



CCNP ONT Portable Command Guide

All the ONT 642-845 commands in
one compact, portable resource

CCNP ONT Portable Command Guide

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Warning and Disclaimer

This book is designed to provide information about the Cisco Certified Network Professional (CCNP) 642-845 Optimizing Converged Cisco Networks (ONT) exam and the commands needed at this level of network administration. Every effort has been made to make this book as complete and as accurate as possible, but no warranty or fitness is implied.

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Introduction

Welcome to ONT! In 2006, Cisco Press came to me and told me, albeit very quietly, that there was going to be a major revision of the CCNP certification exams. Then they asked whether I would be interested in working on a command guide in the same fashion as my previous books for Cisco Press: the Cisco Networking Academy Program *CCNA Command Quick Reference* and the *CCNA Portable Command Guide*. The original idea was to create a single-volume command summary for all four of the new CCNP exams. However, early on in my research I quickly discovered that there was far too much information in the four exams to create a single volume; that would have resulted in a book that was neither portable nor quick as a reference. So when I jokingly suggested that they let me author four books—one for each exam—who would have expected Cisco Press to agree? Well, you have to be careful for what you wish for, as Cisco Press readily agreed. Realizing that this was going to be too much for one part-time author to handle, I quickly got my colleague Hans Roth on board as a co-author.

This book is the fourth and final volume in a four-volume set that attempts to summarize the commands and concepts that you need to know in order to pass one of the CCNP certification exams—in this case, the *Optimizing Converged Cisco Networks (ONT)* exam. It follows the format of my previous books, which are in fact a cleaned-up version of my own personal engineering journals—a small notebook that can be carried around and that contains little nuggets of information—commands that you forget, the IP addressing scheme of some remote part of the network, and little reminders about how to do something you only have to do once or twice a year, but that is vital to the integrity and maintenance of your network.

With the creation of two brand-new CCNP exams, the amount of new information out there is growing on an almost daily basis. There is always a new white paper to read, a new Webinar to view, another slideshow from a Networkers session that was never attended. The engineering journal can be that central repository of information that won't weigh you down as you carry it from the office or cubicle to the server and infrastructure room in some branch office.

To make this guide a more realistic one for you to use, the folks at Cisco Press have decided to continue with an appendix of blank pages—pages that are for you to put your own personal touches—your own configs, commands that are not in this book but are needed in your world, and so on. That way this book will hopefully look less like the authors' journals, but more like your own.

Networking Devices Used in the Preparation of This Book

To verify the commands that are in this book, many different devices were used. The following is a list of the equipment used in the writing of this book:

- C2620 router running Cisco IOS Software Release 12.3(7)T, with a fixed Fast Ethernet interface, a WIC-2A/S serial interface card, and an NM-1E Ethernet interface
- C2811 ISR bundle with PVDM2, CMME, a WIC-2T, FXS and FXO VICs, running 12.4(3g) IOS
- C2821 ISR Bundle with HWICD 9ESW, a WIC-2A/S, running 12.4(16) Advanced Security IOS
- WS-C3560-24-EMI Catalyst switch, running 12.2(25)SE IOS
- WS-C3550-24-EMI Catalyst switch, running 12.1(9)EA1c IOS
- WS-C2960-24TT-L Catalyst switch, running 12.2(25)SE IOS
- WS-C2950-12 Catalyst switch, running version C2950-C3.0(5.3)WC(1) Enterprise Edition software
- C1760 1FE VE 4SLOT DV Mainboard Port adapter with PVDM2, CMME, WIC-2A/S, WIC-4ESW, MOD1700-VPN with 32F/128D running c1700-bk9no3r2sy7-mz.124-15.T1
- C1751 1FE VE DV Mainboard with WIC-4ESW, MOD1700-VPN with 16F/64D running c1700-advsecurityk9-mz.124-5a
- Cisco 3640 with 32F/128DRAM memory, 3 Ethernet interfaces, 2-WIC-1T running c3640-jk9o3s-mz.124-12a
- Cisco 4402 Wireless LAN Controller
- Cisco 1131 LWAP
- Cisco Wireless Control System, version 4.2.62.0 running on a Microsoft Windows Server 2003 Enterprise Edition

These devices were not running the latest and greatest versions of IOS. Some of it is quite old.

Those of you familiar with Cisco devices will recognize that a majority of these commands work across the entire range of the Cisco product line. These commands are not limited to the platforms and IOS versions listed. In fact, these devices are in most cases adequate for someone to continue their studies beyond the CCNP level as well.

Who Should Read This Book

This book is for those people preparing for the CCNP ONT exam, whether through self study, on-the-job training and practice, study within the Cisco Academy Program, or study through the use of a Cisco Training Partner. It also includes some handy hints and tips along the way to hopefully make life a bit easier for you in this endeavor. The book is small enough that you will find it easy to carry around with you. Big heavy textbooks might look impressive on your bookshelf in your office, but can you really carry them all around with you when you are working in some server room or equipment closet somewhere?

Organization of This Book

This book follows the list of objectives for the CCNP ONT exam:

- Chapter 1, “Network Design Requirements,” offers an overview of the two different design models from Cisco: the Service-Oriented Network Architecture and the Enterprise Composite Network Model.
- Chapter 2, “Cisco VoIP Implementations,” describes how to set up Cisco Unified Communications Manager Express (CME) using the CLI, how to use the CLI for CME auto-configuration, how to install IP Communicator, and how to change codecs using the CLI.
- Chapter 3, “Introduction to IP QoS,” describes how to configure QoS through the CLI, using Modular QoS CLI (MQC) for implementing QoS, implementing QoS using AutoQoS, and implementing and monitoring QoS using Cisco Security Device Manager (SDM).
- Chapter 4, “Implementing DiffServ,” describes how to use Network-Based Application Recognition (NBAR) for classification, configuring Priority Queuing (PQ), configuring Custom Queuing (CQ), configuring Weighted Fair Queuing (WFQ), configuring Class-based Weighted Fair Queuing (CBWFQ), configuring Low Latency Queuing (LLQ), configuring LLQ with Class-Based Weighted Random Early Detection (CBWRED), configuring traffic policing and shaping, and implementing QoS preclassify.
- Chapter 5, “AutoQoS,” includes topics such as the phases of AutoQoS, locations where AutoQoS can be implemented, router considerations and prerequisites, and deploying AutoQoS on both routers and IOS-based Catalyst switches.
- Chapter 6, “Wireless Scalability,” includes topics such as configuring wireless LAN QoS using the CLI, configuring encryption and authentication on lightweight access points, and working with Cisco wireless control systems.

Did We Miss Anything?

As educators, we are always interested to hear how our students, and now readers of our books, do on both vendor exams and future studies. If you would like to contact either of us and let us know how this book helped you in your certification goals, please do so. Did we miss anything? Let us know. Contact us at ccnpguide@empson.ca.



CHAPTER 2

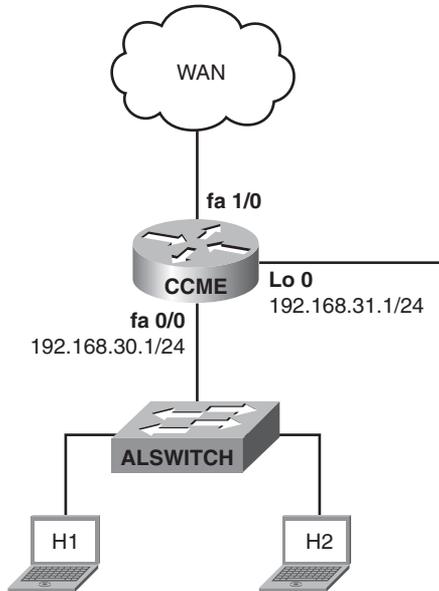
Cisco VoIP Implementations

This chapter provides information and commands concerning the following topics:

- Cisco Unified Communications Manager Express (CME) Files
 - Moving Cisco Unified CME Files to the Router Flash
- Basic Manual CME Setup Using the CLI
 - Enabling Calls in the CME VoIP Network
 - Configuring DHCP for the VoIP Phones
 - Defining a DHCP Relay
 - Enabling Network Time Protocol
 - Creating Directory Numbers
 - Creating Phones
- CME Auto Configuration Using the CLI
- Installing IP Communicator
- Changing Codecs Using the CLI
- Router Configuration

Figure 2-1 shows the network diagram to be used as a reference for the topics covered in this chapter. The complete router configuration and the contents of the router's flash memory is given at the end of this chapter.

Figure 2-1 Cisco Unified Communications Manager Express Sample Design



Cisco Unified Communications Manager Express (CME) Files

Cisco Unified Communications Manager Express is an IOS VoIP solution based on Cisco Integrated Services Routers. There are specific Cisco Unified CME files for each Cisco Unified CME IOS. A tar archive or zip file contains the files needed for Cisco Unified CME. Be sure to download the correct version for your hardware platform and IOS load. This tar archive or zip file typically contains the phone firmware files that you require. Check equipment and IOS compatibilities in “Cisco Unified Communication Manager Express 4.x Supported Firmware, Platforms, Memory, and Voice Products” found in the “Install and Upgrades” section of the Cisco Unified Communications Manager Express support pages at cisco.com.

The tar file does not need to be opened. The router will untar and copy the contents to the router flash maintaining the directory structure specified in the tar file.

Moving Cisco Unified CME Files to the Router Flash

<pre>Router# archive tar /xtract tftp:// ip-address/tar-filename flash:</pre>	<p>Uncompresses and copies each file to router flash memory.</p>
	<p>NOTE: Unzip the files to the TFTP server before copying to router flash.</p>

Router# copy tftp://ip-address/ filename flash:	Copies each file to router flash memory.
Router(config)# tftp-server flash:P0xxxxxxxxx.bin	Permits TFTP access to the specified file by the IP phones.
	NOTE: Each individual Cisco CME phone firmware file requires a separate tftp-server command. SCCP firmware is designated by P003xxyy.bin and SIP firmware by P0S3xxyy.bin.

Basic Manual CME Setup Using the CLI

Router(config)# telephony-service	Enters telephony-service configuration mode.
Router(config-telephony-service)# max-ephones 24	Sets the maximum number of supported IP phones.
Router(config-telephony-service)# max-dn 48	Sets the maximum number of extensions.
	NOTE: The maximum number of phones and extensions is platform and IOS version dependent.
Router(config-telephony-service)# load 79xx P0xxxxxxxxx	Identifies the Cisco IP phone firmware file to be used by specific Cisco IP phones when they register.
Router(config-telephony-service)# ip source-address 192.168.31.1	Identifies the IP address and port number for IP phone registration.
	NOTE: The default port is 2000.
Router(config-telephony-service)# create cnf-files	Builds the XML configuration files required for Cisco CME phones.
Router(config-telephony-service)# reset sequence-all	Resets all phones one at a time.
Router(config-telephony-service)# exit	Returns to global configuration mode.

Enabling Calls in the CME VoIP Network

Router> enable	Enables privileged EXEC mode. Enter your password if prompted.
Router# configure terminal	Enters global configuration mode.
Router(config)# voice service voip	Enters voice service configuration mode and specifies Voice over IP (VoIP) encapsulation.
Router(config-voi-srv)# allow-connections h323 to h323	Enables calls between specific types of endpoints in a VoIP network.
Router(config-voi-srv)# allow-connections h323 to SIP	Enables calls between specific types of endpoints in a VoIP network.
Router(config-voi-srv)# allow-connections SIP to SIP	Enables calls between specific types of endpoints in a VoIP network.
	NOTE: A separate allow-connections command is required for each type of endpoint to be supported.
Router(config-voi-srv)# sip	Enters SIP configuration mode.
	NOTE: Required if you are connecting IP phones running SIP directly in Cisco CME 3.4 and later.
Router(config-voi-sip)# registrar server expires max 600 min 60	Enables SIP registrar functionality in Cisco Unified CME with lowest values.
	NOTE: Cisco Unified CME does not maintain a persistent database of registration entries across CME router reloads. SIP phones will have to register again.
	NOTE: Cisco recommends setting the timers to their minimum values.

Configuring DHCP for the VoIP Phones

Router(config)# ip dhcp pool VoIP-POOL	Creates a name for the DHCP server address pool and enters DHCP pool configuration mode.
Router(config-dhcp)# network 192.168.30.0 255.255.255.0	Specifies the IP address of the DHCP address pool to be configured.

Router(config-dhcp)# option 150 ip 192.168.31.1	Specifies the TFTP server address from which the Cisco Unified IP phone downloads the image configuration file.
	NOTE: This is your Cisco Unified CME router's address. It is recommended to choose a loopback address.
Router(config-dhcp)# default-router 192.168.30.1	Specifies the gateway address for IP phone.
Router(config-dhcp)# end	Returns to privileged EXEC mode.
Router(config)# ip dhcp excluded-address 192.168.30.1 192.168.30.15	Specifies any addresses not to be dynamically allocated.

Defining a DHCP Relay

NOTE: DHCP relay is required if the Cisco Unified CME router is not the DHCP server and/or the CME router is not on a common segment with the VoIP phones.

Router(config)# interface fastethernet 0/0	Enters interface configuration mode for the specified interface.
Router(config-if)# ip helper-address ip-address	Specifies the IP address for any TFTP and/or DNS servers.
	NOTE: A separate ip helper-address command is required for each server if the servers are on different hosts. You configure multiple TFTP server targets by using the ip helper-address commands for multiple servers.
Router(config-if)# end	Returns CLI to the privileged exec prompt.

Enabling Network Time Protocol

Router# configure terminal	Enters global configuration mode.
Router(config)# clock timezone CST -6	Sets the time zone to Central Standard Time (CST), which is 6 hours behind UTC.
Router(config)# clock summer-time CST recurring 2 Sun Mar 2:00 1 Sun Nov 2:00	Optionally specifies daylight savings time.
	NOTE: If the clock summer-time zone recurring command is specified without parameters, the summer time rules default to United States rules.
Router(config)# ntp server ip-address	Synchronizes the software clock of the router with the specified Network Time Protocol (NTP) server.
Router(config)# ntp master	Enables the router's NTP server.
	NOTE: It is recommended to have a single authoritative timer or server that all devices and services in the network query.

Creating Directory Numbers

Router(config)# ephone-dn 1	Configures a directory number.
Router(config-ephone-dn)# number 1001	Assigns a phone number of 1001.
Router(config-ephone-dn)# name Bob Smith	Assigns a name to the directory number.

Creating Phones

Router(config)# ephone 1	Enters the ephone configuration mode.
Router(config-ephone)# mac-address HHHH.HHHH.HHHH	Associates the MAC address with ephone 1.
	NOTE: The address must be in the format <i>HHHH.HHHH.HHHH</i> .
Router(config-ephone)# type cipc	Configures the type of phone.

Router(config-ephone)# button 1:1	Assigns the first button on the phone to directory number 1.
	NOTE: The first 1 indicates the first button. The colon indicates a normal ringer. The second 1 represents directory number 1.
	NOTE: The Directory number ephone-dn 1, using phone number 1001, with the associated name "Bob Smith" is linked to ephone 1 with MAC address <i>HHHH.HHHH.HHHH</i> .

CME Auto Configuration Using the CLI

Winnipeg(config)# telephony-service setup	Enters CME auto-configuration mode.
Cisco IOS Telephony Services Setup:	
Do you want to setup DHCP service for your IP Phones? [yes/no]: yes	Enter yes or no .
Configuring DHCP Pool for Cisco IOS Telephony Services:	
IP network for telephony-service DHCP Pool: 192.168.30.0	Enter DHCP pool network.
Subnet mask for DHCP network : 255.255.255.0	Enter subnet mask.
TFTP Server IP address (Option 150) : 192.168.31.1	Enter TFTP server address.
Default Router for DHCP Pool : 192.168.30.1	Enter default router address.
Do you want to start telephony-service setup? [yes/no]: yes	Enter yes or no .
Configuring Cisco IOS Telephony Services:	
Enter the IP source address for Cisco IOS Telephony Services : 192.168.31.1	Enter source address.
Enter the Skinny Port for Cisco IOS Telephony Services : [2000]:	Press Enter for default answer of 2000.
How many IP phones do you want to configure : [0]: 4	Enter number of phones to configure.

<p>Do you want dual-line extensions assigned to phones? [yes/no]: yes</p>	<p>Answer yes or no.</p>
<p>What Language do you want on IP phones :</p> <ul style="list-style-type: none"> 0 English 1 French 2 German 3 Russian 4 Spanish 5 Italian 6 Dutch 7 Norwegian 8 Portuguese 9 Danish 10 Swedish 11 Japanese <p>[0]: 0</p>	<p>Choose the language on the phone.</p>
<p>Which Call Progress tone set do you want on IP phones :</p> <ul style="list-style-type: none"> 0 United States 1 France 2 Germany 3 Russia 4 Spain 5 Italy 6 Netherlands 7 Norway 8 Portugal 9 UK 10 Denmark 11 Switzerland 12 Sweden 13 Austria 14 Canada 15 Japan <p>[0]: 0</p>	<p>Choose the call progress tone.</p>
<p>What is the first extension number you want to configure : 5001</p>	<p>Enter first number.</p>

Do you have Direct-Inward-Dial service for all your phones? [yes/no]: no	Answer yes or no .
Do you want to forward calls to a voice message service? [yes/no]: no	Answer yes or no .
Do you wish to change any of the above information? [yes/no]: no	Answer yes or no .
Setup completed config	

NOTE: The auto configuration does not prompt for information for individual directory numbers and phone specifics. The auto configuration programming assigns phones and directory numbers in a first-come-first-served sequential manner.

Installing IP Communicator

Double-click the **CiscoIPCommunicatorSetup.exe** icon (or run the program CiscoIPCommunicatorSetup.exe) to start the install wizard on your personal computer, as shown in Figure 2-2. Click **Next** and follow the onscreen instructions to accept the License Agreement, shown in Figure 2-3.

Figure 2-2 Cisco IP Communicator InstallShield Wizard



Figure 2-3 End User License Agreement



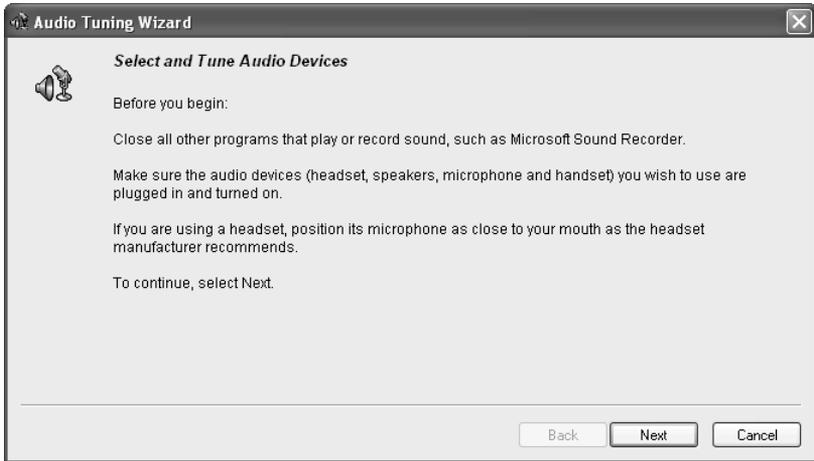
When the installation is complete, you should see the InstallShield Wizard Completed screen, as shown in Figure 2-4. Check the **Launch Cisco IP Communicator** check box and click **Finish**. The Audio Tuning Wizard screen appears.

Figure 2-4 InstallShield Wizard Completed



Figure 2-5 shows the select audio devices screen of the Audio Tuning Wizard. Follow the instructions and then click **Next** to continue.

Figure 2-5 Audio Tuning Wizard



On the next screen, shown in Figure 2-6, you choose the appropriate devices from the drop-down lists and click **Next**.

Figure 2-6 Select Audio Devices

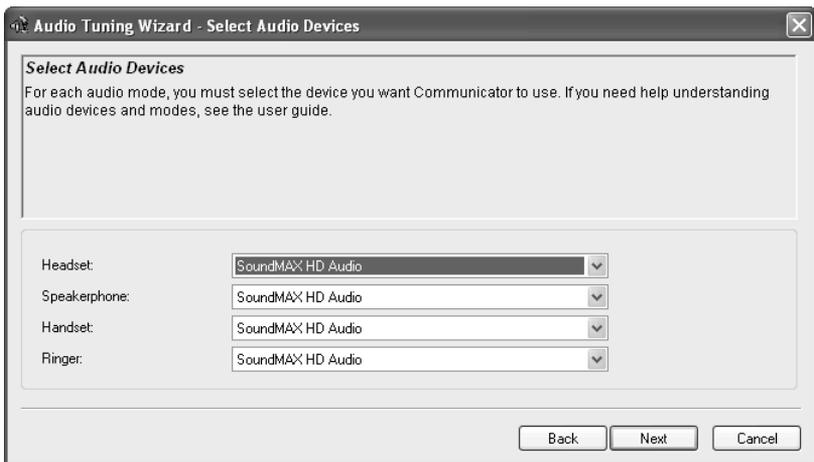


Figure 2-7 shows the Adjust the Listening Volume screen. Click **Play** and follow the onscreen instructions to adjust the listening volume. Click **Next** to continue.

Figure 2-7 Adjust the Listening Volume

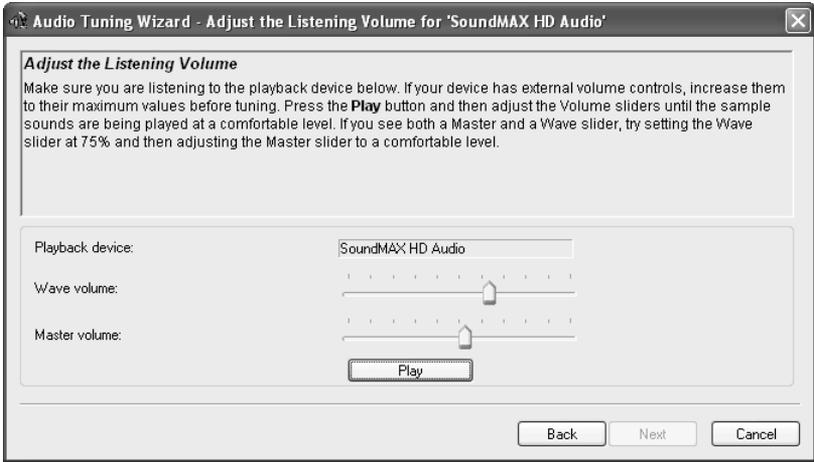
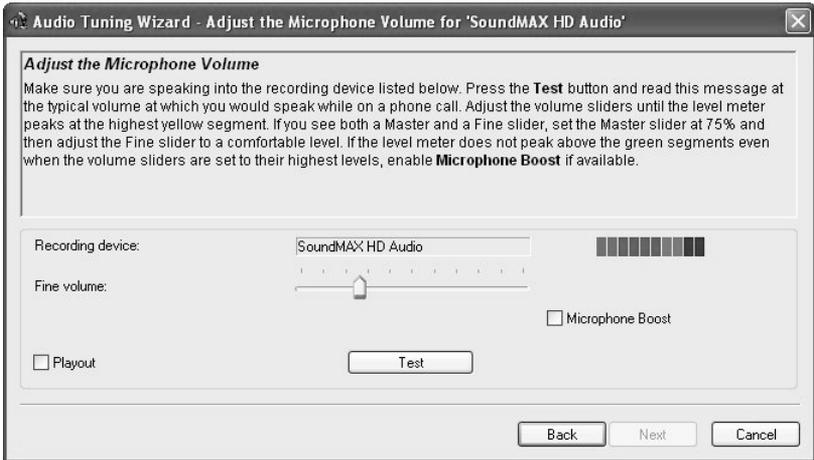


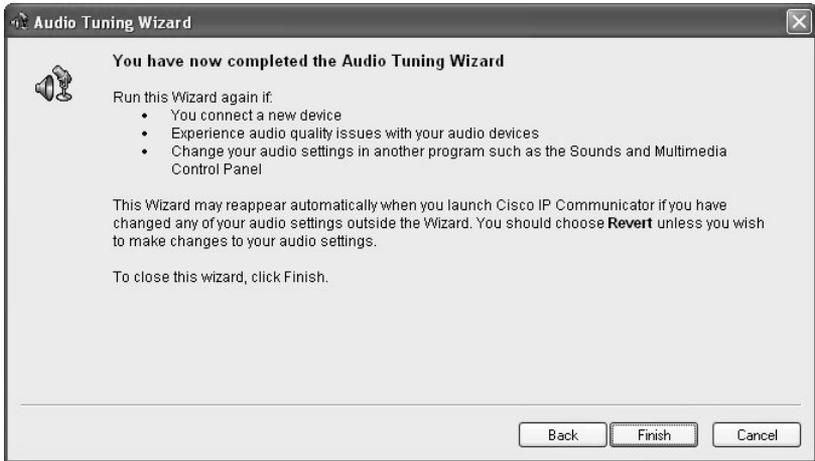
Figure 2-8 shows the Adjust the Microphone Volume screen. Click the **Test** button and follow the onscreen instructions to adjust the microphone volume, and then click **Next**.

Figure 2-8 Adjust the Microphone Volume



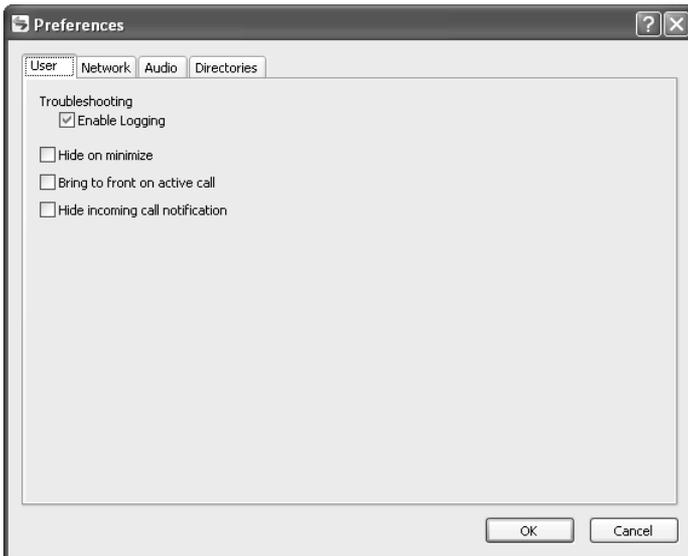
After this you will have completed the Audio Tuning Wizard. The final screen now appears, as shown in Figure 2-9.

Figure 2-9 Complete the Audio Tuning Wizard



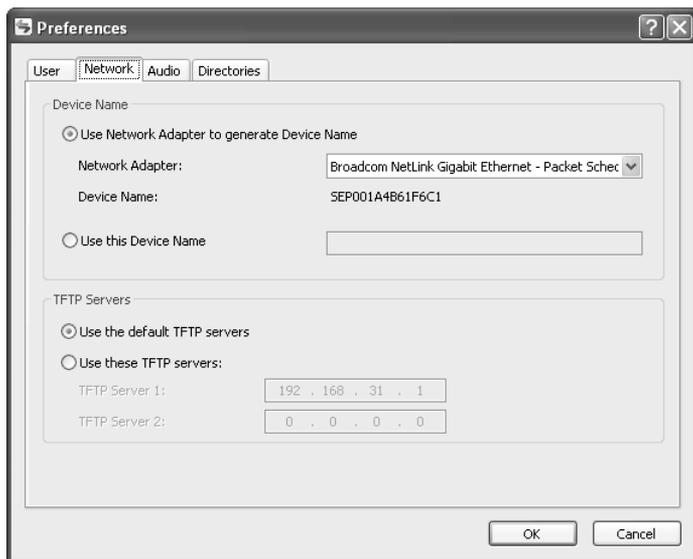
Click **Finish** to close the wizard and open the Preferences window. The Preferences window is shown in Figure 2-10.

Figure 2-10 Preferences Window



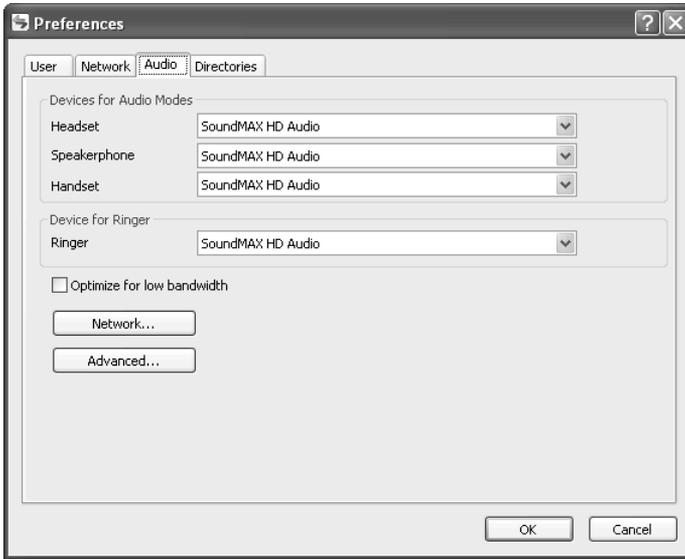
In the Preferences window, click the **Network** tab. If **option 150** pointing to the Cisco Unified Communications Manager Express has been set in the DHCP profile, the **Use the default TFTP servers** radio button will already be selected and the IP of the TFTP server(s) will be visible, as shown in Figure 2-11.

Figure 2-11 Network Preferences – Use the Default TFTP Servers

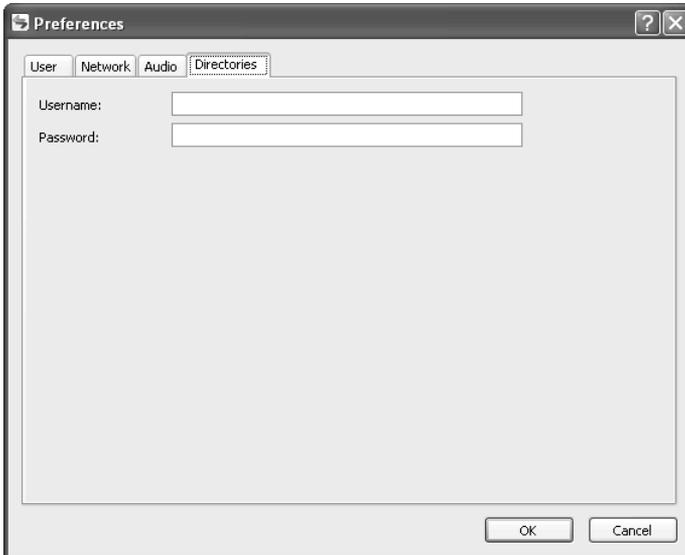


NOTE: The TFTP servers must be specified manually when **option 150 ip-address** is not in the DHCP profile. Click **Use these TFTP servers:** and enter the IP address of the Cisco Unified Communications Manager Express. You must also choose the correct network adapter and device name.

Click the **Audio** tab. The audio properties chosen during audio tuning appear, as shown in Figure 2-12.

Figure 2-12 Audio Preferences

Click the **Directories** tab, as shown in Figure 2-13. Enter the Cisco Unified Communications Manager Express administrator username and password.

Figure 2-13 Directories Preferences

Click **OK**. Cisco IP Communicator now registers with CME.

NOTE: The initial registration with CME can take as long as a few minutes.

Open Cisco IP Communicator. An application appears, as shown in Figure 2-14.

Figure 2-14 Cisco IP Communicator



Cisco IP Communicator is ready to place or receive calls.

Call statistics, including codec, sender and receiver packet information, and the number of packets sent and received, can be obtained. A call must be in progress to view the call statistics. To view the call stats, click **?**, as shown in Figure 2-15, and then click the far end call termination (in this case directory number 5001), as shown in Figure 2-16.

Figure 2-15 Call in Progress Between 5001 and 5002



Figure 2-16 Choosing the Appropriate Connection to See the Call Statistics



Figure 2-17 shows the call statistics of the current call. Call statistics include sender and receiver codecs, sound bite size, jitter, and any lost packets.

Figure 2-17 Call Statistics



Changing Codecs Using the CLI

If you want to change codecs, enter the following commands using the CLI:

Router(config)# ephone 1	Enters the ephone 1 configuration mode.
Router(config-ephone)# codec g729r8	Specifies the G.729 codec for ephone 1.
Router(config-ephone)# ephone 2	Enters the ephone 2 configuration mode.
Router(config-ephone)# codec g729r8	Specifies the G.729 codec for ephone 2.
Router(config-ephone)# end	Returns to the CLI privilege exec program mode.

NOTE: The codec configuration on both ephones must be the same.

NOTE: The G.729 codec uses 29.6 kbps of bandwidth per voice stream when including the layer 2 and layer 3 overhead with the voice payload. In comparison, the G.711 codec uses 85.6 kbps of bandwidth under the same conditions.

Figure 2-18 shows the call statistics on the IP Communicator after the codec has been changed.

Figure 2-18 Call Statistics After the Codec Has Been Changed



Router Configuration

Using Figure 2-1 as a reference, the following shows the output of the **show running-config** and the output of the **show flash:** commands for the router in that diagram, which detail the configuration of CME.

```
Router# show running-config
!
version 12.4
!
hostname Router
!
clock timezone CST -6
clock summer-time CST recurring 2 Sun Mar 2:00 1 Sun Nov 2:00
!
ip dhcp pool ITS
  import all
  network 192.168.30.0 255.255.255.0
  option 150 ip 192.168.31.1
  default-router 192.168.30.1
!
!
username roth privilege 15 secret 5 $some_passwordstring_this_long
!
!
interface Loopback0
  ip address 192.168.31.1 255.255.255.0
```

```
!  
interface FastEthernet0/0  
  ip address dhcp  
  ip nat outside  
!  
interface FastEthernet1/0  
  ip address 192.168.30.1 255.255.255.0  
  ip nat inside  
!  
ip route 0.0.0.0 0.0.0.0 FastEthernet0/0  
!  
ip nat inside source list 1 interface FastEthernet0/0 overload  
!  
access-list 23 permit 192.168.30.0 0.0.0.255  
tftp-server flash:P00308000400.bin  
!  
!  
telephony-service  
  load 7960-7940 P00308000400  
  max-ephones 8  
  max-dn 4  
  ip source-address 192.168.31.1 port 2000  
  auto assign 1 to 4  
max-conferences 4 gain -6  
moh music-on-hold.au  
transfer-system full-consult  
create cnf-files version-stamp 7960 Oct 09 2007 19:17:26  
!  
!  
ephone-dn 1 dual-line  
  number 5001  
!  
ephone-dn 2 dual-line  
  number 5002  
!  
ephone-dn 3 dual-line  
  number 5003  
!  
ephone-dn 4 dual-line  
  number 5004  
!  
!  
ephone 1  
  no multicast-moh  
  mac-address 0050.DA7C.AB03  
  codec g729r8  
  type CIPC  
  button 1:1  
!  
ephone 2
```

```
no multicast-moh
mac-address 001A.4B61.F6C1
codec g729r8
type CIPC
button 1:2
!
ephone 3
no multicast-moh
!
ephone 4
no multicast-moh
!
!
banner login #

    User Authentication Required

#
!
line con 0
login local
line aux 0
login local
line vty 0 4
access-class 23 in
login local
transport input telnet
!
ntp clock-period 17208155
ntp server <IP of time server> source FastEthernet0/0 prefer
end
```

Router# **show flash:**

```
System flash directory:
File Length Name/status
 1 21086616 c1700-ipvoicek9-mz.124-15.T1.bin
 2 4627 admin_user.html
 3 653758 admin_user.js
 4 1029 CiscoLogo.gif
 5 618 CME_GUI_README.TXT
 6 953 Delete.gif
 7 16344 dom.js
 8 864 downarrow.gif
 9 6146 ephone_admin.html
10 4658 logohome.gif
11 3724 normal_user.html
12 80033 normal_user.js
13 1347 Plus.gif
14 843 sxiconad.gif
```

```
15 174      Tab.gif
16 2410     telephony_service.html
17 870      uparrow.gif
18 9968     xml-test.html
19 3412     xml.template
20 129828   P00308000400.bin
21 461      P00308000400.loads
22 701768   P00308000400.sb2
23 130232   P00308000400.sbn
24 496521   music-on-hold.au
[23338772 bytes used, 9953512 available, 33292284 total]
32768K bytes of processor board System flash (Read/Write)
```