not applicable to FXS ports because these types of ports do not receive ringing on incoming calls.

```
CMERouterX(config-voiceport)# ring number 2
```

Step 2 Configure the Dial Peer

a. From global configuration mode, create an analog dial peer with the command **dial-peer voice 5 pots.**

```
CMERouterX(config)# dial-peer voice 5 pots
```

b. Use the command **destination-pattern 5556...** to set the digits that will match this dial-peer. This command sets the pattern to any call that comes in destined for 5556XXX where the X's are any numbers from 0 to 9. The periods shown in the command define the dial pattern digit as any number.

```
CMERouterX(config-dial-peer)# destination-pattern 5556...
```

c. Use the command **port *slot/subunit/port*** to associate the FXO port being used with dial-peer number 5.

```
CMERouterX(config-dial-peer)# port slot/subunit/port
```

d. The router needs to know which phone number digits to forward for voice calls. Use the command **forward-digits all** to forward all the digits (the full length of the destination dial pattern) to the PSTN (the Adtran).

```
CMERouterX(config-dial-peer)# forward-digits all
```

e. Connect an analog phone to a port on the Adtran Octal FXS card. Ensure a second analog phone connects to the router FXS port 0.

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f. From the analog phone attached to router FXS port, dial the number associated with the analog phone attached to the Adtran. The phone numbers used on the Adtran Octal FXS ports are as follows: port 1 phone number is 555-6001; port 2 is 555-6002; port 3 is 555-6003, etc. The analog phone connected directly to the Adtran port should ring.

g. Does the called analog phone ring? If not, perform appropriate troubleshooting before proceeding. _____

h. From enable mode on the router, debug the dial peer information.

```
CMERouterX# debug voice dialpeer all
```

i. While viewing the **debug** output, list the line that proves that the dial peer works correctly.

_____

j. Turn the debugging off.

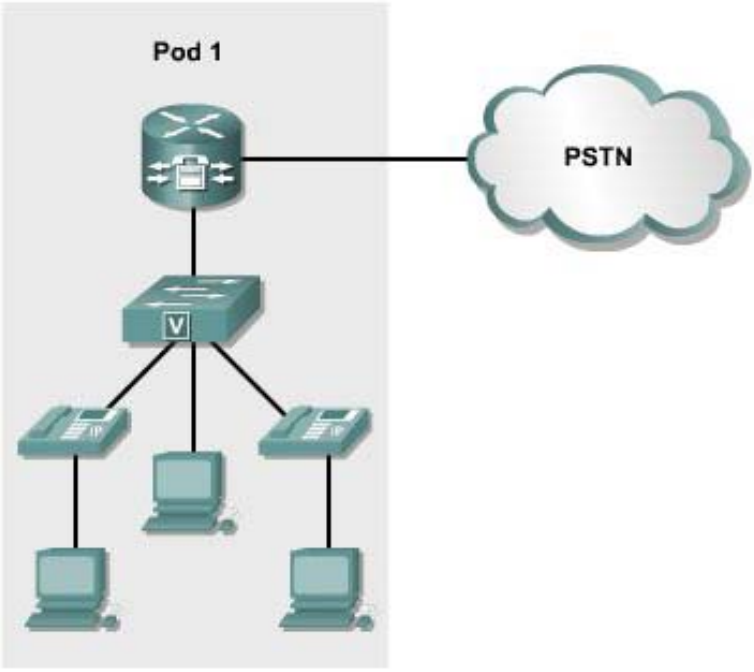
```
CMERouterX# undebug all
```

k. Test the configuration by calling from an IP Phone to the analog phone attached directly to the Adtran.

l. Did the call work? If not, perform appropriate troubleshooting before proceeding. _____

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Lab 4.1.3 Configuring PRI Interface and DID



Objective

- Configure a router POTS and PRI interface

Equipment Requirements

- Cisco CallManager Express (CME) capable router with a T1 PRI port
- Inline power capable switch or non-inline power switch with power injectors
- Two IP phones
- Two analog phones
- Adtran
- Special T1 cable

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This lab relies on labs 2.1.1, 2.1.2, 3.1.1, and 4.1.1, being successfully completed and loaded.

In this lab the ACME.com Company has decided that the analog connection to the PSTN is not sufficient and, as a result, a PRI will be added to give additional capacity and to add DID capability. The analog connection will be kept for a secondary connection to the PSTN. Configure the PRI with the following settings.

Note: This lab uses the Adtran for simulating a PBX. Ensure you have the loaded the latest Adtran IP Telephony configuration for this lab. If you are using the four port Quad T1/PRI card in the Adtran, ensure the card is in slot four of the Adtran chassis. A special cable is used to connect the router T1 PRI port to the Adtran T1 port; a standard crossover or straight-through cable will not work. If you have to make a cable, the RJ-45 connector pinouts are 1-4, 2-5, 4-1, 5-2.

There are multiple types of network modules (NMs) that can be used for T1 connections. If the router has a network module it labeled as NM-DHV2-1T1/E1, the special commands are provided in the lab.

Step 1 Locate the T1 Port on the CME Router

a. Use the **show diag** command to view the hardware installed. Locate the T1 card in the command output and determine what slot it is installed.

b. In what slot does the **show diag** command show the T1 card? _____

c. Perform a **show running-config** command from enable mode.

d. Does the T1 interface appear in the output? If so, how does it list _____
Note that the first number listed in the output is the slot number. This number is important in a later command.

IMPORTANT: If the T1 interface does not appear, use the global configuration command **card type t1 *slot* 1** (where ***slot*** is the number documented previously). Note that this command is only needed on the NM–HDV2-1T1/E1 module.

e. Look at the router ports and locate a port that is labeled CTRL T1/E1 or CTRLR T1. This is the T1 port. The T1 module is integrated into or inserted into the NM-HDV card.

f. Connect a cable from the router T1 port to a T1 port on the Adtran (see table below for correct Adtran Port number). The Adtran can have just one T1 port, or an optional card can be installed that provides four more T1s. The optional card is labeled Quad T1/PRI. The cable that is used to connect the router T1 port to any Adtran T1 port is a special cable. Refer to the note at the beginning of the lab for connector pinouts.

Pod Number	Adtran T1/PRI Port Number
1	T1 Network Module- Port
2	Quad T1/PRI – Port 1
3	Quad T1/PRI – Port 2
4	Quad T1/PRI – Port 3
5	Quad T1/PRI – Port 4

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Step 2 Configure the ISDN Switch Type

a. From global configuration mode, use the command **isdn switch-type primary-ni** to set the PRI switch type. Note that this type must be the same one being used by the provider. In this lab, the provider is the Adtran unit, and it has been configured with the primary-ni ISDN switch type.

```
CMERouterX(config)# isdn switch-type primary-ni
```

b. What other ISDN switch types are available? _____

_____

Step 3 Configure the T1 Controller

a. The **network-clock-participate** command allows the ports on a specific module or voice WAN interface card (VWIC) to use the network clock for timing. The alternative is to restrict a device to use its own clocking signals.

b. From global configuration mode, enter the command **network-clock-participate wic *slot_number*** (where ***slot_number*** is the physical slot where the T1 port is installed). An example is as follows: `CMERouterX(config)# network-clock-participate wic 1`

or `CMERouterX(config)# network-clock-participate slot 1`

```
CMERouterX(config)# network-clock-participate wic slot number
```

c. From global configuration, type **controller t1 ?** to determine what slot numbers are available. If there is only one T1 card installed, only one number lists.

d. How many slot numbers are available in the help output? _____

e. From global configuration mode, enter the mode to control the T1 port by using the **controller t1 *slot/port_or_subslot/port*** command. The ***slot/port_or_subslot/port*** parameters are the same as what was researched earlier. An example in the 2811 router would be **controller t1 1/0/0** or **controller t1 1/0** (depending on NM-HDV2-1T1/E1 type).

```
CMERouterX(config)# controller t1 slot/port_or_subslot/port
```

e. In T1 controller mode, enter the command **framing esf** to set the type of framing used.

```
CMERouterX(config-controller)# framing esf
```

f. In T1 controller mode, enter the command **linecode b8zs** to set the line coding.

```
CMERouterX(config-controller)# linecode b8zs
```

f. Set the clocking to the line with the **clock source line** command.

```
CMERouterX(config-controller)# clock source line
```

g. Use the command **pri-group timeslots 1-12** to assign the first 12 channels to the PRI.

```
CMERouterX(config-controller)# pri-group timeslots 1-12
```

Note: If an error appears that there are not enough DSP resources, reduce the number of timeslots to 8 (1-8 in the command).

The B channels on the TI should go up and messages to that effect should be seen on the console.

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h. Use the command **show isdn status** and verify that Layer 1 is ACTIVE, and that Layer 2 shows MULTIPLE_FRAME_ESTABLISHED.

```
CMERouterX# show isdn status
```

i. Did the **show isdn status** command output show the proper states (ACTIVE and MULTIPLE_FRAME_ESTABLISHED)? If not, perform appropriate troubleshooting. _____

j. In the **show isdn status** output notice on the second line of the output that a serial port is listed.

k. Write the serial interface port number as this number is shown in the command output. This number is needed in the next step. _____

l. Use the **show interface serial *mod/port_or_subslot/port:*23** to verify that the interface status is up and up. Examples of this command on a 2811 router are **show interface serial 1/0/0:23** or **show interface serial 1/0:23** (depending on the hardware being used).

```
CMERouterX# show interface serial mod/port_or_subslot/port:23
```

Step 4 Configure the Dial-Peer to Call the Analog Phone

a. Reference Table 2 to test the configuration. Before testing the TI, test standard phone configuration by calling one of the IP phones from the analog phone attached to the router FXS port. (Note: only four digits are needed for dialing.)

Note that if any connection exists between the router FX0 port and the Adtran unit, remove that connection.

b. Does the analog phone to IP phone connection work properly? If not, troubleshoot as necessary.

_____

c. Connect a second analog phone to the port on the Adtran Octal FXS that corresponds to your pod number. For example, if pod 2 is being used, connect the analog phone to port 2 of the Adtran Octal FXS card. Place a call from one of the IP phones to the analog phone connected directly to the Adtran. (**Note**: The Adtran analog (FXS) port 1 phone number is 555-6001; port 2 is 555-6002; port 3 is 555-6003, etc.) Note that the call should ***not*** connect.

From the analog phone connected to the FXS router port, call the analog phone connected directly to the Adtran analog (FXS) port. (555-600x, where x is the pod number).

d. Based on what has been learned thus far, why did the phone calls fail? _____

_____

e. What audio and visual indications were shown on the IP phone when the call was made?

_____

f. A previous lab configured a dial-peer for the local FXS port. This step and the ones that follow configure a dial-peer for a phone number on the simulated PBX (Adtran). This dial-peer will use the PRI port on the router to access the cloud (the analog (FXS) port on the Adtran). The **dial-peer voice** command creates a specific dial-peer for an analog connection.

```
CMERouterX(config)# dial-peer voice 2 pots
```

g. Commands in this step tell the router which port to forward the call through for a specific number. The **destination-pattern *number*** command defines the phone number that will be forwarded. Different symbols can be used to define the number or range of numbers in the destination

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pattern. For example, the command **destination-pattern *555[4,6]…*** directs the router to send a call starting with 5554XXX or 5556XXX out the specified port. The numbers in the brackets mean either a 4 or a 6. The three periods represent any number 0-9. This step uses this command syntax to allow any number starting with 5554 or 5556 to send out the port designated in the next step.

```
CMERouterX(config-dial-peer)# destination-pattern 555[4,6]…
```

h. The **port X/X/X:23** command references the serial interface associated with the T1 controller configured earlier on the router. Type **do show running config** at the command line to verify the serial interface number, or refer to the earlier question. An example of a serial port interface number is as follows: **port 1/0/0:23** or **port 1/0:23** (depending on what model of NM-HDV2-1T1/E1 is being used).

```
CMERouterX(config-dial-peer)# port X/X/X:23
```

i. The router needs to know which phone number digits to forward for voice calls. Use the command **forward-digits all** to forward all the digits (the full length of the destination dial pattern) to the PSTN (the Adtran).

```
CMERouterX(config-dial-peer)# forward-digits all
```

j. Test the configuration by calling the analog phone attached to the Adtran analog (FXS) port from an IP phone. The Adtran FXS port 1 phone number is 555-6001; port 2 is 555-6002; port 3 is 555-6003, etc.

k. Was the call successful? If not, perform appropriate troubleshooting? _____

l. What message appears on the IP phone when a call is successfully made to the analog phone connected directly to the Adtran FXS port? _____

m. Save the router configuration.

Step 5 Configure the Dial-Peer to Call from the analog phone on the Adtran

a. Test the current configuration by calling the analog phone (seven digits) connected to the router FXS port from the analog phone attached to the Adtran analog (FXS) port. The call should fail.

b. Did the call connect?_____ Why not? _____

_____

c. A previous step configured a dial peer from the router to the simulated PBX (the Adtran). The next few steps configure a dial peer that allows a call made from the analog phone connected to the Adtran into the router using the PRI card.

```
CMERouterX(config)# dial-peer voice 3 pots
```

d. Commands in this step tell the router which numbers to allow from the outside world into the router for processing. The **incoming called-number *number*** command defines the numbers allowed for an incoming call for a specific dial peer. Note that the three periods that follow the four fives in this command are part of the command.

```
CMERouterX(config-dial-peer)# incoming called-number 5555…
```

e. Use the **direct-inward-dial** to enable Direct Inward Dialing (DID). DID is a service provided from the local phone company that provides a block of numbers used to call into a company's own PBX. When DID is used, a company can assign a company employee a phone number without requiring a physical line into the PBX (Adtran) for each person.

```
CMERouterX(config-dial-peer)# direct-inward-dial
```


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f. Use the **port X/X/X:23** command to apply the dial peer to a specific interface. This command allows calls that come in from the previously defined numbers (5555xxx) to be allowed through a particular router port. An example of this command is as follows: **port 1/0/0:23** or **port 1/0:23** (depending on what model of NM-HDV2-1T1/E1 is being used). Use the port parameters previously documented in a question.

```
CMERouterX(config-dial-peer)# port X/X/X:23
```

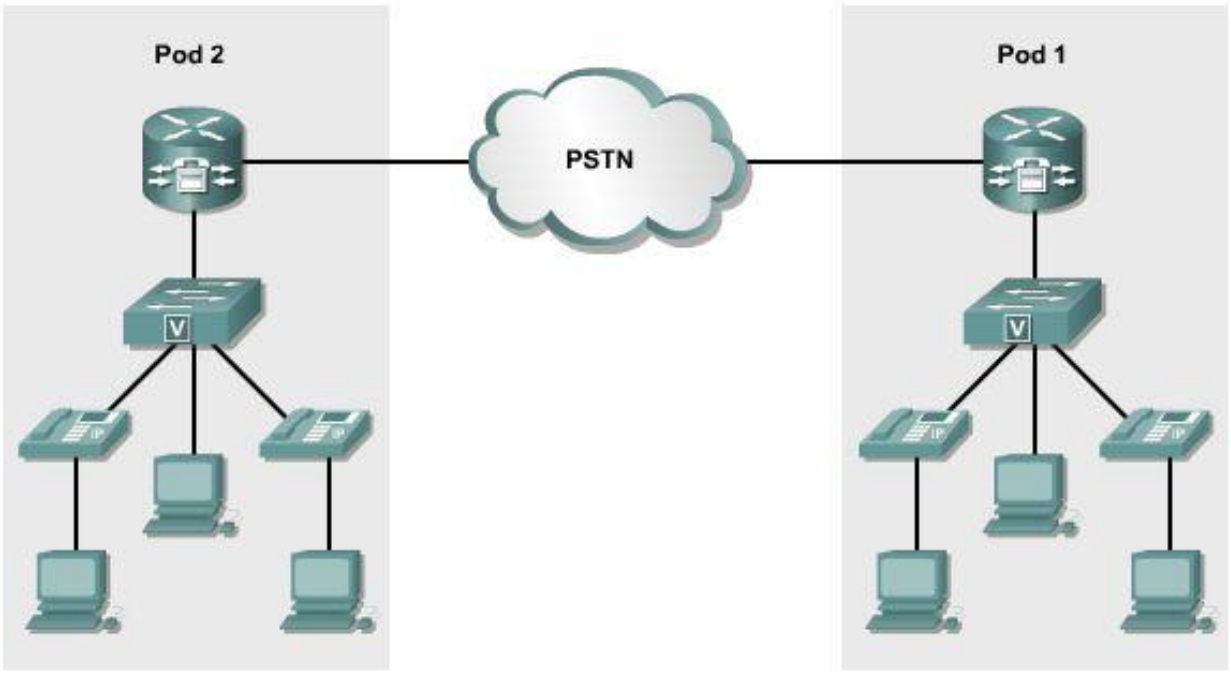
g. Test the configuration by calling from the analog phone attached to the Adtran analog (FXS) port to the analog phone connected to the FXS port on the router.

h. Did the call work properly? If not, perform appropriate troubleshooting. _____

i. Save the router configuration.

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Lab 4.1.4 Configuring VoIP Dial-Peers Across a WAN Link



Objective

- Configure the VoIP dial peers across a WAN link.

Equipment Requirements

- Two Cisco CallManager Express (CME) capable routers with a serial port
- Two inline power capable switch or non-inline power switch with power injectors
- Adtran
- Two IP phones
- Two analog phones

This lab relies on labs 2.1.1, 2.1.2, and 3.1.1 being successfully completed and loaded.

In this lab the ACME.com Company has added another site with its own CallManager Express. A WAN connection to the other site will need to be configured and tested.

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Step 1 Configure the Serial Interface

a. In this lab, Pod 1 and Pod 2 will partner, and Pod 3 and Pod 4 will partner.

b. Ensure that a serial cable connects from the lowest serial interface on *the lowest pod number* router terminating on the other pod's lowest number router serial interface.

c. On both pods, use the **show ip interface brief** command to verify that (1) a serial interface is installed and (2) the lowest numbered serial interface.

d. What is the port/slot number assigned to the lowest numbered serial interface? _____

e. On both pods, use the **show controllers serial *mod/port*** for the lowest serial interface and verify if the cable is a DCE or DTE. Examples of this command are **show controllers serial 0/0** or **show controllers serial 0/1/0**.

```
CMERouterX# show controllers serial mod/port
```

f. Type the **interface serial *mod/port*** command from global configuration mode to access the serial interface. Examples of this command are **interface serial 0/0** or **interface serial 0/1/0**.

```
CMERouterX(config)# interface serial mod/port
```

g. If the pod has the DCE end of the cable, use the command **clock rate 115200** to set the clock rate of the lowest serial interface.

```
CMERouterX(config-if)# clock rate 64000
```

h. Use the **encapsulation hdlc** command to configure the serial link encapsulation to HDLC.

```
CMERouterX(config-if)# encapsulation hdlc
```

i. Refer to Table 1 for the appropriate IP address to apply to the serial interface.

```
CMERouterX(config-if)# ip address 10.X.0.X 255.255.255.0
```

j. Use the command **no shutdown** to enable the serial interface.

```
CMERouterX(config-if)# no shutdown
```

k. Wait for your partner pod to complete the previous steps. Verify connectivity by using ping to test the serial connection. Ping the address of your partner pod serial interface. Enter **ping 10.Y.0.*X*** (refer to Table 1 for the partner pod IP address).

l. From an IP phone connected to the pod, attempt to dial a four digit extension numbers of one of the partner pod IP phones.

m. What was the result, and why is this result? _____

_____

_____

_____

n. What message displayed on the IP phone when the call did not complete? _____

Step 2 Configure the Dial Peer

a. From global configuration mode, create a new dial peer with the command **dial-peer voice 6 voip**.

```
CMERouterX(config)# dial-peer voice 6 voip
```


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b. Associate a pattern to the dial peer by using the global configuration mode command **destination-pattern *digits***. Refer to Table 2 for the destination patterns being used. Depending on the pod number, use one of the following commands to configure a destination pattern. Note that the period(s) at the end of the command is part of the command.

Pod 1- **destination-pattern *50[3,4,5].***

Pod 2- **destination-pattern *50[0,1,2].***

Pod 3- **destination-pattern *51[0,1,]..***

Pod 4- **destination-pattern *50[6,7,8].***

```
CMERouterX(config-dial-peer)# destination-pattern digits_fm_list
```

c. Use the **session target ipv4:10.Y.0.X** (where the IP address is the partner pod router's serial interface address).

```
CMERouterX(config-dial-peer)# session target ipv4:10.X.0.X
```

d. The G711 codec is what is used to translate analog voice data to a digital format. G711 uses a 64kbps data rate. Manually configure the codec to be used by entering the command **codec g711ulaw**. This codec will be used by any call that matches this dial peer.

```
CMERouterX(config-dial-peer)# codec g711ulaw
```

Step 3 Test the Configuration

a. Dial a four digit extension numbers of one of the phones in your partner's pod and stay connected. The lowest number pod partner should count aloud the numbers one to ten slowly into the phone.

b. How is the voice call quality? _____

_____

c. Is the quality of the voice acceptable? _____

d. Coordinating with your partner pod, place a second simultaneous call between the pods using a four digit extension. This will force two calls on the WAN link. The highest number pod partner counts aloud from number one to number 10. After counting, remain connected.

e. How is the voice quality? Is it the same, better, or worse? _____

_____

f. Verify the codec being used by the call is G.711 by quickly pressing blue ***i*** or question mark button (depending on the model of phone) on the IP phones twice while the calls are connected.

g. What does the IP phone display to indicate the codec being used? _____

h. Hang up both calls.

Step 4 Reconfigure the Codec

a. From global configuration mode on both pods, access the dial peer with the command **dial-peer voice 6 voip**.

```
CMERouterX(config)# dial-peer voice 6 voip
```


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b. The G729 codec uses an 8kbps data rate. Reconfigure the codec to use the G729 codec by entering the command **codec g729br8**.

```
CMERouterX(config-dial-peer)# codec g729br8
```

c. Coordinate with the partner pod to place two simultaneous calls across the WAN link by dialing the four digit extensions.

d. How is the voice quality? Remain connected._____

_____

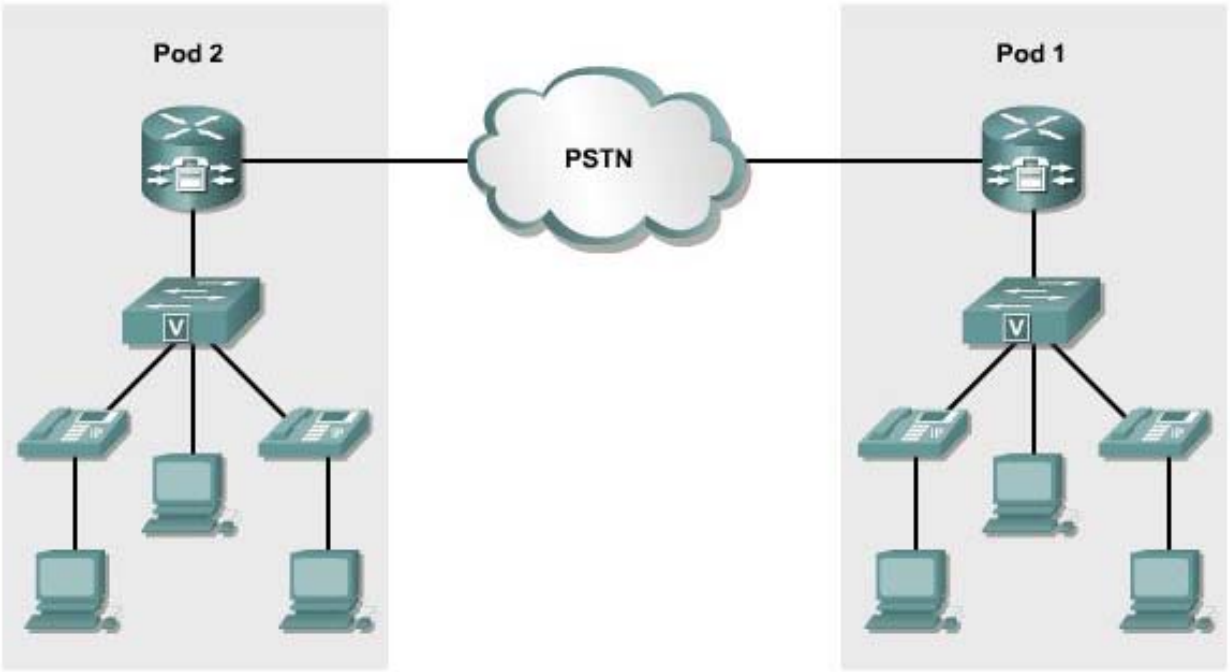
_____

e. On the IP phone, verify the codec is G.729 by quickly pressing the blue ***i*** or ***?*** (question mark) button twice (depending on the model of phone) while the calls are still connected.

f. Save the configuration by using the command **copy running-config startup-config**.

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Lab 4.1.5 Configuring Class of Restriction



Objective

- Configure Class of Service on the IP telephony network.

Equipment Requirements

- Two Cisco CallManager Express (CME) capable routers with a serial and PRI ports
- Two inline power capable switch or non-inline power switch with power injectors
- Adtran
- Two IP phones
- Two analog phones

This lab relies on labs 2.1.1, 2.1.2, 3.1.1, 4.1.1, 4.1.3, and 4.1.4 being successfully completed and loaded.

In this lab ACME.com wishes to implement Class of Service to restrict access to where certain IP phones can call.

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- Configure the lowest numbered IP phone to be able to call over the WAN, but not over the PSTN
- Configure the highest numbered IP phone to be able to call to any destination that the router can call
- The analog phone should be able to call across the WAN or the analog PSTN
- The digital PSTN should not be available to the analog phone

Step 1 Configure Class of Restriction

a. In this lab do NOT save the changes made to the router. A Class of Restriction (COR) is used to determine which incoming dial peer can use which outgoing dial peer to make a call. A dial peer can have one incoming and one outgoing COR list. The **cor** command is used to set the dial-peer COR parameter for dial peers and directory numbers. COR allows a company to deny certain call attempts on the basis of the incoming and outgoing CORs configured on the dial peers. The COR could be used to block calls to 900 numbers from company phones.

   The CME admin guide from Cisco gives another excellent example of a COR.

b. From global configuration mode, enter the command **dial-peer cor custom** to enter the cor mode.

```
CMERouterX(config)# dial-peer cor custom
```

c. Enter the first name by using the command **name Analog**.

```
CMERouterX(config-dp-cor)# name Analog
```

d. Enter the second name by using the command **name PRI**.

```
CMERouterX(config-dp-cor)# name PRI
```

e. Enter the final name by using the command **name WAN**.

```
CMERouterX(config-dp-cor)# name WAN
```

f. Type **exit** to return to global configuration mode.

g. Define a Class of Restriction (COR) list by using the command **dial-peer cor list callAnalog.**

```
CMERouterX(config)# dial-peer cor list callAnalog
```

h. Put a member in the COR list with the command **member Analog**.

```
CMERouterX(config-dp-corlist)# member Analog
```

i. Type **exit** to go to global configuration mode. Define a COR list by using the command **dial-peer cor list callPRI.**.

```
CMERouterX(config)# dial-peer cor list callPRI
```

j. Put a member in the COR list with the command **member PRI**.

```
CMERouterX(config-dp-corlist)# member PRI
```

k. Type **exit** to go to global configuration mode. Define a COR list by using the command **dial-peer cor list callWAN**.

```
CMERouterX(config)# dial-peer cor list callWAN
```

l. Put a member in the COR list with the command **member WAN**.

```
CMERouterX(config-dp-corlist)# member WAN
```


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m. Type **exit** to go to global configuration mode. Define a COR list by using the command **dial-peer cor list Type1**.

```
CMERouterX(config)# dial-peer cor list Type1
```

n. Put a member in the COR list with the command **member WAN**.

```
CMERouterX(config-dp-corlist)# member WAN
```

o. Type **exit** to go to global configuration mode. Define a COR list by using the command **dial-peer cor list Type2**.

```
CMERouterX(config)# dial-peer cor list Type2
```

p. Put the first of two members in the COR list with the command **member WAN**.

```
CMERouterX(config-dp-corlist)# member WAN
```

Put the second of two members in the COR list with the command **member Analog**.

```
CMERouterX(config-dp-corlist)# member Analog
```

q. Type **exit** to go to global configuration mode.

Step 2 Apply Class of Restriction to a Dial Peer

a. Enter dial-peer voice 2 pots to enter dial peer configuration mode.

```
CMERouterX(config)# dial-peer voice 2 pots
```

b. Assign an outbound COR list to the dial peer with the command **corlist outgoing callAnalog**.

```
CMERouterX(config-dial-peer)# corlist outgoing callAnalog
```

c. Without making a phone call, what phone calls do you expect to work and what phone calls do you expect to not work? _____

_____

d. Type **exit** to go to global configuration mode. Enter **dial-peer voice 3 pots** to enter dial peer configuration mode.

```
CMERouterX(config)# dial-peer voice 3 pots
```

e. Assign an outbound COR list to the dial peer with the command **corlist outgoing callPRI**.

```
CMERouterX(config-dial-peer)# corlist outgoing callPRI
```

f. Type **exit** to go to global configuration mode. Enter **dial-peer voice 6 voip** to enter dial peer configuration mode.

```
CMERouterX(config)# dial-peer voice 6 voip
```

g. Assign an outbound COR list to the dial peer with the command **corlist outgoing callWAN**.

```
CMERouterX(config-dial-peer)# corlist outgoing callWAN
```

h. Type **exit** to go to global configuration mode. Enter ephone directory number mode by entering the command **ephone-dn 1**.

```
CMERouterX(config)# ephone-dn 1
```


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i. In ephone-dn mode, enter the command **cor incoming Type1**.

```
CMERouterX(config-ephone-dn)# cor incoming Type1
```

j. Type **exit** to go to global configuration mode. Enter **dial-peer voice 1 pots** to enter dial peer configuration mode.

```
CMERouterX(config)# dial-peer voice 1 pots
```

k. Assign an outbound COR list to the dial peer with the command **cor incoming Type2**.

```
CMERouterX(config-dial-peer)# cor incoming Type2
```

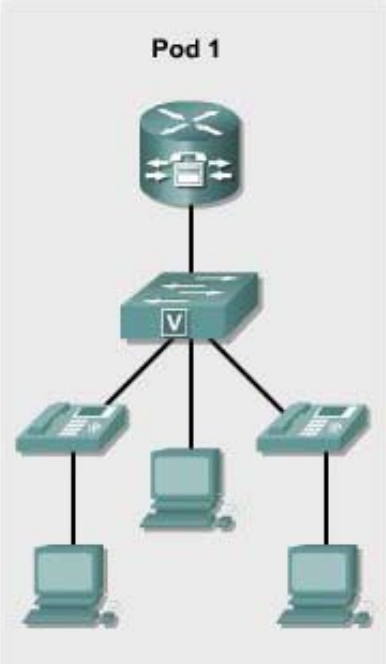
l. Test the COR settings by attempting to dial a partner pod over the WAN, analog connection to the PSTN, and the PRI connection to the PSTN. Test on all three phones. Remember that the highest numbered IP phone should be able to call any destination the router has a dial peer. The lowest numbered IP phone should not be able to call the phone connected directly to the Adtran.

m. Does the test work as it should? If not, perform appropriate troubleshooting. _____

n. When the test is successful, reload the router making sure you do *not* save the configuration.

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Lab 5.1.1 Configure GUI for System Administrator



Objective

- Configure and use the GUI system administrator interface

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Appropriate .tar file loaded on the router or available from the instructor or student assistant
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP phones
- TFTP Server application

This lab relies on labs 2.1.1, 2.1.2, and 3.1.1 being successfully completed and loaded.

In this lab ACME.com wishes to use a Web GUI instead of the CLI for adds, moves, and changes. Currently the GUI is not installed or configured. Configure and use the GUI to do various administrative tasks.

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- Enable the GUI on the CallManager Express router using files located on the TFTP server
- Create a username and password
- Use the GUI to create an ephone-dn and assign it to one of the two IP phones
- Use the GUI to add a speed dial to one of the two IP phones
- Use the GUI to change the date and time format on the IP phones
- Use the GUI to change the system time

Step 1 Configure the GUI interface for the System Administrator

a. The router and switch should be configured with the basic configuration. The IP phones should be plugged into the switch and configured with a basic configuration using any of the methods previously demonstrated.

b. From one of the phones, dial the other phone. Does the call go through properly? If not, troubleshoot as necessary. _____

c. From privileged mode, use the **show flash:** command to verify the IP phone GUI firmware files are present. The firmware files for a 7960 and 7940 will include some HTML files such as admin_user, ephone_admin, and telephony_service.

If these files are not present, there is a file that the instructor must obtain from the Cisco site that starts with the letters “cme-gui” and has a file extension of “.tar”. An example of the filename is cme-gui-123-11T.tar. Note that some of the older IOS versions did not combine these files in a .tar file.

Note: The .tar file must match the IOS version on the CME router.

Once the .tar file is obtained from the Cisco site, the GUI files are extracted from the .tar file and uploaded to the router Flash memory. This is done from a TFTP server. Copy the .tar file into the appropriate TFTP server folder. From privileged mode, use the **archive tar /xtract tftp://*tftp_server_ip_address*/*.tar_filename* flash:**. *tftp_server_ip_address* is the address of the TFTP server (that contains the .tar file). *.tar_filename* is the name of the file that starts with the letters “cme-gui” and has a filename extension of .tar. An example of this command is as follows: **archive tar /xtract tftp://10.3.0.33/cme-gui-123-11T.tar flash:**. A successful extraction shows an output similar to the following:

```
Loading cme-gui-123-11T.tar from 10.3.0.33 (via GigabitEthernet0/0.3):
!
extracting CiscoLogo.gif (1602 bytes)
extracting Delete.gif (953 bytes)
extracting Plus.gif (1347 bytes)!
extracting Tab.gif (174 bytes)
extracting admin_user.html (3845 bytes)!
extracting admin_user.js (641134
bytes)!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!
!!!!
extracting dom.js (16344 bytes)!!!!
extracting downarrow.gif (864 bytes)
```

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```
extracting ephone_admin.html (6146 bytes)!
extracting logohome.gif (4658 bytes)!
extracting normal_user.html (3724 bytes)!
extracting normal_user.js (76732 bytes)!!!!!!!!!!!!!!!
extracting sxiconad.gif (843 bytes)!
extracting telephony_service.html (2357 bytes)
extracting uparrow.gif (870 bytes)!
extracting xml-test.html (9968 bytes)!!
extracting xml.template (3311 bytes)!
[OK - 788992 bytes]
```

d. Was the extraction successful? If not, troubleshoot as necessary. _____

Step 2 Configure the GUI interface for the System Administrator

a. The CME GUI interface allows administrators to configure CallManager Express using web access rather than from a console or Telnet connection. Enter the command **ip http server** to enable the Web server on the Cisco CallManager Express router.

```
CMERouterX(config)# ip http server
```

b. Enter the command **ip http path flash:** to define that the location of the HTML files are in Flash memory of the router. The HTML files on the router are needed to perform GUI administration.

```
CMERouterX(config)# ip http path flash:
```

c. Enter **ip http authentication local** to define that login credentials will be defined locally on the router. Without this command, the default authentication is the router's enable secret password, or the enable password if enable secret is not set.

```
CMERouterX(config)# ip http authentication local
```

d. Move to the telephony service mode by using the command **telephony-service**.

```
CMERouterX(config)# telephony-service
```

e. From telephony service mode define a username and password used for web-based access. The username will be ACMEadmin with a password of cisco.

```
CMERouterX(config-telephony)# web admin system name ACMEadmin
password cisco
```

f. Enter **dn-webedit** to allow changes to the Directory Number through the Web interface.

```
CMERouterX(config-telephony)# dn-webedit
```

g. Enter **time-webedit** to allow the Cisco CallManager Express time to be set from the Web interface.

```
CMERouterX(config-telephony)# time-webedit
```

Currently, the only changes that can be made through the web interface are the directory number and the time based on the commands just entered, but more can be configured.

h. Return to privileged mode and save the router configuration.

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Step 3 Configure a speed dial using the GUI

a. Ensure the PC that will be used to access the CME GUI either (1) connects to a switch port that has been configured for the data VLAN or (2) connects to the 10/100 PC port on one of the IP phones. The PC can be configured for DHCP and if so configured, should receive an IP address from the CME router. Ensure the router has been configured for a data DHCP pool (see previous lab). If the router has not been configured, the PC can be manually configured with an IP address in the data VLAN IP address range. See Table 1 for these addresses.

   If the PC connects to a switch port, ensure the switch interface is configured for (1) access mode and (2) the data VLAN (X0 where *X* is the pod number).

   The PC should be able to ping the router interfaces before any other step is attempted.

b. Can the PC ping all of the router interfaces? If not, troubleshoot as necessary. _____

c. What IP address is assigned to the PC? _____

d. Open the Web browser on the PC and enter the URL of **http://10.*X*0.0.1/ccme.html** (where ***X*** is the pod number). Attempt to log in using a blank username and the enable secret password.

e. Were you able to login using blank username and the enable password? Why or why not?

   _____

   _____

f. Try logging in again and when asked for credentials, use **ACMEadmin** for the username and **cisco** for the password.

g. What are the five menu options available through the web interface? _____

   _____

h. From the Configure menu option, select **Extensions**. The currently configured extensions are shown on the screen.

i. How many extensions display on the screen? If none, the phones have not been configured correctly. Start this lab over. _____

j. From the Configure menu option, select **Phones**. The two configured phones should be listed. If none are listed, the phones are not configured correctly. Start this lab over and connect the phones properly.

k. In the Phone Physical ID(MAC Address) column, click on the first MAC address. The MAC address is underlined. The phone line buttons list in a separate window in a table. Note that popups may have to be enabled in order to see this window.

l. How many buttons list on the screen? Does this correspond to the correct number of buttons located to the right of the IP phone's LCD? _____

m. Scroll down until the Speed Dial Information section is reached. In the Speed Dial 1: textbox, type in the four digit extension of the *other* IP phone. Normally, the number for the phone that is being accessed is shown as the first button. For example, if configuring this for the IP phone that currently has the extension of 1001 (shown higher in this web configuration window), type 1000 (the other IP phone extension). In the Label: textbox, type a name or description that will display on the IP phone. An example is Alyssa.

n. Click on the **Change** button at the bottom of the screen. When prompted if the changes are to be saved, click the **OK** button.

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o. What feedback is received as a result of clicking the OK button? _____

p. In the message that appears on the screen, click the **OK** button to clear the message.

q. Look at the IP phone that was being changed. What happens as a result of creating a speed dial using the GUI? _____

r. Once the phone has reset, what has changed on the phone display?

_____

s. Press the second button on the phone that was just configured (the one that contains the words just created with the speed dial). What happens as a result?

_____

Step 4 Configure system time using the GUI

a. From the Configure menu, select **System Parameters**. Notice the different selections that can be changed.

b. Use the **System Time** option to change the date and/or time to a different time than is currently defined. Note that the current time is based on the time of the computer and not the router.

c. Click on the **Set** button to use the currently configured settings. Click on the **OK** button to save the changes and select the **OK** button to acknowledge the save.

d. Select the **Date and Time Format** option from the left column. Change the format to a different selection.

e. Reset the two IP phones by using the **Configure** drop down menu and selecting the **Phones** option. Use the **Reset All** link to reset the phones. Click **OK** to reset the phones and **OK** again to acknowledge the save.

f. View the changes as they occur on the IP phones. Record your observations.

_____

g. From the Configure menu, select **System Parameters** again. Click on the **Directory Service** option from the left column and select **Name Schema**.

h. What is the other name schema that can be selected? _____

i. Click on the **System Message** option from the left column.

j. In the System Message: textbox, type in a message. Click on the **Set** button and click on **OK** to save the changes. Click on the **OK** button to acknowledge the save.

k. How does the phone change as a result of the last configuration step?

_____

l. How might a system administrator use this option? _____

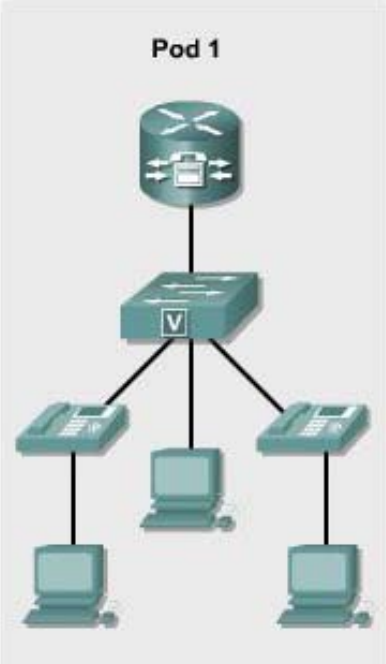
_____

m. Logout of the GUI Web page by clicking on the **Logout** option from the upper right portion of the screen.

n. From the router CLI, save the configuration to be used in future labs.

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Lab 5.1.2 Configure GUI for Customer Administrator



Objective

- Configure and use the GUI interface for the customer administrator

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP phones
- TFTP server application

This lab relies on labs 2.1.1, 2.1.2, 3.1.1, and 5.1.1 being successfully completed and loaded.

In this lab ACME.com wants an administrative assistant to have the ability to perform a subset of the tasks that the system administrator can perform in the GUI web interface. Configure the customer administrator in CallManager Express to enable this.

- Create the customer administrator credentials using the GUI
- Verify changes using the CLI

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- Create credentials of **ACMEcust** with a password of **cisco**
- Copy the XML file using a TFTP server
- Examine the context of the XML file

Step 1 Configure a Phone using the GUI interface for the Customer Administrator

a. Ensure the phones can connect to one another. If they cannot, redo previous labs.

b. Use the **show running-config | begin tele** command to view part of the current configuration.

```
CMERouterX# show running-config | begin tele
```

c. Open the Web browser on the student PC and enter the URL of **http://10.X0.0.1/ccme.html** (where X is the pod number). Use **ACMEadmin** for the username and **cisco** for the password. This allows access to the GUI as the system administrator.

d. Point to the **Configure** menu option, and select **System Parameters**. Ensure the Administrator's Login Account option (the first menu option on the left) is selected.

e. From the Admin User Type: drop-down menu, select **Customer** (instead of System).In the Admin User Name: textbox, type in **ACMEcust**. Note that usernames are case sensitive in Call Manager Express. The Customer Administrator category allows a person to be given rights to change some of the phone parameters. The account by default has the ability to change the same things as the administrator, but this account can be customized to remove authority.

f. Set the New Password and Confirm Password to **cisco** in both textboxes. Passwords are also case sensitive.

g. Click on the **Change** button and select **OK** when asked to confirm the change. A confirmation window pops up stating the change has been implemented. Click on **OK**.

h. Logout of the CallManager GUI by clicking on the **Logout** link in the upper right corner.

Step 2 Review Changes to the Configuration

a. Console into the Cisco CallManager Express router and go to privileged mode.

b. Use the **show running-config | begin tele** command to view the changes to the configuration.

CMERouterX**# show running-config | begin tele**

c. What changes to the configuration occurred as a result of adding the Customer Administrator?

_____

Step 3 Test the New Account

a. Return to the GUI CME Web page by typing the URL **http://10.X0.0.1/ccme.html** (where X is the pod number) in a web browser.

b. When prompted for a username and password, use the newly-created Customer Administrator account (**ACMEcust** for the username and **cisco** for the password).

c. How many System Parameters can be changed using the Customer Administrator account?

_____

d. Logout of the CallManager GUI by clicking on the **Logout** link in the upper right corner.

e. Open up another browser window and return to the CallManager Express GUI interface by typing **http://10.X0.0.1/ccme.html** in the address line.

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f. When prompted for a username and password, use the System Administrator account (**ACMEadmin** for the username and **cisco** for the password).

g. How many System Parameters can be changed using the System Administrator account? _____

h. Note that the Customer Administrator and the System Administrator have the same level of access. Logout of the CallManager GUI by clicking on the **Logout** link in the upper right corner.

Step 4 Download XML Template

a. Return to the router CLI.

b. Use the **show flash:** command to view the contents of Flash memory. Notice that there is a file named xml.template saved in Flash.

c. Start the TFTP server application. The PC that has the TFTP server application should be connected to the switch and be able to ping the router before any transfers occur.

d. Is there connectivity between the TFTP server and the router? _____

e. From the router privileged mode prompt, issue the command to copy the xml.template file in Flash memory from Flash to the TFTP server.

```
CMERouterX# copy flash:xml.template tftp:
```

The transfer should be successful. Troubleshoot as necessary until the file transfers.

f. What indication is given that the TFTP transfer was successful? _____

g. Using a text editor such as Notepad, open the downloaded file (xml.template).

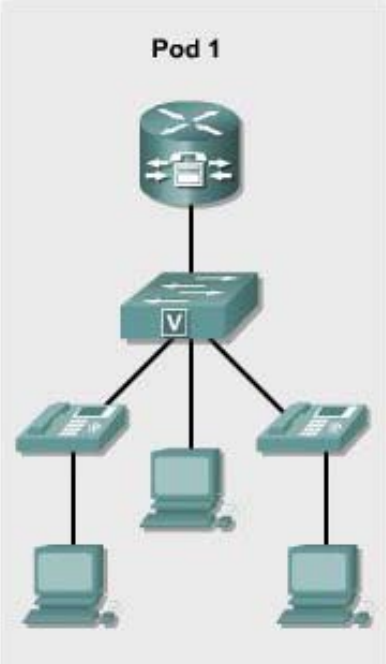
h. What is the first word found inside the greater than and less than symbols of the xml.template file? _____

i. The xml.template file can be modified and uploaded to the router to modify what can be seen through the web interface. The **web customize load *filename*.xml** command is used in telephony-service router configuration mode to specify the new XML file to be used with the web interface. This file must be copied up to the router Flash memory before it can be used. Customizing the login is beyond the scope of this lab.

j. Save the router configuration.

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Lab 5.1.3 Configure GUI for Phone User



Objective

- Configure and use the GUI for the Phone User

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP phones

This lab relies on labs 2.1.1, 2.1.2, 3.1.1, 5.1.1, and 5.1.2 being successfully completed and loaded.

In this lab the ACME.com Company needs to configure user credentials so that the users can make some settings of their assigned phones through the GUI Web interface. Configure two users as listed below and test the levels of access.

- Configure a user named **EFriend** and a password of **cisco** for the IP phone with a sequence number of 1 from the GUI

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- Configure a user named **KHampton** and a password of **cisco** for the IP phone with a sequence number of 2 from the CLI
- Open the GUI and log in as one of the user accounts created

Step 1 Configure a Phone using the GUI for the Phone User

a. Use the **show running-config | begin ephone** command to view part of the current configuration.

```
CMERouterX# show running-config | begin ephone
```

b. Open the Web browser on the student PC and enter the URL of **http://10.X0.0.1/ccme.html** (where ***X*** is the pod number). Use **ACMEadmin** for the username and **cisco** for the password.

c. From the main menu, point to **Configure** and select the **Phones** option.

d. Locate the Phone Sequence Number column. Select the link for the IP phone with a sequence number of 1 by clicking on the MAC address located in the first column (Phone Physical ID) of that same row. Note: Pop-up blocking may need to be disabled for this site.

e. In the window that displays as a result of clicking on the MAC address, what is the default value for Call Blocking? [Exempt | Non Exempt] _____

f. Scroll to the Login Account section. In the Login Username textbox, add a username of **EFriend** and a password of **cisco**. Note that the username and password are case sensitive. Click on the **Change** button to save the configuration change. When prompted to save the change, click on **OK**. When the confirmation message appears, click on **OK**.

g. From the main menu, point to **Administration** and select **Save Router Config**. When prompted to save the change, click on the **OK** button. A message may appear that the change is delayed because a Telnet session is active. This only occurs when a HyperTerminal session is active at the same time as a Web session. Whether or not this message is displayed, proceed to step 1h.

h. Logout of the GUI Web interface by clicking on the **Logout** link in the upper right portion of the screen.

i. Use HyperTerminal to access the Cisco CallManager Express router, and use the command **show running-config | begin ephone** to view the changes made through the GUI Web interface.

```
CMERouterX# show running-config | begin ephone
```

j. What changes to the configuration have been made in the ephone 1 section?

_____

_____

k. From global configuration mode, use the command **ephone 2** to enter ephone configuration mode.

```
CMERouterX(config)# ephone 2
```

l. Enter the command **username KHampton password cisco** to configure a phone user for the second phone.

```
CMERouterX(config-ephone)# username KHampton password cisco
```


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m. Save the router changes.

```
CMERouterX# copy running-config startup-config
```

n. Open a Web browser and use the URL **http://10.X0.0.1/ccme.html** (where ***X*** is the pod number). Authenticate with the **EFriend** account and a password of **cisco**.

o. Point to the **Configure** menu option.

p. What is different from the other Web accounts? _____

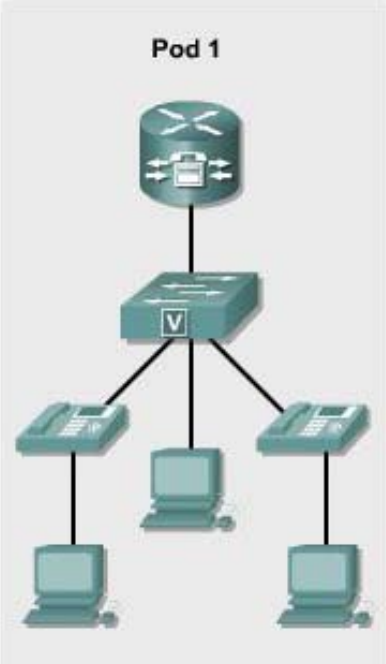
q. Click on the **Phone** option (under Configure).

r. Does the system allow any phone except for ephone1 to be configured? _____

s. Logout of the Web GUI.

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Lab 5.1.4 Configuring Call Transfer and Call Forward



Objective

- Transfer calls and set up call forwarding

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP phones
- One analog phone

This lab relies on labs 2.1.1, 2.1.2, 3.1.1, 4.1.1, 5.1.1, and 5.1.2 being successfully completed and loaded.

In this lab the ACME.com Company currently has the system default of blind transfers and wishes to change to consultative transfers system wide. Configure CallManager Express to use consultative transfers. However, the ability to forward calls should be restricted and the user should not be able to forward calls from the IP phones.

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- Configure consultative transfer
- Use the IP phone to configure call forward to the other IP phone
- Restrict the ability to forward calls from the IP phone using IOS commands

Step 1 Configure Call Transfer and Call Forward

a. Check connectivity between the analog phone and one of the IP phones. From the analog phone, dial one of the IP phones.

b. Does the phone connection work between the analog phone and the IP phone? If not, troubleshoot as necessary.

_____

c. Note that a softkey button on the phone is an option selected by one of the four buttons at the bottom of the IP phone display.

When the analog phone dials one of the IP phones and the IP phone is ringing, press the **Answer** softkey button followed by the **Trnsfer** softkey button. A dial tone emits. Enter the extension of the other IP phone. The other IP phone should ring.

d. Was the transfer successful? If not, troubleshoot as necessary.

_____

e. By default, the phone transfer from one IP phone to the other is blind. What is your best guess as to what the term blind transfer means?

_____

_____

_____

f. Access the router CLI. From global configuration mode, enter telephony-service mode.

```
CMERouterX(config)# telephony-service
```

g. Use the command **transfer-system full-consult** to enable consultative transfers.

```
CMERouterX(config-telephony)# transfer-system full-consult
```

h. From the analog phone, dial one of the IP phones. When the IP phone starts ringing, press the **Answer** softkey button followed by the **Trnsfer** softkey button. A dial tone emits. Enter the extension of the other IP phone. The other IP phone should ring. On the other IP phone (the target IP phone) press the **Answer** softkey. Notice that the call is not automatically transferred and the only connection where a conversation can occur is between the two IP phones. In fact, the caller on the analog phone is on hold, and even if the analog phone is hung up, the call transfer between the two IP phones continues.

i. From the IP phone that initiated the transfer press the **Trnsfer** softkey button a second time to complete the transfer. Now the analog phone and the second IP phone have a connection. Hang up all phones.

j. From the second IP phone, press the **CFwdAll** softkey button then enter the number of the first IP phone followed by the # key. This forwards all calls to the other IP phone.

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k. What message appears when all calls have been forwarded to another IP phone?

_____

l. From the analog phone, call the number of the second IP phone. The call should be forwarded to the first IP phone.

m. Does the first IP phone ring? If not, troubleshoot as necessary. _____

n. Press the **CFwdAll** softkey button on the second IP phone to disable the call forwarding.

Step 2 Examining Call Forward Features

a. From global configuration mode, enter **ephone-dn 1** to enter ephone-dn mode.

```
CMERouterX(config)# ephone-dn 1
```

b. Enter the command **call-forward max-length 0** to disable call forwarding from the first IP phone. Note that even though call forwarding is disabling, a phone call can still be placed to the phone and from the phone.

```
CMERouterX(config-ephone-dn)# call-forward max-length 0
```

c. List one example of when a company might disable call forwarding for an employee that has an IP phone. _____

_____

d. Examine the router configuration to determine which IP phone uses ephone-dn 1.

e. What is the phone number assigned to ephone-dn 1 based on the router configuration output?

_____

f. From the IP phone with ephone-dn 1 assigned to it, press the **CFwdAll** softkey button.

g. What is different than before? _____

h. Use the GUI Web interface as a phone user (for example, KHampton, cisco). Under the **Configure** menu option, select **Phone**. In the Line Information section click on the hyperlink for the line being configured (probably Line 1). Configure call forward busy, and call forward no-answer to forward calls to the other IP phone's number. In the timeout textbox enter 15 (18 seconds is the default). Click on the **Change** button. Then on the Configure > Phone page, scroll down to the end of the page and click on the **Save Changes** button. Click on the **OK** button to save changes, click on the **OK** button to acknowledge the changes. Notice that the user can still configure call forward settings from the GUI even though the **call-forward max-length 0** is set from the router prompt.

i. What happens to incoming calls when call forward busy and call forward no answer options are active and set to the other IP phone?_____

j. If a forwarding number was also entered into the call forward all textbox what would then happen to calls to that number?_____

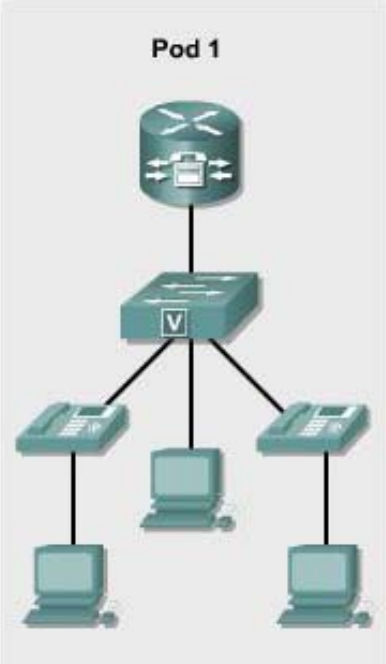
_____

k. Use the analog phone to verify functionality of the call forwards.

l. Remove the call forwarding from the IP phone using any method.

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Lab 5.1.5 Configuring Call Park



Objective

- Configure the Call Park option

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP phones
- One analog phone

This lab relies on labs 2.1.1, 2.1.2, 3.1.1, 4.1.1, and 5.1.1 being successfully completed and loaded.

In this lab the ACME.com Company has an overhead page that is used by the company operator to page someone that is not answering a transferred consultative call. The ability to park the call will be needed so the person being paged can retrieve the call from any phone in the CallManager Express system.

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- Configure the ability to park a call at the extension ***X*800** (where ***X*** is the pod number)
- Configure the system to send a reminder after 10 seconds and to repeat this three times
- Retrieve a parked call from a different IP phone

Step 1 Configure Call Transfer and Call Forward

a. From the router CLI global configuration mode, create an ephone to use as a "call park slot"—a fake ephone that is simply used as a holding spot for a phone call. In this instance, the number 11 is being used.

```
CMERouterX(config)# ephone-dn 11
```

If a message appears that dn 11 exceeds the max-dn limit, move to the telephony-service configuration mode and type the command **max-dn 15**. Return to global configuration and re-enter the **ephone-dn 11** command.

b. What message appears as a result of the **ephone-dn 11** command? _____

_____

c. Use the **number X800** (where ***X*** is the pod number) command to assign an extension.

```
CMERouterX(config-ephone-dn)# number X800
```

d. Use the command **park-slot timeout 10 limit 3** to set a reminder after 10 seconds and to terminate the call after three reminders.

```
CMERouterX(config-ephone-dn)# park-slot timeout 10 limit 3
```

e. What is the maximum amount of time in hours that can be programmed for the call park feature?
_____

f. Try resetting the IP phones by using the keys on the IP phones and pressing the following buttons: *** * # * ***. Note this will work on most 7940 IP phones, however it may not work on 7960 IP phones. If this method does not work then reset the IP phone using the method previously learned from an earlier lab. Refer to lab 2.1.2 if necessary.

g. From the analog phone, call one of the IP phones and answer the call.

h. Use the **more** softkey button to find and press the **Park** softkey button. You may need to press the **more** softkey multiple times before the **Park** softkey is seen.

i. Wait 10 seconds. What is heard on the analog phone and on the IP phone?

_____

j. Wait another 20 seconds. What happens to the call?_____

_____

_____

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k. The Park IP phone feature allows a call to be picked up from a remote location. Say that a hardware store has multiple lines coming into the store. Every phone in every department does not need every one of these lines to be connected to it. Instead, the Park feature can be used. When the main office tells a department to pick up on a particular number, it could be the Park feature that is being used. Another good time to use the Park feature is when someone is taking a call in their office, the employee needs the boss to hear what the caller is saying. The employee can park the call and pick the call back up in the supervisor's office.

   From the analog phone, call one of the IP phones and answer the call.

l. On the IP phone, use the **more** softkey button to find and press the **Park** softkey button.

m. From the second IP phone, use the **more** softkey button to find and press the **PickUp** softkey button. When dial tone is heard, dial **X800** (where ***X*** is the pod number) to retrieve the parked call. Note that the number dialed is the same number that was programmed into the virtual ephone-dn earlier in this lab.

n. The second IP phone and the analog phone are now connected and can communicate, and the first IP phone has been disconnected.

o. Did the call connect? If not, troubleshoot as necessary. _____

p. Disconnect the call. The Park feature can also allow the original IP phone that places the call in Park to pick up the call. From the analog phone, dial one of the IP phones and answer the call.

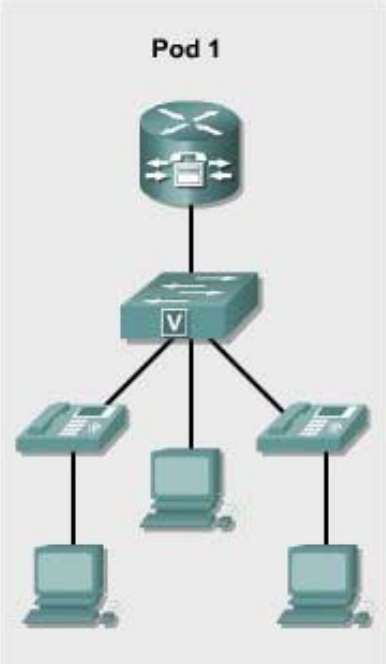
q. Use the **more** softkey button to find and press the **Park** softkey button.

r. From the IP phone that parked the call, use the **more** softkey button to find and press the **PickUp** softkey button. When a dial tone is heard, press ***** to retrieve the call.

s. Did the call connect? If not, troubleshoot as necessary. _____

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Lab 5.1.6 Customize the IP Phone Display



Objective

- Customize the IP Phone Display

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP phones
- IP Telephony Table 2

This lab relies on labs 2.1.1, 2.1.2, 3.1.1, 5.1.1, and 5.1.3 being successfully completed and loaded.

In this lab the ACME.com Company wishes to customize the IP phones with the Direct Inward Dial (DID) number of the phone, the company name on the display, and a label on the line. Configure the following with IOS commands or by using the GUI.

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- Configure the top line of the two IP phones
- Configure the system message on the IP phone using the CLI
- Label the first line on the first IP phone with **my line *X*000** (where ***X*** is the pod number)

Step 1 Customize the IP Phone Display

a. Ensure the two IP phones can connect to one another before this lab begins. Troubleshoot as necessary.

b. Browse to the URL **http://10.X0.0.1/ccme.html** (where ***X*** is the pod number) to access the GUI Web interface. Use the system administrator credentials of **ACMEadmin** and **cisco**.

c. Point to **Configure** and select the **System Parameters** option.

d. In the list of system parameters on the left, select **System Message**. Enter a message of **ACME Classroom**. Click on the **Set** button. When asked if the change is to be saved, click on the **OK** button. When the change is successful and that message appears, click **OK**.

If this change was to be completed from the router CLI, telephony-service configuration mode is used, and the **system message** command is used The number of characters that can be displayed on an IP phone system message is not set because the IP phone normally uses a proportional font rather than a fixed font. Normally, there is room for approximately 30 characters.

e. What change took place on the connected IP phones? _____

_____

f. Logout of the Web interface. Access the CME router CLI. From global configuration mode, enter the ephone directory number configuration mode for the first IP phone.

```
CMERouterX(config)# ephone-dn 1
```

g. Use the **description** command to set the label on the IP phone header bar.

```
CMERouterX(config-ephone-dn)# description Phone1
```

h. Enter the ephone directory number configuration mode for the second phone by using the **ephone-dn 2** command.

```
CMERouterX(config)# ephone-dn 2
```

i. Use the **description *DIDnumber*** (where ***DIDnumber*** is the first E.164 DID number listed for each pod in IP Telephony Table 2) to set the IP phone header bar. An example for Pod 1 would be **description 5105555000**.

```
CMERouterX(config-ephone-dn)# description DIDnumber
```

j. Return to the ephone directory number configuration mode for the first IP phone.

```
CMERouterX(config)# ephone-dn 1
```

k. Use the command **label my line X000** (where ***X*** is the pod number) to set a label on ephone-dn 1. A label displays on the phone next to the line button associated with an ephone dialer number.

```
CMERouterX(config-ephone-dn)# label my line X000
```


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l. Reset both IP phones by pressing *** * # * *** on the keypad, or by using the method shown in lab 2.1.2. Some IP phone firmware versions may require selecting the “Settings” button prior to pressing **#**.

m. What visible changes are on the IP phones? _____

_____

n. View the changes made on the router.

```
CMERouterX# show running-config | begin tele
```

o. Save the router changes.

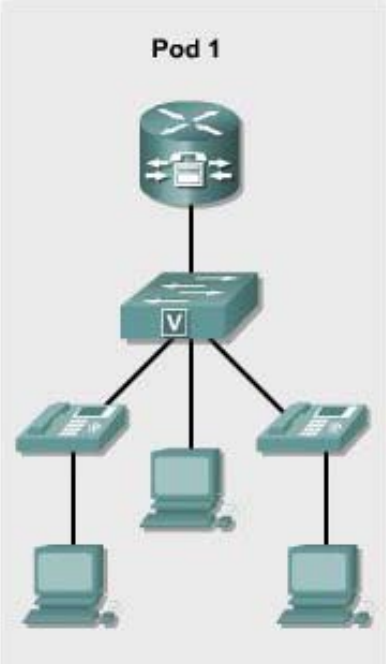
```
CMERouterX# copy running-config startup-config
```

p. Notice the system message **ACME Classroom** appears on the bottom of every phone, Phone1 appears in the top right of the first IP phone, the first button on the first IP phone has the label my line X000 (where ***X*** is the pod number), and the number 5105555000 appears at the top of the second IP phone.

q. Do all four items appear correctly? If not, troubleshoot as necessary. _____

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Lab 5.1.7 Configure the Intercom Feature



Objective

- Configure an intercom between the two IP phones

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP phones

This lab relies on labs 2.1.1, 2.1.2, 3.1.1, and 5.1.1 being successfully completed.

In this lab the ACME.com Company wishes to configure an intercom between the CEO and the corresponding administrative assistant. No one else in the company should be able to dial this intercom.

- Configure an intercom between two IP phones
- Test that the intercom works

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Step 1 Configure the Intercom

a. Ensure the two IP phones can connect to one another before this lab begins. Troubleshoot as necessary.

b. Access the CME router using the Web-based GUI configuration method. Login as the system administrator (username **ACMEadmin** password **cisco**). Point to the **Configure** menu option and select the **Extensions** option.

c. Click on the **Add** link. In the Extension Number: textbox, type **D3333**. Select a Sequence number from the drop-down box. This number will be the ephone-dn (directory number) shown in the router configuration. The sequence number must be unique.

d. What sequence number was selected for the D3333 extension? _____
This number will be used later in the configuration.

e. In the Extension Type drop-down menu, select **Intercom**. Type **Intercom** for the name of the Intercom in the Name: textbox. In the first Label: textbox, type **Intercom**. In the Intercom Number: textbox, type **D4444**.

f. Click on the **Add** button to add this extension. When prompted to save the changes, click on the **OK** button. A message appears that the extension was added; click **OK**. When prompted to add the new extension to the new phone, click on the **OK** button. When the message appears that there is no new phone to add or that there is no free sequence number, click **OK**.

g. Add a second new extension using the same method. Set the extension number to **D4444** with a unique sequence number, an extension type of **Intercom**, a name of **Intercom**, a label of **Intercom**, an intercom number of **D3333**, and all other settings left at default. Save these changes.

h. What sequence number was chosen for the D444 extension? _____
This number will be used in the next part of the configuration.

i. Point to the **Configure** menu option and select the **Phones** option. Click on the MAC address of the first IP phone. The MAC address is located in the Phone Physical ID column.

j. Go to the Speed Dial Information section and delete any speed dials located there. This is done in case the phone has only two buttons. Even if the phone has multiple buttons, future labs are not affected.

k. In the Phone Line Buttons section, select an unused button by clicking on the button number link located in the Button column.

l. Locate the D3333 Intercom option and click in the checkbox beside the sequence number.

m. Click on the **Save** link at the top of the window. Click on the **Change** button at the bottom of the window. Respond to the next two messages by clicking on **OK**. The IP phone should reboot.

n. What indication does the first IP phone give that this configuration was made successfully?
_____

o. Select the MAC address of the second IP phone. Delete any speed dials. Select a free phone line button number link. Locate the D4444 Intercom option and click in the checkbox beside the sequence number. Click on the **Save** link at the top of the window. Click on the **Change** button. Respond to the next two messages by clicking on **OK**. The IP phone should reboot.

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Step 2 Test the Intercom Configuration

a. Once the second IP phone has rebooted and the Intercom option appears beside one of the phone buttons on the second IP phone, press the button that corresponds to the word Intercom. Speak some words out loud.

b. What indication are there that the Intercom works from the second IP phone? _____

_____

Note that if the intercom does not work properly, troubleshoot at necessary until it does.

c. Press the Speaker button on either IP phone to disconnect the Intercom.

d. From the first IP phone, test the intercom function and ensure it works.

e. Does the first IP phone intercom work properly? If not, troubleshoot as necessary. _____

f. Access the router CLI. From the privileged exec mode, use the command **show running-config | begin tele** command to view the changes.

```
CMERouterX# show running-config | begin tele
```

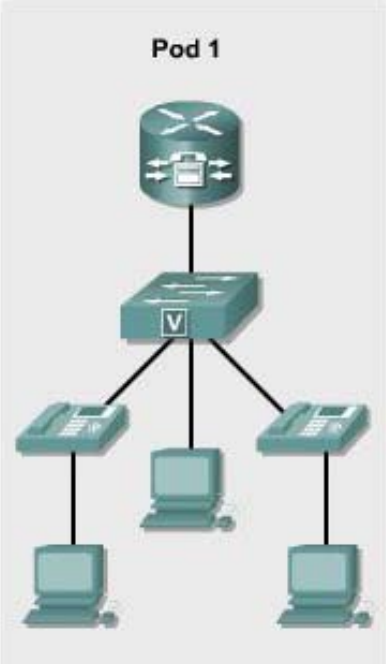
g. What settings changed under the ephone-dn and ephone sections?

_____
_____
_____
_____
_____
_____

h. Save the router configuration.

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Lab 5.1.8 Configuring a Dialable Intercom



Objective

- Configure an intercom that can be accessed from an outside line

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP phones
- One analog phone

This lab relies on labs 2.1.1, 2.1.2, 3.1.1, and 4.1.1 being successfully completed. Reference IP Telephony Tables 1 and 2 for extension numbers.

In this lab the ACME.com Company wishes to configure an intercom to the receptionist at the front desk that anyone in the enterprise can dial.

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- Configure a second intercom on the two IP phones
- Test that the intercom works and that the analog phone can access the intercom

Step 1 Configure the dialable intercom

a. Ensure that the two IP phones can call one another and that the analog phone can successfully dial either IP phone. Troubleshoot as necessary before proceeding.

b. Use the command **show running-config | begin tele** command to view part of the current configuration. Verify that two IP phones have registered, and the MAC addresses used by the two phones are shown in the configuration output.

```
CMERouterX# show running-config | begin tele
```

c. What are the MAC addresses for the two IP phones? _____

_____

d. From a workstation connected to an IP phone (that can ping all router IP addresses), access the CME using a Web interface by typing **http://10.X0.0.1/ccme.html** (where ***X*** is the pod number). When prompted for a username and password use **ACMEadmin** and **cisco**.

e. Click on the **Configure** menu option and select **Phones**.

f. Locate both of the MAC addresses of the IP phones. Write the MAC address and its associated Primary Line Number based on the information seen on the Web interface.

MAC Address	Primary Line Number

g. Click on the **Configure** menu option and select the **Extensions**.

h. Click on the Add link and set the Extension Number to **XXXX** (where ***X*** is the pod number). An example of an extension number for Pod 1 is 1111. Select an unused Sequence Number. Select an Extension Type of **Intercom** from the drop-down menu. Type a name of **Dialable Intercom**. Type a label of **Dialable Intercom** in the Label field. The Intercom Number will be set to **XXX0** (where ***X*** is the pod number). All other settings are left to the default.

i. The sequence number for this phone will be used in a future step. What sequence number was selected? _____

j. Click on the **Add** button. When prompted if the changes are to be saved, click on **OK**. A confirmation message appears. Click **OK**. When prompted if the next extension is to be added to a new phone, click **OK**. When the No new phone to add or no sequence number message appears, click **OK**.

k. Click on the **Add** link and set the Extension Number to **XXX0** (where ***X*** is the pod number). An example of an extension number for Pod 1 is 1111. Select an unused Sequence Number. Select an Extension Type of **Intercom** from the drop-down menu. Type a name of **Dialable Intercom**. Type a label of **Dialable Intercom** in the Label field. The Intercom Number will be set to **XXXX** (where ***X*** is the pod number). All other settings are left to the default.

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l. The sequence number for this phone will be used in a future step. What sequence number was selected? _____

m. Click on the **Add** button. When prompted if the changes are to be saved, click on **OK**. A confirmation message appears. Click **OK**. When prompted if the next extension is to be added to a new phone, click **OK**. When the No new phone to add or no sequence number message appears, click **OK**.

n. The sequence number is what creates the ephone-dn (directory number). From a command prompt, look at the router configuration and see how there are two new ephone-dn entries. Each new entry has a number using the sequence number. From the web interface, click on the **Configuration** menu option and select **Phones**. Select one of the IP phone MAC addresses for one that is being used. Click on a button number. If a checkmark is beside one of the sequence numbers, click on the checkbox to remove the checkmark. Click in the checkbox beside one of the new sequence numbers.

o. What sequence number was chosen in the previous step? _____

p. Click on the **Save** link located at the top of the page. Click on the **Change** button located at the bottom of the page. When prompted if the changes are to be saved, click on the **OK** button. A confirmation message appears; click on **OK**.

q. Select the other IP phone MAC address that is being used. Click on a button number. If a checkmark is beside one of the sequence numbers, click on the checkbox to remove the checkmark. Click in the checkbox beside one of the other new sequence number (the one NOT used in the previous step).

r. Click on the **Save** link located at the top of the page. Click on the **Change** button located at the bottom of the page. When prompted if the changes are to be saved, click on the **OK** button. A confirmation message appears; click on **OK**.

s. Verify that the intercom connects in both directions on the IP phones. If the Dialable Intercom does not work in both directions, troubleshoot as necessary.

t. Using the analog phone dial both **XXX0** and **XXXX** (where **X** is the pod number). Note the intercom works even through an analog phone connection.

u. From privileged exec mode, use the command **show running-config | begin tele** command to view the changes.

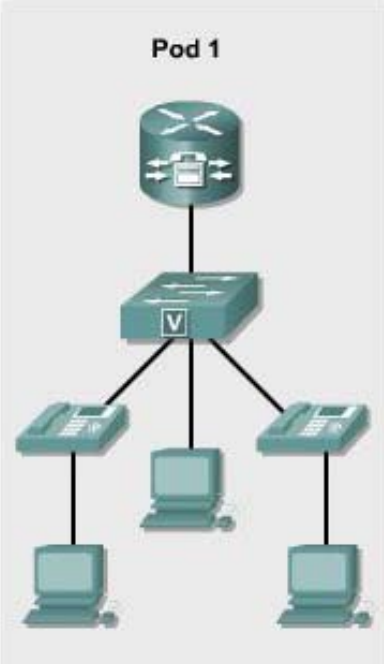
```
CMERouterX# show running-config |begin tele
```

v. What settings changed under the ephone-dn and ephone sections?

_____
_____
_____
_____
_____
_____

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Lab 5.1.9 Configure Paging Groups



Objective

- Set up two paging groups. Each IP phone will be in a different paging group, and both paging groups will belong to yet another paging group.

Equipment Requirements

- Cisco CallManager Express (CME) capable router
- Inline power capable switch or non-inline power switch with power injectors
- Workstation with an Ethernet 10/100 NIC installed
- Two Cisco IP phones
- One analog phone

This lab relies on labs 2.1.1, 2.1.2, 3.1.1, and 4.1.1 being successfully completed and access to IP Telephony Tables 1 and 2.

In this lab the ACME.com Company wishes to configure paging groups that will use the speaker feature of the IP phones. A paging group for the sales staff and a paging group for the technical support staff are required. In addition, when an emergency page is needed, all phones in the sales paging group and all phones in the tech support group should receive the emergency page.

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- Configure one IP phone in the Sales paging group
- Configure the other IP phone in the Technical Support paging group
- Configure the emergency paging group to contain all sales and technical support phones
- Test the paging feature
- Configure all pages to use multicast

Step 1 Configure paging groups

a. Ensure that the two IP phones can call one another and that the analog phone can successfully dial either IP phone. Troubleshoot as necessary before proceeding. It may be necessary to undo the configurations from lab 5.18, or load the configuration from lab 5.1.7, if lab 5.1.8 used up all the available lines into one or both of the IP phones.

b. Use the command **show running-config | begin tele** command to view part of the current configuration. Verify that two IP phones have registered and the MAC addresses used by the two IP phones.

```
CMERouterX# show running-config | begin tele
```

c. What are the MAC addresses of the two IP phones? _____

_____

d. From a workstation connected to an IP phone (that can ping all router IP addresses), access the CME using a Web interface by typing **http://10.X0.0.1/ccme.html** (where ***X*** is the pod number). When prompted for a username and password use **ACMEadmin** and **cisco**.

e. From the Web interface, click on the **Configure** menu option and select **Extensions**.

f. Click on the **Add** link. In the Extension Number textbox, type **X500** (where ***X*** is the pod number). Select an unused sequence number. In the Extension Type dropdown box, select **Paging.** In the Name textbox, type **Sales** and in the Description textbox, type **Sales**. All other settings are left to the default.

g. What sequence number was used? _____ Note that this number will be useful in future steps.

h. Click on the **Add** button. When prompted if the changes are to be saved, click on **OK**. A confirmation message appears. Click **OK**.

i. Using the same procedures, add a second paging extension with an extension number of **X600** (where ***X*** is the pod number), an Extension Type of **Paging**, an unused Sequence Number, a Name and Description of **Support**.

j. What sequence number is used? This information is important for a future step. _____

k. Click on the **Configure** menu option and select **Phones**. Select a MAC address link for one of the IP phones being used. Scroll down to the Paging Information section. In the Paging Extension dropdown box, select **X500** (where ***X*** is the pod number). Select the Unicast **Yes** radio button. Click on the **Change** button. When asked if the change is to be saved, click on the **OK** button. When the confirmation message box appears, click **OK**.

l. Select the other MAC address link for the other IP phone. Set the Paging Extension to **X600** (where ***X*** is the pod number). Select the Unicast **Yes** radio button and save the changes.

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m. The paging function allows you to dial a number and talk to a group of IP phones. In this scenario, the X500 (where X is the pod number) represents Sales, which could be a group of Sales representatives that have IP phones. The other paging function was assigned a number of X600 that represents Support. This could be the IT support staff. A helpdesk call could come in for the mail server and three administrators can manage the mail server. The helpdesk staff can dial one number and page one of the three administrators to pick up on a particular phoneline.

Test the paging function by dialing **X500** (where ***X*** is the pod number) from the analog phone. Also test the paging function with the **X600** number (where ***X*** is the pod number) from the analog phone.

n. Does the paging function work properly? If not, troubleshoot as necessary. _____

Step 2 Configure a combined group

a. Access the router CLI and view the current configuration.

b. Write down all dialer numbers currently in use (ephone-dn).

_____

_____

c. From global configuration mode, type the command **ephone-dn ?**.

d. How many dialer numbers are possible? _____

e. From global configuration mode, type the command **ephone-dn X** (where ***X*** is an unused dialer number) to create a new dialer number.

f. What dialer number was chosen? _____

g. Assign a directory number to the page using the **number X700** command (where ***X*** is the pod number).

```
CMERouterX(config-ephone-dn)# number X700
```

h. Enter the **name EmergencyAll** command to assign a name.

```
CMERouterX(config-ephone-dn)# name EmergencyAll
```

i. The **paging** command is used to specify that this dialer number is used to broadcast audio paging messages to idle IP phones. The **ip** parameter, when used with the **paging** command, specifies that multicasting is used to do the audio paging. The number that follows is the multicast group number. Note that Cisco IP phones do not support multicasting to a multicast address of 224.X.X.X. The **port** parameter followed by a number defines the UDP port number used to communicate the message to the IP phone. The number 2000 is recommended because it is already used for normal non-multicast messaging.

Enter the command **paging ip 239.1.1.1 port 2000**.

```
CMERouterX(config-ephone-dn)# paging ip 239.1.1.1 port 2000
```

j. The **paging group** command allows multiple groups already created to be combined into one group. The group numbers that follow are separated by one or more commas. The group number is the sequence number (ephone-dn - dial numbers) configured through the Web interface earlier in the lab. Refer back to the sequence numbers used earlier in the lab. These will be the **X** and **Y** values used in the command. For example, if sequence numbers 9 and 10 were used previously, the command entered would be paging group 9,10.

```
CMERouterX(config-ephone-dn)# paging group X,Y
```


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k. From the privilege exec mode, use the command **show running-config | begin telephony-service** command to view the changes.

```
CMERouterX# show running-config | begin telephony-service
```

l. What settings changed under the ephone-dn and ephone sections?

_____
_____
_____
_____
_____
_____

m. Use the **copy running-config startup-config** to save the changes.

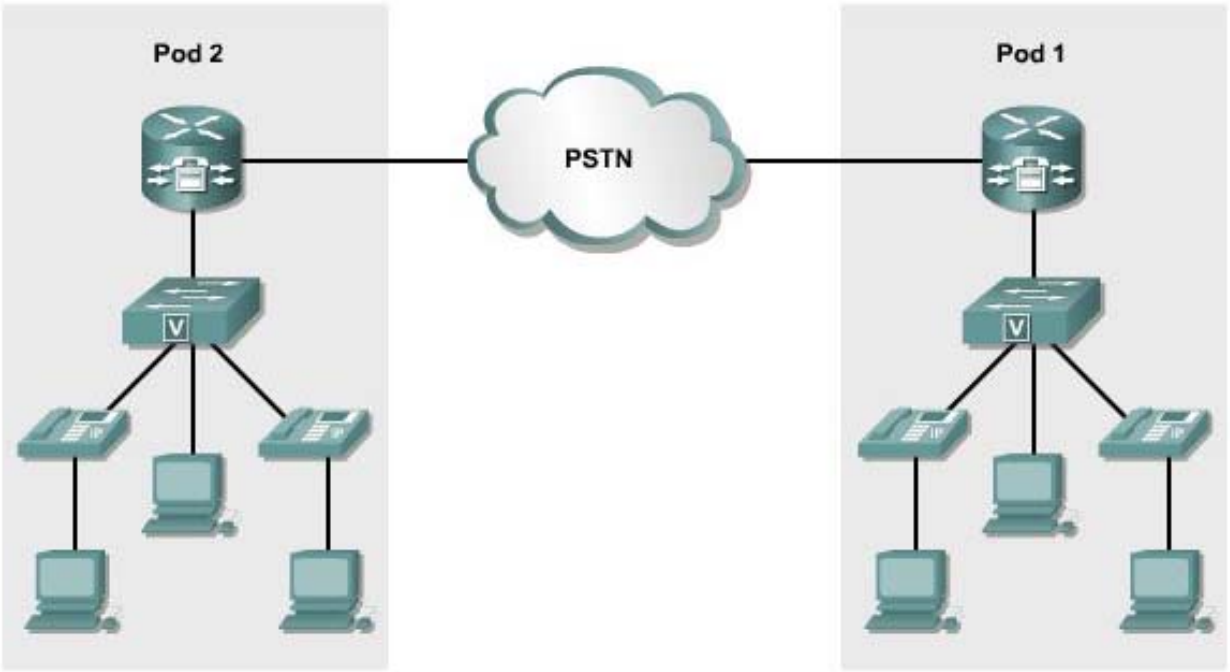
```
CMERouterX# copy running-config startup-config
```

n. Use the analog phone to test the paging function by dialing the **X700** paging number.

o. Does the emergency paging function work from the analog phone? If not, troubleshoot as necessary until it does. _____

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Lab 7.1.1 Configuring AutoQoS



Objective

- Enable the AutoQoS for VoIP feature on workgroup router interfaces

Equipment Requirements

- Two Cisco CallManager Express (CME) capable routers (each with a serial and PRI port configured)
- Two inline power capable switches or non-inline power switches with power injectors
- Adtran
- Two IP phones

This lab relies on labs 2.1.1, 2.1.2, 2.1.4, 3.1.1, 4.1.3, and 4.1.4 being successfully completed and loaded.

In this lab ACME.com wishes to implement AutoQoS for the VoIP network. The network support staffs are not very skilled in QoS, but they do know that Cisco has a command that will implement Cisco's "best guess" for QoS based on the router configuration currently implemented.

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- Configure the command to implement AutoQoS for VoIP
- Examine the results of implementing AutoQoS for VoIP

Step 1 Verify Connectivity and IP Phones

a. This lab requires that two pods be used and both pods are functional. Ensure that an IP phone from one pod can call an IP phone on the other pod.

b. Does the phone call work from one pod to the other? If not, perform appropriate troubleshooting.

_____

c. Have one pod partner slowly count from one to 10 while one or two phone connections are made.

d. How is the voice quality? _____

e. From the lowest numbered pod router, do an extended ping to the other router with a packet size of 1500 bytes. Refer to IP Telephony Table 1 for a list of IP addresses

```
CMERouterX# ping
Protocol [ip]: <Enter>
Target IP address: <ip_address>
Repeat count [5]: 1000
Datagram size [100]: 15000
Timeout in seconds [2]: <Enter>
Extended commands [n]: <Enter>
```

While the ping is occurring, place at least one phone call from one pod to another. Multiple calls can be made. Have one pod partner slowly count from one to 10 while the phone connection is active.

f. How is the voice quality? _____

g. Stop the ping by pressing **CTRL+Shift+6** or wait for the ping to finish.

h. Display and examine the running configuration of the CME router.

Step 2 Configuring AutoQoS on Cisco IOS Routers

a. Set the clock rate on the DCE serial link between the two router pods to **72000**.

```
CMERouterX(config-if)# clock rate 72000
```

b. On both CME routers in dial peer configuration mode, set the codec to the G.711 u-law (pronounced myoo (like the greek leter) law) standard. Codec stands for coder/decoder. The defined codec is the set of rules for converting analog signals to digital and vice versa. The two main types of codecs used are G.711 and G.729. G.711 encodes audio on a 64kbps channel. G.729 encodes audio on a 8kbps channel. G.711 and G.729 come in two different types: a-law and u-law. A-law is used with international circuits and u-law is used with U.S. circuits.

```
CMERouterX(config)# dial-peer voice 6 voip
(CMERouterX(config-dial-peer)# codec g711ulaw
```

c. From the lowest numbered pod router, do an extended ping to the other router with a packet size of 1500 bytes. Refer to IP Telephony Table 1 for a list of IP addresses

```
CMERouterX# ping
Protocol [ip]: <Enter>
```


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```
Target IP address: <ip_address>
Repeat count [5]: 1000
Datagram size [100]: 15000
Timeout in seconds [2]: <Enter>
Extended commands [n]: <Enter>
```

While the ping is occurring, place at least one phone call from one pod to another. Multiple calls can be made. Have one pod partner slowly count from one to 10 while the phone connection is active.

d. How is the voice quality? _____

e. On both CME routers in global configuration mode, enable CEF (Cisco Express Forwarding) on both CME routers.

```
CMERouterX(config)# ip cef
```

f. What is the purpose of CEF? _____

_____

g. On only one of the router pods, enable the AutoQoS for VoIP feature for traffic on the serial interface. Do not configure AutoQoS to trust differential services code point (DSCP) markings. Type the interface **serial slot/*mod/port*** command from global configuration mode to access the serial interface.

```
CMERouterX(config)# interface serial mod/port
CMERouterX(config-if)# auto qos voip
```

h. What happened to the serial link? _____

i. On the pod that does not have QoS enabled yet, enable AutoQoS for VoIP. Note that the module/port number that follows the **serial** parameter may be three digits separated by forward slashes.

```
CMERouterX(config)# interface serial mod/port
CMERouterX(config-if)# auto qos voip
```

j. Display and examine the running configuration and the resulting AutoQoS configuration after enabling AutoQoS. The following is a sample output.

```
class-map match-any AutoQoS-VoIP-Remark
 match ip dscp ef
 match ip dscp cs3
 match ip dscp af31

class-map match-any AutoQoS-VoIP-Control-UnTrust
 match access-group name AutoQoS-VoIP-Control

class-map match-any AutoQoS-VoIP-RTP-UnTrust
 match protocol rtp audio
 match access-group name AutoQoS-VoIP-RTCP
!
```


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```
policy-map AutoQoS-Policy-UnTrust
 class AutoQoS-VoIP-RTP-UnTrust
  priority percent 70
  set dscp ef

 class AutoQoS-VoIP-Control-UnTrust
  bandwidth percent 5
  set dscp af31

 class AutoQoS-VoIP-Remark
  set dscp default

 class class-default
  fair-queue

interface Serial0/1/0
 ip address 10.19.0.2 255.255.255.0
 service-policy output AutoQoS-Policy-UnTrust
 auto qos voip

ip access-list extended AutoQoS-VoIP-Control
 permit tcp any any eq 1720
 permit tcp any any range 11000 11999
 permit udp any any eq 2427
 permit tcp any any eq 2428
 permit tcp any any range 2000 2002
 permit udp any any eq 1719
 permit udp any any eq 5060

ip access-list extended AutoQoS-VoIP-RTCP
 permit udp any any range 16384 32767
```

k. Do another extended ping and test voice quality by counting to ten.

l. How is the voice quality? _____

m. What is at least one disadvantage of AutoQoS for VoIP? _____

_____

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Table 1 IP Telephony Addressing Scheme

Pod	Hostname of Cisco CME router or Switch	IP Address on Ethernet Interface	Type	DHCP Pool Exclusion	IP Network for DHCP Pool	Default Router	Option 150	IP Address on Serial Interface
Pod 1	CMERouter1	10.10.0.1 /24	Data	10.10.0.1-10.10.0.10	10.10.0.0/24	10.10.0.1		10.19.0.1 /24
		10.15.0.1/24	Voice	10.15.0.1-10.15.0.10	10.15.0.0/24	10.15.0.1	10.10.0.1	
		10.1.0.1/24	Mgmt					
	CMESwitch1	10.1.0.4/24	Mgmt			10.1.0.1		
Pod 2	CMERouter2	10.20.0.1 /24	Data	10.20.0.1-10.20.0.10	10.20.0.0/24	10.20.0.1		10.19.0.2 /24
		10.25.0.1/24	Voice	10.25.0.1-10.25.0.10	10.25.0.0/24	10.25.0.1	10.20.0.1	
		10.2.0.1/24	Mgmt					
	CMESwitch2	10.2.0.4/24	Mgmt			10.2.0.1		
Pod 3	CMERouter3	10.30.0.1 /24	Data	10.30.0.1-10.30.0.10	10.30.0.0/24	10.30.0.1		10.39.0.1 /24
		10.35.0.1/24	Voice	10.35.0.1-10.35.0.10	10.35.0.0 24	10.35.0.1	10.30.0.1	
		10.3.0.1/24	Mgmt					
	CMESwitch3	10.30.0.4/24	Mgmt			10.3.0.1		
Pod 4	CMERouter4	10.40.0.1 /24	Data	10.40.0.1-10.40.0.10	10.40.0.0/24	10.40.0.1		10.39.0.2 /24
		10.45.0.1/24	Voice	10.45.0.1-10.45.0.10	10.45.0.0/24	10.45.0.1	10.40.0.1	
		10.4.0.1/24	Mgmt					
	CMESwitch4	10.40.0.4/24	Mgmt			10.4.0.1		

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Table 2 IP Telephony Dial Plan

Pod	Dial Plan – Extension Numbers	Voicemail Extension	First E.164 DID number	Router FXS Port 0	Router FXS Port 1
Pod 1	5000-5029	5555028	5105555000	5555028	5555029
Pod 2	5030-5059	5555058	5105555030	5555058	5555059
Pod 3	5060-5089	5555088	5105555060	5555088	5555089
Pod 4	5100-5129	5555128	5105555100	5555128	5555129
Pod 5	5130-5159	5555158	5105555130	5555158	5555159

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TCP and UDP Port Numbers

This document lists real important TCP/UDP port numbers related to voice QoS.

TCP or UDP	Port Number	Purpose
TCP	2000 to 2002	Skinny (CM Encore)
TCP	11000 to 11999	H.323/H.245 Standard Connect ports
TCP	1720	H.323/H.245 Fast Connect or H.323/H.225 ports
TCP	1719	H.323/H.225
UDP	1719	Gatekeeper RAS
TCP	8001-8002	ICCP (CM Encore)
UDP	2427	MGCP (CM Encore)
TCP	2428	MGCP (CM Encore)
UDP	5060	SIP
TCP	5060	SIP
UDP	16384 to 32767	RTCP

Protocol	Remote Source Port	CallManager Destination Port	CallManager Source Port	Remote Device Destination Port	Remote Devices	Notes
DTC			TCP 135		CallManagers in the same cluster	
SSH		TCP 22			Secure Shell Client	
Telnet		TCP 23			Telnet Client	
DNS		UDP 53			DNS Servers	
DHCP	UDP 68	UDP 67			DHCP Server	
DHCP			UDP 68	UDP 67	DHCP Client	
TFTP		UDP 69				Dynamic Ports used after initial connect
HTTP		TCP 80			Administrator / User Web browsers	CCMAdmin and CCMUser pages

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Protocol	Remote Source Port	CallManager Destination Port	CallManager Source Port	Remote Device Destination Port	Remote Devices	Notes
OSI (DAP, DSP, DISP)		TCP or UDP 120			DCD Directory	
NTP		UDP 123				
WINS		UDP 137-139			WINS Server	Windows Internet Name Service
SNMP		UDP 161				
SNMP Trap				UDP 162		
LDAP		TCP 389		TCP 389	Directory Services	When integrated with Corporate Directory
HTTPS / SSL		TCP 443				
SMB		TCP 445		TCP 445	CallManagers in the same cluster	
Syslog		TCP 514		UDP 514	Syslog service	
RMI		TCP 1099-1129			RMI Service. Attendant Console	
MS SQL		TCP 1433		TCP 1433	CallManagers in the same cluster	
H.323 RAS				UDP 1719	Gatekeeper RAS	CallManager prior to 3.3. Cisco Conference Connection
H.323 RAS			UDP 1024-4999	UDP 1719	Gatekeeper RAS	CallManager 3.3
H.323 H.225		TCP 1720		TCP 1720	H.323 Gateways / Anonymous Device Cisco Conference Connection / Non-Gatekeeper Controlled H.323 Trunk	
H.323 H.225/ICT		TCP 1024-4999			CallManager Gatekeeper Controlled H.323 Trunks	CallManager 3.3
H.323 H.245		TCP 1024-4999	TCP 1024-4999		CallManager H.323 Gateways / Anonymous Device / H.323 Trunks	

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Protocol	Remote Source Port	CallManager Destination Port	CallManager Source Port	Remote Device Destination Port	Remote Devices	Notes
H.323 H.245		TCP 11000-65535			IOS H.323 Gateways. Cisco Conference Connection	
SCCP		TCP 2000			Skinny Clients (IP Phones)	
Skinny Gateway (Analogue)		TCP 2001			Analogue Skinny Gateway	Obsolete
Skinny Gateway (Digital)		TCP 2002			Digital Skinny Gateway	Obsolete
MGCP Control		UDP 2427			MGCP Gateway Control	
MGCP Backhaul		TCP 2428			MGCP Gateways Backhaul	
RTS Serv			2500			
Cisco Extended Service		TCP 2551			Active / Backup Determination	
Cisco Extended Service		TCP 2552			DB Change Notification	
RIS Data Collector		TCP 2555			Inter RIS communication	
RIS Data Collector		TCP 2556			Used by clients (IIS) to communicate with RIS	
CTI/QBE		TCP 2748			TAPI/JTAPI Applications	Connects with CTI Manager. Used by IVR, CCC, PA, Cisco Softphone, CRS, ICD, IPCC, IPMA, Attendant Console and any other application that utilizes the TAPI or J/TAPI plugin / TSP.
IPMA Service		TCP 2912			IPMA Assistant Console	
Media Streaming Application		UDP 3001			Change Notification	

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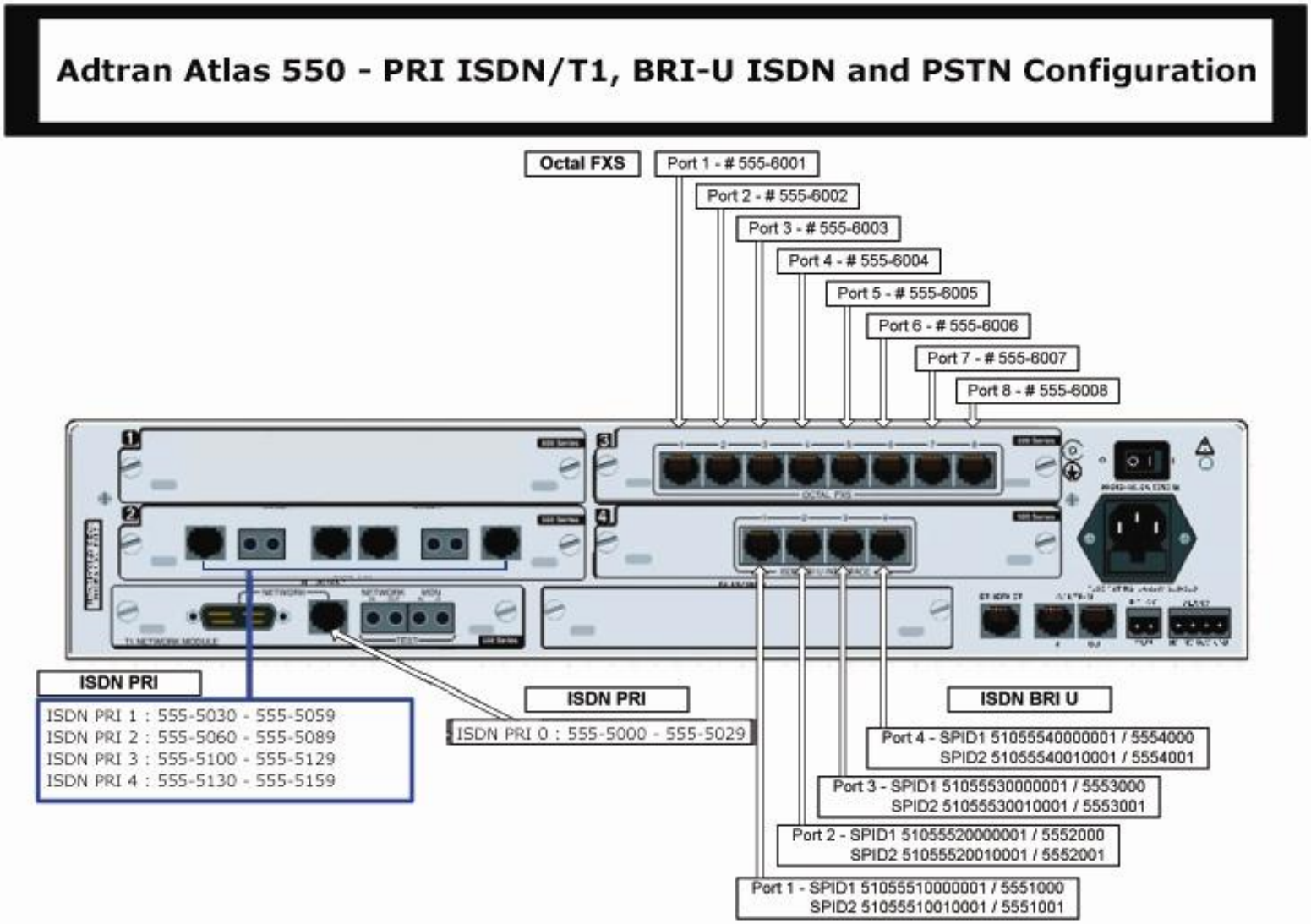
Protocol	Remote Source Port	CallManager Destination Port	CallManager Source Port	Remote Device Destination Port	Remote Devices	Notes
SCCP		TCP 3224			Media Resources	Conference Bridges / Xcoders
MS Terminal Services		TCP 3389			Windows Terminal Services	
Entercept HID Agent				TCP 5000	Host Intrusion Detection Console	
CallManager SIP		TCP/UDP 5060		TCP 5060	SIP Trunk Default Port	Can use TCP 1024 - 65535
VNC http helper		TCP 580x				Remote Control
VNC Display		TCP 690x			Virtual Network Computer Display	Remote Control
CallManager Change Notification		TCP 7727			CallManager Change Notification. Cisco database layer monitor, Cisco TFTP, Cisco IP media streaming, Cisco TCD, Cisco MOH	RealTime Change Notification
IPMA Service		TCP 8001			IP Manager Assistant	Change Notification
ICCS		TCP 8002		TCP 8002	CallManagers in the same cluster	Intra Cluster Communication
CTIM		TCP 8003				
Cisco Tomcat		TCP 8007			Web Requests	
Cisco Tomcat		TCP 8009			Web Requests	
Cisco Tomcat		TCP 8111			IIS, Web Requests to IPMA worker thread	
Cisco Tomcat		TCP 8222			IIS, Web Requests to EM application worker thread	
Cisco Tomcat		TCP 8333			IIS, Web Requests to WebDialer application worker thread	

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Protocol	Remote Source Port	CallManager Destination Port	CallManager Source Port	Remote Device Destination Port	Remote Devices	Notes
DC Directory		TCP 8404			Embedded Directory Services	Used for Directory services. Application Authentication / configuration. SoftPhone Directory. User Directory
Cisco Tomcat		TCP 8444			IIS, Web Requests to EM Service worker thread	
Cisco Tomcat		TCP 8555			IIS, Web Requests to Apache SOAP worker thread	
Cisco Tomcat		TCP 8998			Web Requests	
Cisco Tomcat		TCP 9007			IIS, Web Requests to CAR worker thread	
RTP	UDP 16384-32767			UDP 16384-32767	Voice Media	IP IVR Media. CCC IVR Media, Cisco SoftPhone, Media Streaming Application
Cisco SNMP Trap Agent		UDP 61441			Cisco Alarm Interface	Receives some SNMP alarm in XML format.

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