

# Cisco CME Network Parameters

## Auxiliary VLANs

This topic describes auxiliary VLANs.

### Auxiliary VLANs

- **Prevent unnecessary IP address renumbering**
- **Simplifies Quality of Service (QoS) configurations**
- **Separates Voice and Data traffic**
- **Requires two Virtual Local Area Networks (VLANs) one for Data and one for Voice**
- **Requires only one drop down Ethernet for the CallManager Express IP phone and the PC plugged into the phone**

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Cisco IP phones can act as a three-port switch. Just like a switch they can support trunking between themselves and another switch. This allows for the existence of more than one VLAN to be supported between the IP phone and the access switch that it is plugged into.

The three ports of the IP phone are the port that connects to the 10/10 Ethernet switch, the 10/100 Ethernet port that a PC can be plugged into, and an internal port where voice traffic is originated and terminated. The 10/100 Ethernet port which attaches to a switch, supports the 802.1Q trunking protocol. This allows for the existence of two VLANs arriving at the phone, one for the voice traffic and the other for the PC data traffic. The VLAN that the voice traffic goes across is called the auxiliary VLAN or the voice VLAN.

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**Note** Inter Switch Link (ISL) trunking is not supported on the Cisco IP phone.

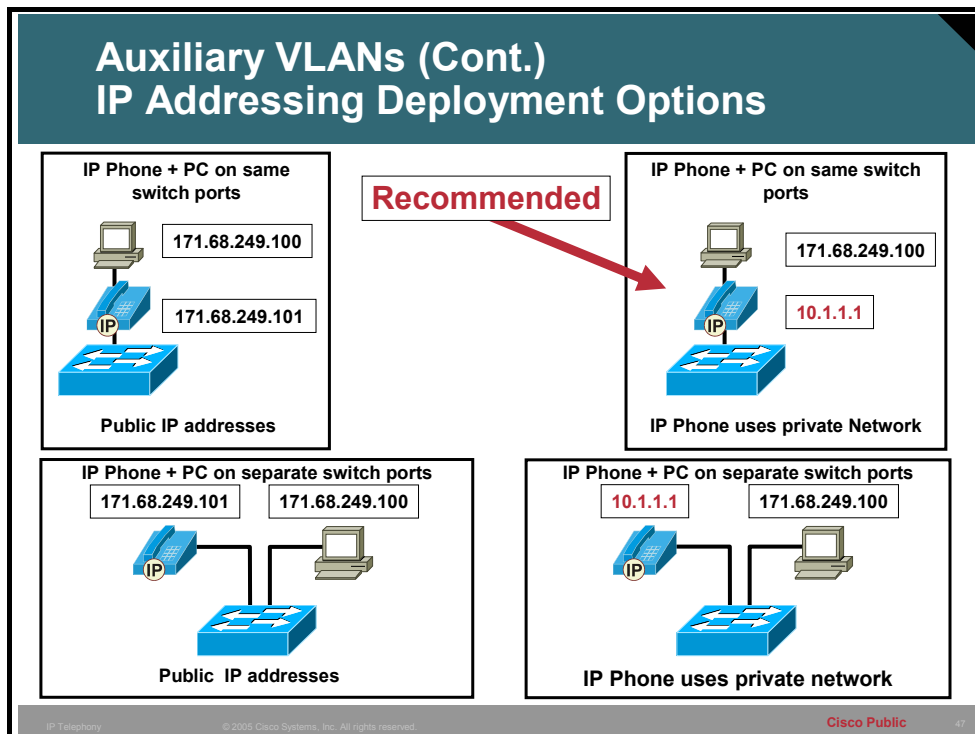
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The benefits of this type of configuration include the following:

- This solution allows the deployment of IP phones onto the network without scalability problems from an addressing perspective. IP subnets usually have more than 50 percent (often more than 80 percent) of their IP addresses allocated. A separate VLAN (separate IP subnet) to carry the voice traffic allows an introduction of a large number of new devices,

such as IP phones, in the network without extensive modifications to the IP addressing scheme.

- This solution allows the logical separation of data and voice traffic that have different characteristics. This separation allows the network to individually handle each of these traffic types and apply differing Quality of Service (QoS) policies.
- The data and voice traffic are separated and can be monitored and managed separately.
- This solution allows you to connect two devices to the switch using only one physical port and one Ethernet cable between the wiring closet and the IP Phone and /or PC location.



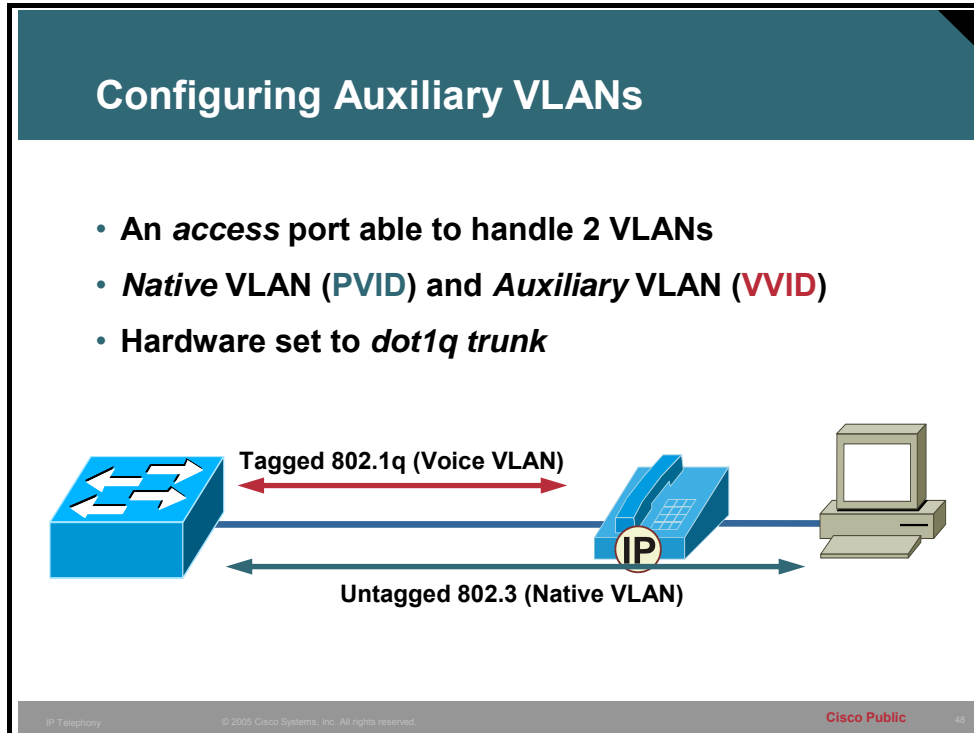
Cisco IP Phones require network IP addresses. Cisco makes the following recommendations for IP addressing deployment:

- Continue to use existing addressing for data devices (PCs, workstations, and so forth).
- Add IP Phones with Dynamic Host Configuration Protocol (DHCP) as the mechanism for obtaining addresses.
- Use subnets for IP Phones if they are available in the existing address space.
- Use private addressing (network 10 or network 172.16 – 172.20) if subnets are not available in existing address space.

LANs and private IP WANs will carry these routes between both of the address spaces. The WAN gateway to the Internet should block private addresses, which data devices currently block.

# Configuring Auxiliary VLANs

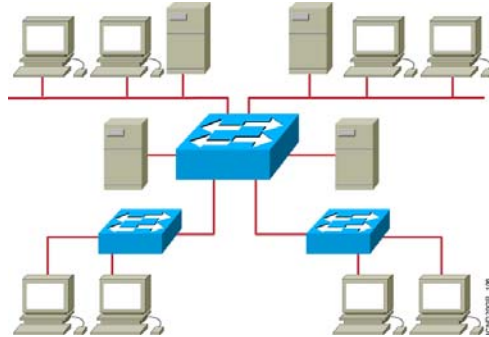
This topic describes how to configure auxiliary VLANs on the Catalyst 3550 and EtherSwitch Network Modules.



All data devices typically reside on data VLANs in the traditional switched scenario. You may need a separate voice VLAN when you combine the voice network into the data network. The Catalyst software command-line interface (CLI) refers to this new voice VLAN as the auxiliary VLAN for configuration purposes. You can use the new auxiliary VLAN to represent other types of devices. Currently, the device is an IP phone, so you can think of it as a voice VLAN. In the future, other types of non-data devices will reside in the auxiliary VLAN.

These non-data devices (such as IP phones) should reside in a separate VLAN (auxiliary VLAN), which will make it easier for customers to automate the process of deploying IP Phones. IP Phones will boot up and reside in the auxiliary VLAN if you configure the switch to support them; just as data devices come up and reside in the native VLAN (also referred to as the default VLAN) of the switch. The IP phone communicates with the switch via Cisco Discovery Protocol (CDP) when it powers up. The switch will provide the telephone with the appropriate VLAN ID, known as the Voice VLAN ID (VVID). This VVID is analogous to the data VLAN ID, known as Port VLAN ID (PVID).

## Configuring Auxiliary VLANs - Switching Review



- **Address learning**
- **Forward/filter decision**
- **Loop avoidance**

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A layer 2 switch provides layer 2 services and intelligence. Address learning is performed by the Ethernet switch and allows the switch to listen on ports for source MAC addresses and build a table that will be stored in RAM. These addresses that have been learned will be used to forward unicast frames to the appropriate port based on the destination MAC address. This allows the switch to make more efficient use of bandwidth by only forwarding frames out the port where the destination MAC address resides. Broadcasts are sent out all ports in the same VLAN except the port on which it was received.

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**Note** Unknown MAC addresses will be treated like broadcasts and forwarded to all ports in the same VLAN.

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In the layer 2 Ethernet header there is no loop avoidance mechanism and, as a result, the switch will have to perform this function. The protocol that is used for loop avoidance is called Spanning Tree Protocol (STP). This protocol only runs on layer 2 switches and, in most deployments, should be considered mandatory. The Spanning Tree Protocol can take a significant amount of time to converge or re-converge when there is a topology change. This re-convergence time can be minimized on ports where IP phones, PCs, or servers reside through the use of portfast. Portfast can take a convergence time of 30 seconds and reduce it down to 1-2 seconds.

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**Caution** Using portfast on interfaces that connect to other switches can result in temporary layer 2 loops.

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## Configuring Auxiliary VLANs (Cont.)

### Example 3550 switch or EtherSwitch Network Module

```
Console(config)#interface FastEthernet0/1
Console(config-if)#switchport trunk encapsulation dot1q
Console(config-if)#switchport trunk native vlan 1
Console(config-if)#switchport access vlan 12
Console(config-if)#switchport mode trunk
Console(config-if)#switchport voice vlan 112
Console(config-if)#spanning-tree portfast
```

- 802.1q trunking is enabled on the port
- The access VLAN is used for the PC plugged into the IP phone
- The voice VLAN is used for voice and signaling that originates and terminates on the IP phone
- Spanning tree portfast enables the port to initialize quickly

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To configure the trunk on a physical interface between the access switch port and the IP phone, an 802.1Q trunk needs to be created. In addition the native or untagged VLAN will need to be defined as well as the auxiliary or voice VLAN.

The example above shows the configuration of a 3550 or an EtherSwitch network module.

## Configuring Auxiliary VLANs (Cont.)

```
Switch# show interface fa0/17 switchport

Name: Fa0/17
Switchport: Enabled
Administrative mode: trunk
Operational Mode: trunk
Administrative Trunking Encapsulation: dot1q
Operational Trunking Encapsulation: dot1q

Negotiation of Trunking: Disabled
Access Mode VLAN: 0 ((Inactive))
Trunking Native Mode VLAN: 12 (VLAN0012)
Trunking VLANs Enabled: ALL
Trunking VLANs Active: 1-3,5,10,12
Pruning VLANs Enabled: 2-1001

Priority for untagged frames: 0
Override vlan tag priority: FALSE
Voice VLAN: 112
Appliance trust: none
```

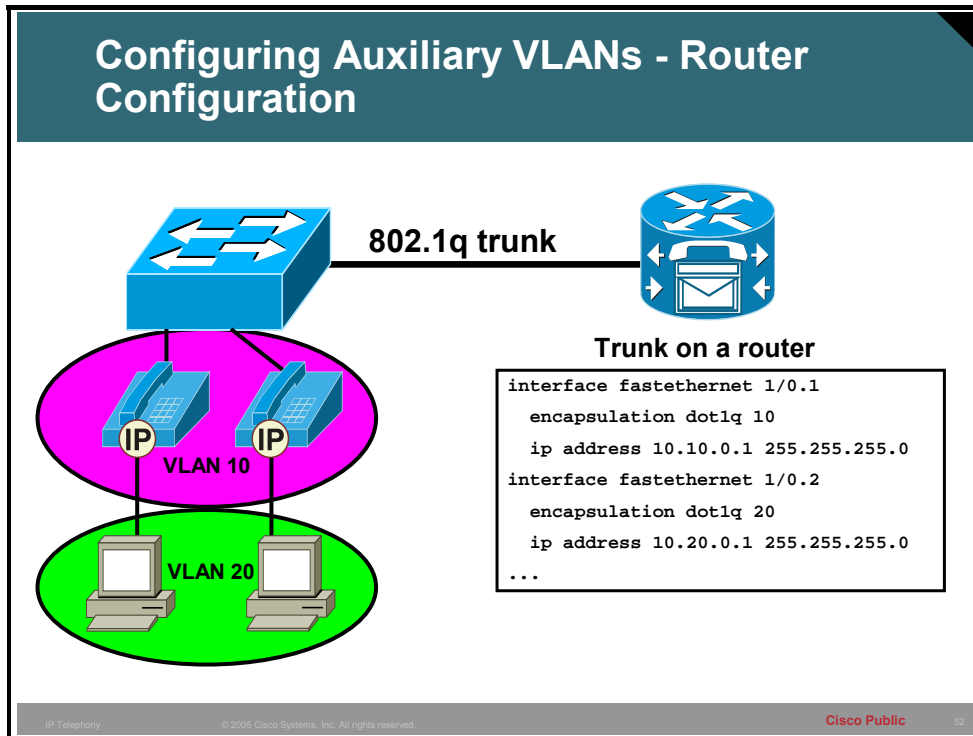
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You can verify your voice VLAN configuration on the Catalyst switch by using the **show interface <mod/port> switchport** command.



Routing between the different VLANs requires a layer 3 router. The router will need to have an interface local to all of the VLANs to which it will route. The most efficient way to get multiple VLANs to the router is by connecting a trunk between the switch and the router. This configuration is known as “router on a stick”.

The router will have one sub-interface local to each VLAN and only one VLAN can be assigned to that sub-interface.

# DHCP Service Setup

This topic identifies the DHCP service options.

## DHCP Service Setup

### Dynamic Host Configuration Protocol

- **Assigns an IP addresses and subnet masks for one or more subnets**
- **Optionally can assign a default gateway**
- **Optionally can assign DNS servers**
- **Optionally can assign other commonly used servers**
- **The DHCP scope can be customized to assign a TFTP server to IP phones**
- **Best practice is to configure a DHCP scope for the IP phones**

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DHCP is a very common and familiar protocol to many network administrators. A scope will be defined per subnet and is used to hand out IP addresses from a pool of available addresses, along with a subnet mask. Optionally, other values like the default gateway and DNS can be assigned to the scope by setting option values if desired. For example, the default gateway option is “003” and DNS is “006.”

These option values can include values specific to an implementation and can be customized by the administrator. Cisco phones look for an option 150 from their DHCP server, which will contain the IP address of the TFTP server where the IP phones configuration file will reside. The administrator will need to configure an option 150 with the IP address of the TFTP server, which is the Cisco CME router in the case of Cisco CME.

DHCP can be deployed on any platform that supports customized scope options. This includes Windows, Linux, Novell, UNIX and others operating systems.

## DHCP Service Setup (Cont.)

### DHCP Service Options

- **Single DHCP IP Address Pool**
- **Separate DHCP IP Address Pool for Each Cisco IP Phone**
- **DHCP Relay Server**

You can set up DHCP service for IP Phones by defining a single DHCP IP address pool, defining a separate pool for each Cisco IP Phone, or defining a DHCP relay server.

**Single DHCP IP Address Pool:** Define a single DHCP IP address pool if the Cisco CME router is a DHCP server and if you can use a single shared address pool for all your DHCP clients.

**Separate DHCP IP Address Pool for Each Cisco IP Phone:** Define a separate pool for each Cisco IP Phone if the Cisco CME router is a DHCP server and you need different settings on non-IP phones on the same subnet.

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**Note** This option should be avoided if possible because it adds configuration complexity.

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**DHCP Relay Server:** Define a DHCP relay server if the Cisco CME router is not a DHCP server and you want to relay DHCP requests from IP Phones to a DHCP server on a different subnet.



## DHCP Service Setup (Cont.): Phone Bootup

The IP phone powers on

The phone performs a Power on Self Test (POST)

The phone boots up

Through CDP the IP phone learns what the auxiliary VLAN is

The phone initializes the IP stack

On the Cisco CME router a DHCP Scope can be configured. The scope should define the following:

- Range of available IP addresses
- The subnet mask
- A default gateway
- The address of the TFTP server
- DNS server(s)

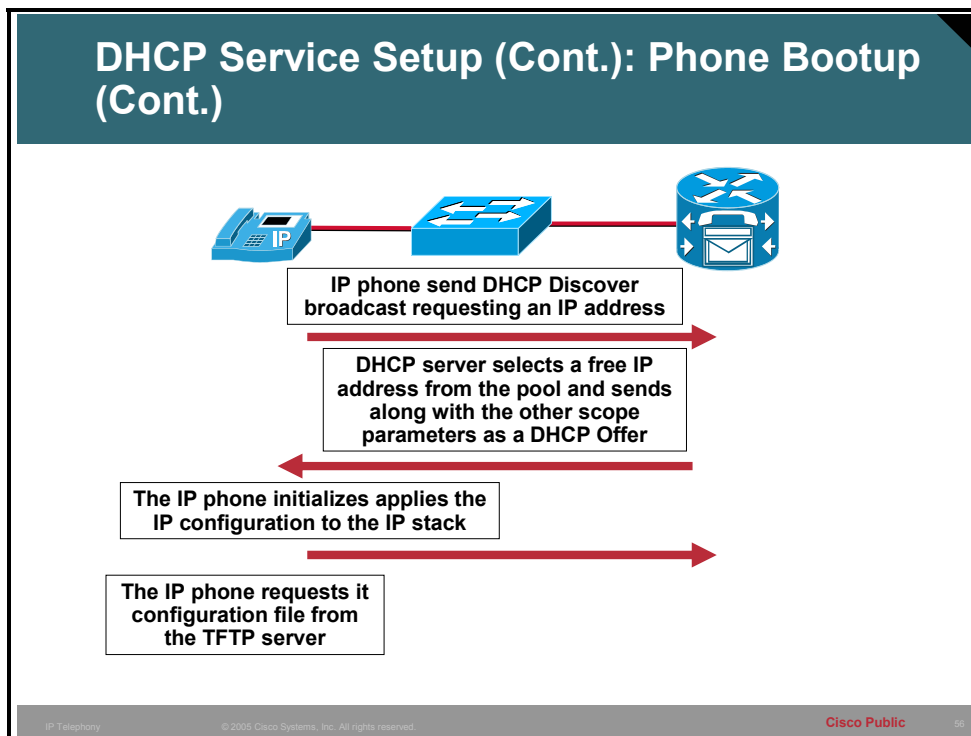


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When an IP phone first receives power, the following steps happen:

- **Receives power** - The IP phone receives power
- **POST** - The phone will perform some basic tests called a Power On Self Test (POST).
- **Boot** - The IP phone will then bootstrap
- **Discover the Voice VLAN** - Learn which VLAN is the voice VLAN through the layer 2 Cisco Discovery Protocol (CDP).
- **Initialize the IP stack** - The IP phone will then initialize a basic IP stack.

## DHCP Service Setup (Cont.): Phone Bootup (Cont.)



The process of a phone booting up continues with the following:

- **Send DHCP Discover** – By default, the IP phone (DHCP client) will then send a DHCP request to the 255.255.255.255 broadcast address
- **DHCP server assigns an IP address** – If this broadcast is heard by a local DHCP server, the server will assign a free IP address, the subnet mask for the scope, the default gateway for the scope, the DNS server (optional) for the scope, and a TFTP server (option 150) for the scope
- **DHCP Offer** –The Scope setting will be sent to the DHCP client (the IP phone) using the broadcast address of 255.255.255.255
- **IP phone initialized DHCP settings** – The IP phone will take the values received from the DHCP response and apply them to the IP stack of the IP phone
- **Request configuration from TFTP server** – The IP phone will use the value received in option 150 to attempt to get a configuration file from the TFTP server (Cisco CME router is always the TFTP server in Cisco CME)

## DHCP Service Setup (Cont.)

```
CMERouter(config)#
```

```
ip dhcp excluded-address start-IP end-IP
```

- Sets a range of addresses to be excluded from the configured scopes

```
CMERouter(config)#
```

```
ip dhcp pool pool-name
```

- Creates and enters a the DHCP scope mode

```
CMERouter(dhcp-config)#
```

```
network subnet subnet-mask
```

- Defines the range of addresses that will be used to assign to DHCP clients

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These commands are not needed for the IP phones if the automated setup is used because the setup will prompt for these setting and configure a DHCP scope automatically. However, if it is not configured or the administrator wishes to manually configure or change the settings the following commands will need to be used.

The command **ip dhcp exclude-address *start-IP end-IP*** allows the administrator to exclude static addresses within the scope range that might be statically assigned to a server or router interface. For Cisco CME the exclusions should include the IP address of the routers interface that may be local to the IP phones.

The command **ip dhcp pool *pool-name*** defines and creates a DHCP pool. After this command has been executed, the router will be in a DHCP sub mode. The automated setup mode will create a DHCP pool named ITS (the old name of the Cisco CME product).

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**Note**      The pool name is case-sensitive.

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Within the DHCP sub mode under a pool, enter the **network *subnet subnet-mask*** command to assign a range of IP addresses to be available for DHCP clients to be assigned. This will not include any exclusion previously defined. The lowest available IP address will be used first when the addresses are assigned. In Cisco CME, this will be the subnet on which the IP phones are.

## DHCP Service Setup (Cont.)

```
CMERouter(dhcp-config)#
```

```
option option-number ip IP-address
```

- Defines a custom option and its value

```
CMERouter(dhcp-config)#
```

```
default-router IP-address
```

- Sets the default gateway that will handed out to the DHCP clients

```
CMERouter(dhcp-config)#
```

```
dns-server primary-IP [secondary IP]
```

- Sets the DNS server(s) that will assigned to the DHCP clients

The command **default-router *IP-address*** will set option 003 on the DHCP scope that is being defined. This option will send the IP address of the default gateway to the DHCP client. The default gateway for Cisco CME will be the router interface that is on the same subnet as the IP phones.

The optional command **dns-server *primary-IP secondary-IP*** allows the DNS server to be sent in option 006 to the DHCP clients. For Cisco CME, this setting becomes important if names will be used for any of the URL values that can be assigned. Lack of a DNS server has the effect of requiring use of IP addresses only.

Finally, a critical command that must be configured correctly is the custom option for the TFTP server. This is configured using the command **option 150 ip *CallManagerExpress-IP***. This IP address must be the IP address on the Cisco CME router with which the IP phones register.

## DHCP Service Setup (Cont.)

### Configuring DHCP on an IOS router

```
CMERouter(config)#ip dhcp excluded-address 10.90.0.1 10.90.0.10
CMERouter(config)#ip dhcp pool mypool
CMERouter(dhcp-config)#network 10.90.0.0 255.255.255.0
CMERouter(dhcp-config)#option 150 ip 10.90.0.1
CMERouter(dhcp-config)#default-router 10.90.0.1
CMERouter(dhcp-config)#dns-server 10.100.0.1 10.100.0.2
CMERouter(dhcp-config)#exit
```

- Option 150 sets the TFTP server on the IP phone
- The TFTP server contains the configuration files and firmware for the IP phone

This is a sample configuration in which the DHCP server is the Cisco CME router. This shows the command **option 150 ip 10.90.0.1**, where 10.90.0.1 is the IP address of a local interface on the Cisco CME router.