

**All-in-One CCIE Collaboration V1.1**  
**400-051 Written Exam Cert Guide**

SAMPLE GUIDE

## Contents at a Glance

**Chapter 1** Cisco Collaboration Infrastructure

**Chapter 2** Telephony Standards and Protocols

**Chapter 3** Cisco Unified Communications Manager (CUCM)

**Chapter 4** Cisco IOS UC Applications and Features

**Chapter 5** Quality of Service and Security in Cisco Collaboration Solutions

**Chapter 6** Cisco Unity Connection

**Chapter 7** Cisco Unified Contact Center Express

**Chapter 8** Cisco Unified IM and Presence

**Chapter 9** Cloud

**Chapter 10** Network Programmability

**Chapter 11** Internet of Things (IoT)

SAMPLE GUIDE

## Table of Contents

<i>Chapter 1: Cisco Collaboration Infrastructure</i> .....	18
<i>Cisco UC Deployment Models</i> .....	18
<i>Single-Site Model</i> .....	18
<i>Supported Applications</i> .....	19
<i>Multisite Centralized Call Processing Model</i> .....	20
<i>Supported Applications</i> .....	21
<i>Multisite Distributed Call Processing Model</i> .....	22
<i>Supported Applications</i> .....	23
<i>Clustering Over IP WAN Call Processing Model</i> .....	24
<i>Supported Applications</i> .....	25
<i>Major Components of Deployment Models</i> .....	27
<i>Further Reading</i> .....	32
<i>User Management</i> .....	32
<i>Further Reading</i> .....	36
<i>IP routing in Cisco Collaboration Solutions</i> .....	40
<i>Architecture</i> .....	41
<i>High Availability</i> .....	42
<i>Capacity Planning</i> .....	43
<i>Further Reading</i> .....	44
<i>Virtualization in Cisco Collaboration Solutions</i> .....	45
<i>UCS / VMware</i> .....	45
<i>Hypervisor</i> .....	45
<i>Server Hardware Options</i> .....	46
<i>Cisco Unified Computing System (Cisco UCS)</i> .....	46
<i>Cisco UCS B-Series Blade Servers</i> .....	47
<i>Cisco UCS 5100 Series Blade Server Chassis</i> .....	47
<i>Cisco UCS 2100 and 2200 Series I/O Modules</i> .....	47
<i>Cisco UCS 6100 and 6200 Series Fabric Interconnect Switch</i> .....	47
<i>Cisco UCS Manager</i> .....	47
<i>Storage Area Networking</i> .....	48
<i>Design Considerations for Running Virtual Unified Communications Applications on B-Series Blade Servers</i> .....	48
<i>SAN and Storage Arrays</i> .....	48
<i>Cisco UCS C-Series Rack-Mount Servers</i> .....	48
<i>Design Considerations for Running Virtual Unified Communications Applications on C-Series Rack-Mount Servers</i> .....	49
<i>Answer Files</i> .....	49
<i>Further Reading</i> .....	50
<i>Wireless in Cisco Collaboration Solutions</i> .....	50
<i>Architecture for Voice and Video over WLAN</i> .....	51

<i>Wireless Access Points</i> .....	51
<i>Wireless LAN Controllers</i> .....	51
<i>Authentication Database</i> .....	52
<i>Supporting Wired Network</i> .....	52
<i>Wireless Unified Communications Endpoints</i> .....	53
<i>WLAN High Availability</i> .....	53
<i>Capacity Planning for Voice and Video over WLAN</i> .....	54
<i>Network Services</i> .....	55
<i>DNS</i> .....	55
<i>DHCP</i> .....	55
<i>Further Reading</i> .....	56
<i>TFTP</i> .....	56
<i>Further Reading</i> .....	56
<i>NTP</i> .....	57
<i>Further Reading</i> .....	57
<i>CDP/LLDP</i> .....	57
<i>PoE</i> .....	58
<i>Further Reading</i> .....	59
<i>Voice and data VLAN</i> .....	59
<i>IP Multicast</i> .....	60
<i>IPv6</i> .....	61
<i>Cisco IP Phones and IPv6 Addresses</i> .....	61
<i>Further Reading</i> .....	63
<i>Exam Essentials</i> .....	63
<i>Chapter 2: Telephony Standards and Protocols</i> .....	66
<i>SCCP</i> .....	66
<i>Further Reading</i> .....	66
<i>Call Flows</i> .....	67
<i>IP Phone to IP Phone - Successful Intracluster Call</i> .....	67
<i>Further Reading</i> .....	68
<i>Call States</i> .....	69
<i>Further Reading</i> .....	69
<i>Endpoint types</i> .....	69
<i>MGCP</i> .....	70
<i>Call flows</i> .....	70
<i>Call states</i> .....	72
<i>Endpoint types</i> .....	72
<i>Further Reading</i> .....	73
<i>SIP</i> .....	73
<i>Call flows</i> .....	74
<i>SIP Gateway-to-SIP Gateway--Call Setup and Disconnect</i> .....	74
<i>SIP Gateway-to-SIP Gateway--Call via SIP Redirect Server</i> .....	75

**FULL GUIDE HAS 400+ PAGES.**

<i>SIP Gateway-to-SIP Gateway--Call via SIP Proxy Server</i> .....	76
<i>Call states</i> .....	77
<i>DP</i> .....	77
<i>BFCP</i> .....	78
<i>BFCP Support on Cisco Video Endpoints</i> .....	78
<i>BFCP Support on Third-Party Phones</i> .....	79
<i>H.323 and RAS</i> .....	79
<i>H.225 RAS Signaling</i> .....	79
<i>Call flows</i> .....	80
<i>Call states</i> .....	81
<i>Gatekeeper</i> .....	81
<i>Gatekeeper Functionality</i> .....	81
<i>Mandatory Gatekeeper Functions</i> .....	81
<i>Optional Gatekeeper Functions</i> .....	82
<i>H.239</i> .....	82
<i>Further Reading</i> .....	83
<i>Voice and video CODECs</i> .....	83
<i>H.264</i> .....	83
<i>ILBC</i> .....	83
<i>ISAC</i> .....	83
<i>LATM</i> .....	83
<i>G.722</i> .....	83
<i>Wide band</i> .....	83
<i>RTP, RTCP, and SRTP</i> .....	83
<i>Exam Essentials:</i> .....	83
<i>Chapter 3: Cisco Unified Communications Manager (CUCM)</i> .....	87
<i>Device registration and redundancy</i> .....	87
<i>SCCP Phone Registration Process</i> .....	87
<i>SIP Phone Registration Process</i> .....	87
<i>Device settings</i> .....	90
<i>Codec selection</i> .....	96
<i>Further Reading</i> .....	97
<i>Call features</i> .....	97
<i>Call park</i> .....	97
<i>Call pickup</i> .....	97
<i>Further Reading</i> .....	98
<i>BLF speed dials</i> .....	98
<i>Further Reading</i> .....	98
<i>Native call queuing</i> .....	98
<i>Further Reading</i> .....	100
<i>Call hunting</i> .....	101
<i>Further Reading</i> .....	101

**FULL GUIDE HAS 400+ PAGES.**

<i>Meet-Me</i> .....	101
<i>Further Reading</i> .....	101
<i>Dial plan</i> .....	101
<i>Globalized call routing</i> .....	101
<i>Local route group</i> .....	103
<i>Further Reading</i> .....	103
<i>Time-of-day routing</i> .....	103
<i>Further Reading</i> .....	103
<i>Application dial rules</i> .....	104
<i>Further Reading</i> .....	104
<i>Digit manipulations</i> .....	104
<i>Further Reading</i> .....	105
<i>Media resources</i> .....	105
<i>TRP</i> .....	105
<i>Further Reading</i> .....	105
<i>MOH</i> .....	105
<i>CFB</i> .....	106
<i>Transcoder and MTP</i> .....	106
<i>Annunciator</i> .....	108
<i>MRG and MRGL</i> .....	108
<i>Further Reading</i> .....	108
<i>CUCM mobility</i> .....	109
<i>EM/EMCC</i> .....	109
<i>Device Mobility</i> .....	110
<i>Further Reading</i> .....	110
<i>Mobile Connect</i> .....	110
<i>Further Reading</i> .....	111
<i>MVA</i> .....	111
<i>CUCM serviceability and OS administration</i> .....	112
<i>Database replication</i> .....	112
<i>Further Reading</i> .....	112
<i>CDR</i> .....	113
<i>Enabling CDR</i> .....	113
<i>Service activation</i> .....	113
<i>Further Reading</i> .....	114
<i>CMR</i> .....	114
<i>Further Reading</i> .....	114
<i>CUCM disaster recovery</i> .....	115
<i>Further Reading</i> .....	115
<i>ILS/URI dialing</i> .....	115
<i>Directory URI</i> .....	115
<i>ISL topology</i> .....	116

FULL GUIDE HAS 400+ PAGES.

<i>ILS Network Components</i> .....	116
<i>Hub Clusters</i> .....	116
<i>Spoke Clusters</i> .....	117
<i>Directory URI Imported Catalogs</i> .....	117
<i>Further Reading</i> .....	117
<i>Blended addressing</i> .....	118
<i>Example 1</i> .....	119
<i>Example 2</i> .....	119
<i>Example 3</i> .....	119
<i>Call Admission Control</i> .....	120
<i>CAC/ELCAC</i> .....	120
<i>Configuration Procedure</i> .....	120
<i>Further Reading</i> .....	121
<i>RSVP</i> .....	122
<i>Configuration Procedure</i> .....	122
<i>Further Reading</i> .....	123
<i>SIP preconditions</i> .....	123
<i>Overview of SIP Preconditions</i> .....	123
<i>Unified Communications Manager and RSVP SIP Preconditions</i> .....	124
<i>Further Reading</i> .....	124
<i>SIP and H.323 trunks</i> .....	125
<i>SIP trunks</i> .....	125
<i>H.323 trunks</i> .....	125
<i>Configuration Procedure</i> .....	125
<i>Further Reading</i> .....	126
<i>Number presentation and manipulation</i> .....	126
<i>Further Reading</i> .....	126
<i>SAF and CCD</i> .....	127
<i>Further Reading</i> .....	128
<i>Call recording and silent monitoring</i> .....	128
<i>Further Reading</i> .....	129
<i>Exam Essentials</i> .....	129
<i>Chapter 4: Cisco IOS UC Applications and Features</i> .....	133
<i>CUCME</i> .....	133
<i>SCCP phones registration</i> .....	133
<i>SIP phones Registration</i> .....	142
<i>SNR</i> .....	147
<i>SNR Enhancements</i> .....	148
<i>Hardware Conference</i> .....	149
<i>Further Reading</i> .....	149
<i>SRST</i> .....	149
<i>CME-as-SRST</i> .....	150

<i>MGCP fallback</i> .....	154
<i>MMOH in SRST</i> .....	155
<i>Music on Hold for SIP Phones</i> .....	156
<i>Music On Hold Enhancement</i> .....	156
<i>Configuration Steps</i> .....	156
<i>CUE</i> .....	157
<i>AA</i> .....	158
<i>Scripting</i> .....	159
<i>Further Reading</i> .....	161
<i>Voiceview</i> .....	161
<i>Further Reading</i> .....	161
<i>Web inbox</i> .....	161
<i>Further Reading</i> .....	161
<i>MWI</i> .....	162
<i>Further Reading</i> .....	162
<i>VPIM</i> .....	162
<i>Further Reading</i> .....	162
<i>Cisco IOS-based call queuing</i> .....	163
<i>B-ACD</i> .....	163
<i>Voice hunt groups</i> .....	164
<i>Further Reading</i> .....	165
<i>Parallel Hunt Groups (Call Blast)</i> .....	165
<i>Further Reading</i> .....	167
<i>Cisco IOS media resources</i> .....	167
<i>Conferencing / Transcoding</i> .....	167
<i>DSP Resources</i> .....	167
<i>Restrictions for Conferencing and Transcoding for Voice Gateway Routers</i> .....	168
<i>Further Reading</i> .....	168
<i>DSP Management</i> .....	169
<i>Plan for the Number of DSPs Installed</i> .....	169
<i>Enable Voice Card Services</i> .....	169
<i>Enable the DSPFARM</i> .....	169
<i>CUBE</i> .....	170
<i>Mid-call signaling</i> .....	170
<i>Mid-call Signaling Passthrough - Media Change</i> .....	171
<i>Restrictions for Mid-call Signaling Passthrough - Media Change</i> .....	171
<i>Behavior of Mid-call Re-INVITE Consumption</i> .....	171
<i>Configuring Passthrough of Mid-call Signalling</i> .....	173
<i>Example Configuring Passthrough SIP Messages at Dial Peer Level</i> .....	173
<i>Example Configuring Passthrough SIP Messages at the Global Level</i> .....	174
<i>Mid-call Signaling Block</i> .....	174
<i>Further Reading</i> .....	175



<i>SIP Profiles</i> .....	175
<i>Configuration Steps</i> .....	176
<i>Further Reading</i> .....	177
<i>Early and delayed offer</i> .....	178
<i>Configuring Delayed-Offer to Early-Offer for SIP Audio Calls at the Global Level</i> .....	178
<i>Further Reading</i> .....	178
<i>DTMF interworking</i> .....	179
<i>Symmetric and Asymmetric Calls</i> .....	179
<i>Configuring Dynamic Payload Support at the Global Level</i> .....	179
<i>Configuration Steps</i> .....	180
<i>Further Reading</i> .....	180
<i>Box-to-box failover and redundancy</i> .....	180
<i>Configuration Steps</i> .....	181
<i>Further Reading</i> .....	182
<i>Fax and modem protocols</i> .....	182
<i>Further Reading</i> .....	184
<i>Analog telephony signalling</i> .....	184
<i>Analog telephony signalling theories [FXS/FXO]</i> .....	184
<i>Caller ID</i> .....	185
<i>Further Reading</i> .....	186
<i>Line voltage detection</i> .....	186
<i>Idle Battery Voltage</i> .....	186
<i>Idle Line Voltages</i> .....	186
<i>Further Reading</i> .....	187
<i>THL sweep</i> .....	187
<i>FXO disconnect</i> .....	188
<i>Further Reading</i> .....	188
<i>Echo</i> .....	189
<i>Further Reading</i> .....	189
<i>Digital telephony signalling</i> .....	189
<i>Digital telephony signalling theories [T1/E1, BRI/PRI/CAS]</i> .....	189
<i>T1 CAS</i> .....	189
<i>E1 CAS</i> .....	190
<i>Basic Rate Interface (BRI)</i> .....	190
<i>T1 Primary Rate Interface (T1 PRI)</i> .....	190
<i>E1 Primary Rate Interface (E1 PRI)</i> .....	191
<i>Further Reading</i> .....	191
<i>QSIG, Q.921 and Q.931</i> .....	191
<i>Caller ID</i> .....	191
<i>Further Reading</i> .....	192
<i>R2</i> .....	192
<i>Further Reading</i> .....	193

NFAS.....	193
NFAS Terminology.....	193
Cisco IOS dial plan .....	194
Translation profile.....	194
Further Reading .....	195
Dial-peer matching logics .....	195
Configuring an Inbound Dial Peer to Match on URI .....	195
Further Reading .....	196
SAF/CCD.....	196
The SAF Forwarder Protocol .....	197
SAF Neighbor Relationships.....	198
Further Reading .....	198
IOS CAC.....	199
Further Reading .....	200
IOS accounting.....	200
Further Reading .....	202
Exam Essentials.....	202
Chapter 5: Quality of Service and Security in Cisco Collaboration Solutions .....	205
QoS: link efficiency .....	205
LFI.....	205
Further Reading .....	206
MLPPP.....	206
Multilink PPP Bundles .....	207
Multilink PPP Bundles and PPP Links.....	207
Further Reading .....	209
FRF.12.....	209
Further Reading .....	209
cRTP.....	209
Further Reading .....	210
VAD.....	210
QoS: classification and marking .....	211
Voice versus video classification.....	211
Further Reading .....	212
Trust boundaries .....	212
Conditionally-Trusted IP Phone + PC with Scavenger-Class QoS (Basic) Model .....	215
Conditionally-Trusted IP Phone + PC with Scavenger-Class QoS (Advanced) Model .....	215
Further Reading .....	216
QoS: congestion management .....	216
Layer 2 priorities.....	216
Further Reading .....	217
Low latency queue.....	218
Further Reading .....	219

<i>Traffic policing and shaping</i> .....	219
<i>Further Reading</i> .....	221
<i>QoS: Medianet</i> .....	221
<i>Medianet Campus QoS Design Considerations</i> .....	222
<i>Internal DSCP</i> .....	222
<i>Trust States and Operation</i> .....	223
<i>Further Reading</i> .....	224
<i>QoS: wireless QoS</i> .....	224
<i>WMM</i> .....	224
<i>CoS and DSCP Switch Operation</i> .....	225
<i>Different UP Markings for the Same Traffic Class</i> .....	227
<i>QoS Profiles</i> .....	228
<i>Tagged WLC Interfaces</i> .....	229
<i>DSCP Recommendation</i> .....	230
<i>Further Reading</i> .....	230
<i>Security: mixed mode cluster</i> .....	230
<i>CTL Client and CTL File</i> .....	232
<i>Further Reading</i> .....	232
<i>Security: secured phone connectivity</i> .....	233
<i>SRTP and TLS</i> .....	233
<i>Further Reading</i> .....	233
<i>VPN phones</i> .....	233
<i>Further Reading</i> .....	235
<i>Phone Proxy</i> .....	235
<i>Supported Cisco UCM and IP Phones for the Phone Proxy</i> .....	236
<i>Cisco Unified IP Phones</i> .....	236
<i>Further Reading</i> .....	238
<i>TLS proxy</i> .....	238
<i>Supported Cisco UCM and IP Phones for the TLS Proxy</i> .....	239
<i>Cisco Unified Communications Manager</i> .....	239
<i>Cisco Unified IP Phones</i> .....	239
<i>Further Reading</i> .....	240
<i>IEEE 802.1x</i> .....	240
<i>Further Reading</i> .....	241
<i>Security: default security features</i> .....	241
<i>Further Reading</i> .....	242
<i>Security: firewall traversal</i> .....	242
<i>How to Configure Cisco Unified Communications Trusted Firewall Control</i> .....	243
<i>Prerequisites</i> .....	243
<i>Configuration Steps</i> .....	244
<i>Further Reading</i> .....	244
<i>Security: toll fraud</i> .....	244

FULL GUIDE HAS 400+ PAGES.

<i>Cisco Voice Gateway Toll-Fraud Prevention Application</i> .....	246
<i>Voice Gateway Class of Restriction</i> .....	246
<i>Example of Cisco IOS Gateway CoR Configuration</i> .....	247
<i>Cisco Unity Connection Restriction Rules</i> .....	248
<i>Further Reading</i> .....	248
<i>Exam Essentials</i> .....	248
<i>Chapter 6: Cisco Unity Connection</i> .....	250
<i>CUCM and CUCME integration</i> .....	250
<i>Call Transfer</i> .....	254
<i>H.323 Call Transfer Using an Empty Capabilities Set</i> .....	255
<i>H.323-to-H.323 Call Transfer</i> .....	256
<i>Call Transfer and the Media Termination Point</i> .....	256
<i>Connecting Cisco Unified CallManager with Cisco Unified CME</i> .....	257
<i>Intersite Call Transfer with Multiple Cisco Unified CME Systems</i> .....	258
<i>Call Forwarding</i> .....	259
<i>Connected Party Name and Number Services</i> .....	259
<i>Using H.450.x Cisco IP-to-IP Gateway</i> .....	261
<i>Further Reading</i> .....	261
<i>Single inbox</i> .....	261
<i>Deploying Single Inbox for a Unity Connection Cluster</i> .....	262
<i>Deploying Single Inbox for a Unity Connection Intrasite Network</i> .....	262
<i>Deploying Single Inbox During Gradual Migrations from Cisco Unity</i> .....	262
<i>Further Reading</i> .....	262
<i>MWI</i> .....	262
<i>Further Reading</i> .....	263
<i>Call handlers</i> .....	263
<i>Creating, Modifying, and Deleting Call Handler Templates</i> .....	264
<i>Further Reading</i> .....	265
<i>CUC dial plan</i> .....	265
<i>Default Partition and Search Space</i> .....	265
<i>Further Reading</i> .....	266
<i>Directory handlers</i> .....	266
<i>Creating a Directory Handler</i> .....	267
<i>Further Reading</i> .....	268
<i>CUC features</i> .....	268
<i>High availability</i> .....	268
<i>Publisher Server</i> .....	268
<i>Subscriber Server</i> .....	269
<i>Unity Connection Cluster Requirements When the Servers Are in Separate Buildings or Sites</i> .....	269
<i>Balancing the Load of Calls Unity Connection Servers Handle</i> .....	270
<i>Cisco Unified Communications Manager by Skinny Client Control Protocol (SCCP)</i> .....	270

**FULL GUIDE HAS 400+ PAGES.**

<i>Further Reading</i> .....	271
<i>Visual voicemail</i> .....	271
<i>Visual Voicemail Release 7.1</i> .....	272
<i>Configuration Procedure</i> .....	272
1. <i>Creating a Voicemail Pilot Number for Visual Voicemail</i> .....	272
2. <i>Creating a Hunt Pilot for the Voicemail Pilot Number</i> .....	272
3. <i>Configuring the Reverse Trap Rule on Cisco Unity Connection</i> .....	273
4. <i>Create a Condition</i> .....	273
5. <i>Testing Visual Voicemail .Jad file on your Voicemail server</i> .....	273
6. <i>Adding the Visual Voicemail Service</i> .....	274
7. <i>Select New Parameter to add a parameter to the service</i> .....	274
8. <i>Select Add New to add another parameter to the service</i> .....	274
9. <i>Select Add New to add another parameter to the service</i> .....	275
10. <i>Subscribing Individual Phones to Visual Voicemail</i> .....	275
<i>Further Reading</i> .....	275
<i>Voicemail for Jabber</i> .....	275
<i>Further Reading</i> .....	277
<i>Voicemail networking</i> .....	277
<i>Designing a Unity Connection Network using HTTPS</i> .....	277
<i>OVA Selection and HTTPS</i> .....	278
<i>Intrasite Networking</i> .....	278
<i>Intersite Networking Between Two Unity Connection Sites</i> .....	280
<i>Intersite Networking Between Unity Connection and Cisco Unity</i> .....	281
<i>Designing a Unity Connection Network with Intrasite and Intersite Links</i> .....	282
<i>VPIM Networking</i> .....	283
<i>Using VPIM Between Cisco Unity Connection and the Avaya Message Networking Solution or Avaya Interchange</i> .....	283
<i>Survivable Remote Site Voicemail</i> .....	283
<i>Further Reading</i> .....	284
<i>Exam Essentials</i> .....	284
<i>Chapter 7: Cisco Unified Contact Center Express</i> .....	286
<i>UCCX CTI Integration</i> .....	286
<i>Unified CCX CTI Client/Server Architecture</i> .....	286
<i>Two Client Modes for Connecting with Unified CCX</i> .....	287
<i>Further Reading</i> .....	288
<i>ICD functions</i> .....	289
<i>IP ICD Script Variables</i> .....	289
<i>Further Reading</i> .....	292
<i>UCCX Scripting Components</i> .....	292
<i>Further Reading</i> .....	295
<i>Exam Essentials</i> .....	295
<i>Chapter 8: Cisco Unified IM and Presence</i> .....	297

<i>Cisco Unified IM Presence Components</i> .....	297
<i>Presence</i> .....	297
<i>Cisco IM and Presence Components</i> .....	298
<i>Further Reading</i> .....	299
<i>CUCM integration</i> .....	299
<i>Configure Inter-Presence Group Subscription Parameter</i> .....	300
<i>SIP Trunk Configuration on Cisco Unified Communications Manager</i> .....	300
<i>Configure SIP Trunk Security Profile for IM and Presence Service</i> .....	301
<i>Configure SIP Trunk for IM and Presence Service</i> .....	301
<i>Configure Phone Presence for Unified Communications Manager Outside of Cluster</i> .....	302
<i>Further Reading</i> .....	302
<i>Cisco Jabber</i> .....	302
<i>Verify Essential Services on Unified Communications Manager and IM and Presence Service and Cisco Jabber</i> .....	303
<i>Further Reading</i> .....	304
<i>Federation</i> .....	304
<i>SIP Federation with AOL</i> .....	305
<i>SIP Federation Deployments</i> .....	305
<i>XMPP Federation Deployments</i> .....	305
<i>Further Reading</i> .....	306
<i>Presence Cloud Solutions</i> .....	306
<i>Hybrid Cloud-Based and On-Premises Deployment Model</i> .....	308
<i>Further Reading</i> .....	308
<i>Group chat and compliance</i> .....	308
<i>Chat Deployment Scenario 1</i> .....	308
<i>Chat Deployment Scenario 2</i> .....	309
<i>Chat Deployment Scenario 3</i> .....	309
<i>Chat Deployment Scenario 4</i> .....	310
<i>IM Compliance Components</i> .....	312
<i>Further Reading</i> .....	313
<i>Exam Essentials</i> .....	313
<i>Chapter 9: Cloud</i> .....	315
<i>Compare and Contrast Cloud Deployment Models</i> .....	315
<i>Private Cloud</i> .....	315
<i>Community Cloud</i> .....	316
<i>Public Cloud</i> .....	316
<i>Hybrid Cloud</i> .....	316
<i>Infrastructure, Platform, and Software Services (XaaS)</i> .....	317
<i>Performance and Reliability</i> .....	318
<i>Security and Privacy</i> .....	319
<i>Scalability and Interoperability</i> .....	322
<i>Describe Cloud implementations and Operations</i> .....	322

**FULL GUIDE HAS 400+ PAGES.**

<i>Automation and Orchestration</i> .....	322
<i>Workload Mobility</i> .....	323
<i>Troubleshooting and Management</i> .....	324
<i>OpenStack Components</i> .....	324
<i>Compute</i> .....	324
<i>Swift</i> .....	325
<i>Cinder</i> .....	325
<i>Keystone</i> .....	325
<i>Dashboard</i> .....	326
<i>Glance</i> .....	326
<i>Ceilometer</i> .....	326
<i>Heat</i> .....	326
<i>Ironic</i> .....	327
<i>Exam Essentials</i> .....	327
<i>Further Reading</i> .....	328
<i>Chapter 10: Network Programmability (SDN)</i> .....	331
<i>Describe Functional Elements of Network Programmability (SDN) and How They Interact</i> ..	331
<i>Controllers</i> .....	331
<i>APIs</i> .....	333
<i>Scripting</i> .....	334
<i>Agents</i> .....	335
<i>Northbound versus Southbound protocols</i> .....	335
<i>Describe Aspects of Virtualization and Automation in Network Environments</i> .....	337
<i>DevOps Methodologies, Tools and Workflows</i> .....	338
<i>Network/Application Function Virtualization (NFV)</i> .....	339
<i>Service Function Chaining</i> .....	340
<i>Performance, Availability, and Scaling Considerations</i> .....	342
<i>Exam Essentials</i> .....	343
<i>Further Reading</i> .....	345
<i>Chapter 11: Internet of Things</i> .....	347
<i>Describe Architectural Framework and Deployment Considerations for Internet of Things (IoT)</i> .....	347
<i>Performance, Reliability and Scalability</i> .....	347
<i>Mobility</i> .....	350
<i>Security and Privacy</i> .....	352
<i>IoT Threats</i> .....	354
<i>Security in IoT/M2M</i> .....	355
<i>Authentication</i> .....	357
<i>Authorization</i> .....	358
<i>Network Enforced Policy</i> .....	359
<i>Secure Analytics: Visibility and Control</i> .....	359
<i>Standards and Compliance</i> .....	360

*Environmental Impacts on the Network*.....364  
*Exam Essentials*.....365  
*Further Reading* .....366

SAMPLE GUIDE



## Chapter 1: Cisco Collaboration Infrastructure

This chapter covers the following exam topics from Cisco's official 400-051 (V1.1) written exam curriculum.

- Cisco UC Deployment Models
- User management
- IP routing in Cisco Collaboration Solutions
- Virtualization in Cisco Collaboration Solutions
  - UCS
  - VMware
  - Answer files
- Wireless in Cisco Collaboration Solutions
- Network services
  - DNS
  - DHCP
  - TFTP
  - NTP
  - CDP/LLDP
- PoE
- Voice and data VLAN
- IP multicast
- IPv6

## Chapter 1: Cisco Collaboration Infrastructure

### Cisco UC Deployment Models

In general terms, the deployment model architecture follows that of the enterprise it is deployed to serve. Deployment models describe the reference architecture required to satisfy the Unified Communications needs of well-defined, typical topologies of enterprises. For example, a centralized call processing deployment model caters to enterprises whose operational footprint is based on multiple sites linked to one or few centralized headquarters offices. In some cases, the deployment model of a technology will depart from that of the enterprise, due to technological constraints.

CUCM can be deployed using several different models:

- **Single site:** In this model, CUCM provides call processing at a single site, with no telephony being implemented over an IP WAN.
- **Multisite WAN with centralized call processing:** In this case, CUCM is deployed at a central site, and it provides call processing for a number of sites, with VoIP/IP telephony traffic being carried over an IP WAN between sites.
- **Multisite WAN with distributed call processing:** When using this model, call-processing agents such as CUCM are deployed at multiple sites, with VoIP/IP telephony traffic being transported over an IP WAN between sites.
- **Clustering over the IP WAN:** This involves deploying a single CUCM cluster with constituent CUCM servers spread across several sites connected by the WAN.

### Single-Site Model

The Single-Site model is designed for autonomous offices in which most or all employees are IPC users. This model supports up to 30,000 users. The Single-Site model is suitable for medium-sized businesses and government operations that reside at one site and that need basic call processing, some contact center capabilities, and basic messaging and conferencing. Such operations include legal and financial professional offices, and municipal government offices. The Single-Site model is

designed to be locally managed and administered. It can operate on a wired or wireless LAN. Local and long distance calling is achieved through gateway connectivity with the PSTN by various combinations of T1/E1 CAS and PRI. The Single-Site model provides flexible communications features for operators and administrative assistants. There are some executive phones, some of which are video-capable. Most other employees use digital telephones, including wireless telephones, and a voice messaging system, which this model also provides. In addition, some staff may take orders or provide technical support. This model provides basic contact center capabilities to handle these requirements. Some users, such as building services and shipping and receiving employees, may require mobile phones. This model provides on-campus device mobility features for these users.

### **Supported Applications**

The Single-Site model supports applications that provide a wide array of advanced features. These applications include:

- Call processing:
  - Cisco Unified Communications Manager
  - Cisco Unified Communications Manager Express
  - Cisco Unified Communications Manager Business Edition
- Contact Center:
  - Cisco Unified Contact Center Express
  - Cisco Unified Contact Center Enterprise
  - Cisco Unified IP IVR
  - Cisco Unified Customer Voice Portal
- Messaging:
  - Cisco Unity
  - Cisco Unity Connection
  - Cisco Unity Express
- Instant messaging and presence: Cisco Unified Presence
- Conferencing:
  - Cisco Unified MeetingPlace Express

- Cisco Unified Videoconferencing
- System management:
  - Cisco Unified Communications Manager Serviceability Tools
  - Cisco Unified Operations Manager
  - Cisco Unified Service Monitor
  - Cisco Unified Service Statistics Manager
  - Cisco Unified Provisioning Manager
  - Cisco Monitor Manager and Monitor Director (for small or medium size deployments with Cisco Unified Communications Manager Express and or Cisco Unity Express)

### **Multisite Centralized Call Processing Model**

The Multisite Centralized Call Processing model is designed for distributed operations with a large central or headquarters site and multiple remote or branch sites. This model can support up to a total of 30,000 phones distributed among up to a maximum of 1000 sites. Based upon the bandwidth available, each site can support any number of users up to the overall total of 30,000 phones. The Multisite Centralized Call Processing model is suitable for businesses such as banks, which include a corporate headquarters and many local or regional offices.

In the Multisite Centralized Call Processing model, each branch site connects to the headquarters site or sites through a WAN. Branch sites receive call processing functions from the headquarters site. Failover capabilities at each branch site ensure that it can continue to operate if the WAN connection to the headquarters site is lost. Branch sites include small contact center capabilities.

The WAN connection between the headquarters and branch sites can be frame relay, MPLS, or site-to-site VPN. Each branch site can operate on a wired or wireless LAN. Connectivity with legacy PBXs in the headquarters site can be provided T1/E1 CAS, PRI, Q SIG, and DPNSS. Connectivity to the PSTN in the headquarters site is provided through various combinations of T1/E1 CAS and PRI. Local calling is achieved through gateway connectivity. Long distance calling for branch sites uses the WAN for on-net calling. Off-net long distance traffic is backhauled over the WAN to one or more drop-off gateways. This model is designed to be administered at the headquarters location.

Headquarters roles and endpoints are identical to those described in the "Single-Site Model" section above. Branch sites access the call processing capabilities in the headquarters site. While there are some executive phones, most employees use digital telephones and the central voice messaging system.

Some staff may take orders or provide technical support. This model provides basic contact center capabilities in the branches to handle these requirements.

## Supported Applications

The Multisite Centralized Call Processing model supports applications that provide comprehensive features for all sites. These applications include:

- Call processing:

- Cisco Unified Communications Manager (in central site)
- Cisco Unified Communications Manager Express for fixed remote teleworker applications (in central site)
- Cisco Unified Communications Manager Business Edition (in central site)
- Unified SRST or Cisco Unified Communications Manager Express in SRST mode (as backup for Cisco Unified Communications Manager in branch sites and for Cisco Unified Communications Manager Business Edition in branch or central sites).

- Contact Center:

- Cisco Unified Contact Center Enterprise (in headquarters)
- Cisco Unified Contact Center Express (based in headquarters)
- Cisco Unified Customer Voice Portal (for queueing and self-service at headquarters or branches). Unified Customer Voice Portal is an interactive voiceXML-based response (IVR) solution that provides carrier-class IVR and IP switching services on Voice over IP (VoIP) networks. You can integrate Unified CVP with Unified Contact Center Enterprise or can deploy as a self-service IVR solution.
- Cisco unified IP IVR for centralized queuing.

- Messaging:

- Cisco Unity (based in headquarters)
- Cisco Unity Connection

–Cisco Unity Express

- Instant messaging and presence: Cisco Unified Presence (based in headquarters)

- Conferencing:

- Cisco Unified MeetingPlace (based in headquarters)

- Cisco Unified Videoconferencing

- System management:

- Cisco Unified Operations Manager (based in headquarters)

- Cisco Unified Service Monitor (based in headquarters)

- Cisco Unified Service Statistics Manager (based in headquarters)

- Cisco Unified Provisioning Manager

- Cisco Monitor Manager and Monitor Director (for monitoring deployments with Cisco Unified Communications Manager Express and Cisco Unity Express or Cisco Unified Communications Manager Express in SRST mode as backup to Cisco Unified Communications Manager)

- Cisco netManager

- LAN Management Solution

### **Multisite Distributed Call Processing Model**

The Multisite Distributed Call Processing model is designed for organizations with large user populations or large numbers of geographically distributed sites resulting in the need for more than a single call processing entity. This model is suited for deployments that require multiple Cisco Unified Communications Manager clusters or Cisco Unified Communications Manager Express platforms. Each call processing entity in this model is configured as a Single-Site Model or Multisite Centralized Call Processing Model and each has a common dial plan and feature set. The Multisite Distributed Call Processing model is suitable for business operations that consist of multiple sites in various regions. Such operations include technology, manufacturing, transportation, and distribution and logistics companies. Each site in the Multisite Distributed Call Processing model can operate on a wired or wireless LAN. The intersite WAN connection can be frame relay, MPLS, or site-to-site VPN. Each branch site can operate on a wired or wireless LAN. Local calling is achieved through gateway connectivity at each site. Long distance

calling for each site uses the WAN for on-net calling. Off-net long distance traffic is backhauled over the WAN to one or more drop-off gateways.

## Supported Applications

The Multisite Distributed Call Processing model supports applications that provide powerful, flexible, and scalable features. These applications include:

- Call processing:

- Cisco Unified Communications Manager (large sites or deployments)
- Cisco Unified Communications Manager Business Edition
- Cisco Unified Communications Manager Express (smaller sites or deployments)

- Contact Center:

- Cisco Unified Contact Center Enterprise (in one or more locations)
- Cisco Unified IP IVR (for centralized queueing)
- Cisco Unified Customer Voice Portal (for centralized or distributed queueing and self-service). Unified Customer Voice Portal is an interactive voiceXML-based response (IVR) solution that provides carrier-class IVR and IP switching services on Voice over IP (VoIP) networks. You can integrate Unified CVP with Unified Contact Center Enterprise or can deploy as a self-service IVR solution.

- Messaging:

- Cisco Unity
- Cisco Unity Connection
- Cisco Unity Express

- Instant messaging and presence: Cisco Unified Presence (in one or more locations)

- Conferencing:

- Cisco Unified MeetingPlace
- Cisco Unified Videoconferencing

- System management:

- Cisco Unified Operations Manager
- Cisco Unified Service Monitor
- Cisco Unified Service Statistics Manager

- Cisco Unified Provisioning Manager
- Cisco Monitor Manager and Cisco Monitor Director
- Cisco netManager
- LAN Management Solution

### **Clustering Over IP WAN Call Processing Model**

The Clustering Over IP WAN Call Processing model is designed for organizations with large user populations across multiple sites that are connected by an IP WAN with the QoS features enabled. The Clustering Over IP WAN supports the two deployment models:

Local failover requires that you place the Unified Communications Manager subscriber and backup servers at the same site, with no WAN between them. This deployment model is ideal for two to four sites with Unified Communications Manager. Remote failover allows you to deploy primary and backup call processing servers split across the WAN. Using this deployment model, you may have up to eight sites with Unified Communications Manager subscribers being backed up by Unified Communications Manager subscribers at another site. You can also use a combination of the two deployment models to satisfy specific site requirements. For example, two main sites may each have primary and backup subscribers, with another two sites containing only a primary server each and utilizing either shared backups or dedicated backups at the two main sites. The Clustering Over IP WAN Call Processing model is suitable for business operations that consist of multiple sites in various regions connected over an IP WAN. Such operations include technology, manufacturing, transportation, and distribution and logistics companies.

The local failover and remote failover sites in the Clustering Over IP WAN Call Processing model operates over an IP WAN. The intersite WAN connection can be frame relay, MPLS, or site-to-site VPN. The IP WAN must conform to the following maximum delay and minimum bandwidth requirements:



- The maximum allowed round-trip time (RTT) between any two servers in the Unified Communication Manager cluster is 80 ms.
- A minimum of 1.544 Mbps (T1) bandwidth is required for Intra-Cluster Communication Signaling (ICCS) for every 10,000 busy hour call attempts (BHCA) between sites that are clustered over the WAN. This is a minimum bandwidth requirement for call control traffic, and it applies to deployments where directory numbers are not shared between sites that are clustered over the WAN.
- In addition to the bandwidth required for Intra-Cluster Communication Signaling (ICCS) traffic, a minimum of 1.544 Mbps (T1) bandwidth is required for database and other inter-server traffic for every remote subscriber server.

The IP WAN network should also be engineered to provide sufficient prioritized bandwidth for all ICCS traffic, especially the priority ICCS traffic. Standard QoS mechanisms must be implemented to avoid congestion and packet loss. If packets are lost due to line errors or other conditions, the ICCS packet will be retransmitted because it uses the TCP protocol for reliable transmission. The retransmission might result in a call being delayed during setup, disconnect (teardown), or other supplementary services during the call.

The local failover and remote failover sites in the Clustering Over IP WAN Call Processing model has the same user roles and endpoints that are described in the "Multisite Centralized Call Processing Model" section.

Some of the key advantages of clustering over the WAN are:

- Single point of administration for users for all sites within the cluster
- Feature transparency
- Shared line appearances
- Extension mobility
- Unified dial plan

## Supported Applications

The Clustering Over IP WAN Call Processing model supports applications that provide powerful, flexible, and scalable features. These applications include:

- Call processing:

- Cisco Unified Communications Manager (subscriber and backup)
- Cisco Unified Communications Manager Express (smaller sites or deployments)
- Unified SRST or Cisco Unified Communications Manager Express in SRST mode.

- Contact Center:

- Cisco Unified Contact Center Enterprise
- Cisco Unified IP IVR (for centralized queueing)
- Cisco Unified Customer Voice Portal (for centralized or distributed queuing and self-service). Unified Customer Voice Portal is an interactive voiceXML-based response (IVR) solution that provides carrier-class IVR and IP switching services on Voice over IP (VoIP) networks. You can integrate Unified CVP with Unified Contact Center Enterprise or can deploy as a self-service IVR solution.

- Messaging:

- Cisco Unity
- Cisco Unity Connection
- Cisco Unity Express

- Instant messaging and presence: Cisco Unified Presence

- Conferencing:

- Cisco Unified MeetingPlace
- Cisco Unified Videoconferencing

- System management:

- Cisco Unified Operations Manager
- Cisco Unified Service Monitor
- Cisco Unified Service Statistics Manager
- Cisco Unified Provisioning Manager
- Cisco Monitor Manager and Cisco Monitor Director (for deployments of Cisco Unified Communications Manager Express in SRST mode as a backup to Cisco Unified Communications Manager)
- Cisco netManager

## –LAN Management Solution

**Major Components of Deployment Models**

<b>Single-Site Model</b>	<b>Multisite Centralized Call Processing Model</b>	<b>Multisite Distributed Call Processing Model</b>	<b>Clustering Over IP WAN Call Processing model</b>	
Scale	<ul style="list-style-type: none"> <li>Up to 30,000 phones with Cisco Unified Communications Manager</li> <li>Up to 240 phones with Cisco Unified Communications Manager Express</li> <li>Up to 575 phones (and up to 500 users) with Cisco Unified Communications Manager Business Edition</li> </ul>	<ul style="list-style-type: none"> <li>Up to 30,000 phones and 1,000 sites with Cisco Unified Communications Manager</li> <li>Up to 240 phones with Cisco Unified Communications Manager Express for small or branch site or fixed remote teleworker applications</li> <li>Up to 575 phones (and 500 users) and up to a total of 20 sites</li> </ul>	<ul style="list-style-type: none"> <li>Up to 30,000 phones per Cisco Unified Communications Manager instance</li> <li>Up to 240 phones per Cisco Unified Communications Manager Express instance.</li> </ul>	<ul style="list-style-type: none"> <li>Up to 30,000 phones per Cisco Unified Communications Manager instance</li> </ul>

		with Cisco Unified Communications Manager Business Edition		
Call Processing	<ul style="list-style-type: none"> <li>• Cisco Unified Communications Manager</li> <li>• Cisco Unified Communications Manager Express</li> <li>• Cisco Unified Communications Manager Business Edition</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Communications Manager Business Edition (in central site)</li> <li>• Cisco Unified Communications Manager Express for fixed remote teleworker applications (in central site)</li> <li>• Unified SRST or Cisco Unified Communications Manager Express (as</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Communications Manager (in one or more locations)</li> <li>• Cisco Unified Communications Manager Express (in one or more locations)</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Communications Manager (subscriber and backup)</li> </ul>

		backup to Cisco Unified Communications Manager and Cisco Unified Communications Manager Business Edition)		
Contact Center	<ul style="list-style-type: none"> <li>• Cisco Unified Contact Center Enterprise</li> <li>• Cisco Unified Contact Center Express</li> <li>• Cisco Unified IP IVR</li> <li>• Cisco Unified Customer Voice Portal</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Contact Center Enterprise (based in headquarters)</li> <li>• Cisco Unified Contact Center Express (based in headquarters)</li> <li>• Cisco Unified Customer Voice Portal (in headquarters or branches)</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Contact Center Enterprise (in one or more locations)</li> <li>• Cisco Unified IP IVR</li> <li>• Cisco Unified Customer Voice Portal</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Contact Center Enterprise</li> <li>• Cisco Unified Customer Voice Portal</li> </ul>
Messaging	<ul style="list-style-type: none"> <li>• Cisco Unity</li> <li>• Cisco Unity Connection</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unity (based in headquarters)</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unity (in one or more locations)</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unity</li> <li>• Cisco Unity Connection</li> </ul>

	<ul style="list-style-type: none"> <li>• Cisco Unity Express</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unity Connection</li> <li>• Cisco Unity Express</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unity Connection</li> <li>• Cisco Unity Express</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unity Express</li> </ul>
Instant Messaging and Presence	<ul style="list-style-type: none"> <li>• Cisco Unified Presence</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Presence (in head- quarters)</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Presence (in one or more locations)</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Presence</li> </ul>
Conferenci ng	<ul style="list-style-type: none"> <li>• Cisco Unified Meeting-Place</li> <li>• Cisco Unified Video-conferencing</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Meeting-Place (based in head- quarters)</li> <li>• Cisco Unified Video-conferencing</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Meeting-Place (in one or more locations)</li> <li>• Cisco Unified Video-conferencing</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Meeting-Place</li> <li>• Cisco Unified Video-conferencing</li> </ul>
System Managem ent	<ul style="list-style-type: none"> <li>• Cisco Unified Operations Manager</li> <li>• Cisco Unified Service Monitor</li> <li>• Cisco Unified Service Statistics Manager</li> <li>• Cisco Unified</li> </ul>	<p>Based in head- quarters:</p> <ul style="list-style-type: none"> <li>• Cisco Unified Operations Manager</li> <li>• Cisco Unified Service Monitor</li> <li>• Cisco Unified Service Statistics Manager</li> </ul>	<p>Distributed:</p> <ul style="list-style-type: none"> <li>• Cisco Unified Operations Manager</li> <li>• Cisco Unified Service Monitor</li> <li>• Cisco Unified Service Statistics Manager</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Operations Manager</li> <li>• Cisco Unified Service Monitor</li> <li>• Cisco Unified Service Statistics Manager</li> <li>• Cisco Unified</li> </ul>

	<p>Provisioning Manager</p> <ul style="list-style-type: none"> <li>• Cisco Monitor Manager and Monitor Director (for small or medium size deployments with Cisco Unified Communications Manager Express and or Cisco Unity Express)</li> <li>• LAN Management Solution</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Provisioning Manager</li> <li>• Cisco Monitor Manager and Monitor Director (for monitoring deployments with Cisco Unified Communications Manager Express and Cisco Unity Express or Cisco Unified Communications Manager Express in SRST mode as backup to Cisco Unified Communications Manager)</li> <li>• Cisco netManager</li> </ul>	<ul style="list-style-type: none"> <li>• Cisco Unified Provisioning Manager</li> <li>• Cisco Monitor Manager and Monitor Director</li> <li>• Cisco netManager</li> <li>• LAN Management Solution</li> </ul>	<p>Provisioning Manager</p> <ul style="list-style-type: none"> <li>• Cisco Monitor Manager and Cisco Monitor Director (for deployments of Cisco Unified Communications Manager Express in SRST mode as a backup to Cisco Unified Communications Manager)</li> <li>• Cisco netManager</li> </ul>
--	---	--	---	---

		<ul style="list-style-type: none"> <li>• LAN Management Solution</li> </ul>		
Off-Premises Calling	<ul style="list-style-type: none"> <li>• PSTN via gateway</li> </ul>	<ul style="list-style-type: none"> <li>• Site to Site over IP WAN</li> <li>• PSTN as backup for branch sites</li> </ul>	<ul style="list-style-type: none"> <li>• Site to Site over IP WAN</li> <li>• PSTN for off-network calling</li> </ul>	<ul style="list-style-type: none"> <li>• Site to Site over IP WAN</li> </ul>

### Further Reading

<https://goo.gl/kfCkkj>

<https://goo.gl/doUgmD>

### User Management

Roles and user groups provide multiple levels of security to Cisco Unified Communications Manager Administration and to other applications. The system groups the resources that are available to Cisco Unified Communications Manager Administration and to other applications into roles. Each application comes with standard, predefined roles. Each application defines its own access privilege for Cisco Unified Communications Manager Administration. Administrators can configure additional roles for an application. A role contains, for a particular application, the list of resources that an application comprises. For each resource that a role comprises, the administrator defines the access privilege. For the Cisco Unified Communications Manager Administration application, the access privileges include read and update. Other applications specify their own access privileges.

Because Cisco Unified Communications Manager allows administrators to manage user groups, roles, and resources, no guarantee exists that a particular user group or role goes unchanged or that administrators will use the predefined user groups or roles.

**FULL GUIDE HAS 400+ PAGES.**



The system groups the resources that are available to Cisco Unified Communications Manager Administration and to other applications into roles. A role includes a collection of resources for an application, such as Cisco Unified Communications Manager Administration. The following types of roles exist:

- Custom roles—Administrator-defined roles that you configure in Cisco Unified Communications Manager Administration after a Cisco Unified Communications Manager installation; for example, a help desk role.
- Standard roles—Default roles that get created automatically with Cisco Unified Communications Manager installation; you cannot modify or delete standard roles, but you can copy them to create custom roles, which allows you to modify them for your preferences.

Each role contains a group of resources, with privileges assigned to each resource. For most applications with graphical user interfaces, such as Cisco Unified Communications Manager Administration, privileges allow you to perform tasks, such as viewing or updating data, in a specific window or a group of related windows, which are defined as resources in the Role Configuration window. For example, for the Standard CCM Feature Management role, you can view and configure message waiting in the Message Waiting Configuration window in Cisco Unified Communications Manager Administration. For each role that is associated with Cisco Unified Communications Manager Administration, the specified privilege allows a certain level of access to each of the resources (windows). For example, privileges specify the following access in Cisco Unified Communications Manager Administration:

- Read— Allows users in a user group to view data in specific windows (defined as resources), but the user(s) cannot modify data in the window. Buttons such as Insert, Delete, Update, and Reset do not display.

- Update**—Allows users in a user group to view and modify data in certain windows (defined as resources for the role). Users with the update privilege can perform operations such as Insert, Delete, Update, and Reset.

Other applications, such as CTI applications, specify their own access privileges and do not use the read and update privileges or a common list of resources (which are configuration windows in most cases); for example, the Standard CTI Allow Call Recording role allows CTI devices/CTI applications to record calls, and the Standard EM Authentication Proxy Rights manages Cisco Extension Mobility authentication rights for application users that interact with Cisco Extension Mobility.

Directories are specialized databases that are optimized for a high number of reads and searches, and occasional writes and updates. Directories typically store data that does not change often, such as employee information, user policies, user privileges, and group membership on the corporate network. Directories are extensible, meaning that the type of information stored can be modified and extended. The term directory schema defines the type of information stored, its container (or attribute), and its relationship to users and resources. The Lightweight Directory Access Protocol (LDAP) provides applications with a standard method for accessing and potentially modifying the information stored in the directory. This capability enables companies to centralize all user information in a single repository available to several applications, with a remarkable reduction in maintenance costs through the ease of adds, moves, and changes.

Authentication of end users and administrators of the voice and/or video applications using their corporate directory credentials is also a common requirement. Enabling directory authentication allows the IT department to deliver single log-on functionality while reducing the number of passwords each user needs to maintain across different corporate applications.

By default, all users are provisioned manually in the publisher database through the Unified CM Administration web interface. Cisco Unified CM has two types of users:

- End users — All users associated with a physical person and an interactive login. This category includes all Unified Communications users as well as Unified CM administrators when using the User Groups and Roles configuration (equivalent to the Cisco Multilevel Administration feature in prior Unified CM versions).
- Application users — All users associated with other Cisco Unified Communications features or applications, such as Cisco Attendant Console, Cisco Unified Contact Center Express, or Cisco Unified Communications Manager Assistant. These applications need to authenticate with Unified CM, but these internal "users" do not have an interactive login and serve purely for internal communications between applications.

Application User	Used by:
CCMAdministrator	Unified CM Administration (default "super user")
CCMQRTSecureSysUser	Cisco Quality Reporting Tool
CCMQRTSysUser	
CCMSysUser	Cisco Extension Mobility
IPMASecureSysUser	Cisco Unified Communications Manager Assistant
IPMASysUser	
WDSecureSysUser	Cisco WebDialer
WDSysUser	

End users access the Unified CM User Options page via HTTPS and authenticate with a username and password. If they have been configured as administrators by means of User Groups and Roles, they can also access the Unified CM Administration pages with the same credentials. Similarly, other Cisco features and applications authenticate to

Unified CM via HTTPS with the username and password associated with their respective application users.

The authentication challenge carried by the HTTPS messages are relayed by the web service on Unified CM to an internal library called Identity Management System (IMS). In its default configuration, the IMS library authenticates both end users and application users against the embedded database. In this way, both "physical" users of the Unified Communications system and internal application accounts are authenticated using the credentials configured in Unified CM. End users may also authenticate with their user name and a numeric password (or PIN) when logging into the Extension Mobility service from an IP phone. In this case, the authentication challenge is carried via HTTP to Unified CM but is still relayed by the web service to the IMS library, which authenticates the credentials against the embedded database.

In addition, user lookups performed by Unified Communications endpoints via the Directories button communicate with the web service on Unified CM via HTTP and access data on the embedded database.

#### **Further Reading**

<https://goo.gl/m4L8yZ>

<https://goo.gl/wZBJXv>