Official Cert Guide

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CCNP Collaboration Cloud and Edge Solutions

CLCEI 300-820

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About the Authors

Anyone who has worked with **Jason Ball** or has sat in one of his classes knows that his enthusiasm for collaboration is matched only by his engaging zeal for teaching. Jason's current position as a solution readiness engineer in Collaboration for Cisco awards him with the opportunity to create and provide training to Cisco partners on new, innovative collaboration solutions as Cisco releases them. He has been operating as a collaboration engineer for more than 11 years and holds 19 different certifications, including a CCNP Collaboration certification and a Cisco Certified Systems Instructor (CCSI) certification. He has been teaching Cisco Voice, Video, and Collaboration certification courses for as many years as he has been involved with Cisco.

Some of the accomplishments that Jason has achieved include serving as a subject matter expert (SME) for two certification courses Cisco has developed: the TVS Advanced Services Course and the CIVND2 certification course for the former CCNA Collaboration certification. He also wrote the Video Infrastructure Implementation (VII) Advanced Services course for Cisco, coauthored *CCNA Collaboration CIVND 210-065 Official Cert Guide* (Cisco Press, 2015), and was the sole author of *CCNP and CCIE Collaboration Core CLCOR 350-801 Official Cert Guide* (Cisco Press). Jason currently resides in Raleigh, North Carolina, with his wife and two children.

TJ Arneson is a Cisco Certified Systems Instructor (CCSI) who has had a history with Cisco products since his enlistment days in the U.S. Army. He has obtained both the CCNP Routing & Switching and Collaboration certifications. TJ's current position is a Customer Success Specialist for Cisco Systems, where he is enabling and empowering customers through the Customer Experience (CX) team under the Service Provider theater. TJ currently resides in sunny Tampa, Florida. When he is not working, he is either fishing in Tampa Bay or grinding levels in video games with his wife.

About the Technical Reviewers

Jeff Hubbard, CCNP Collaboration, CCSI No. 34456, is an engineering project manager with Cisco focusing on training products in the Cloud Collaboration segment. He has been in the technology industry for more than 30 years in a wide variety of roles, and devoted himself solely to Cisco products beginning in 2008, when he started working as a Cisco Certified Systems Instructor with an emphasis on video and voice solutions. In his free time Jeff is an avid motorcyclist and spends most of his time exploring the less-traveled dirt roads of Colorado's Rocky Mountains.

Daniel Ball is a leader in Cisco Collaboration technologies, with a strong background in higher education. He is currently a senior training specialist for PCH Collaboration, focusing on programmability and API integrations. Daniel also maintains a growing YouTube channel called Collab Crush, which is dedicated to promoting quality training for the Cisco Collaboration solution. Daniel received a Bachelor of Arts degree from the University of Texas at Austin and a Master of Science degree in Education from Shenandoah University. His Cisco certifications include CCNA Route/Switch, CCNA Collaboration, and CCNP Collaboration. Currently, Daniel lives in Kobe, Japan, with his wife, Miki, and two daughters, Midori and Hana.

Dedications

I would like to dedicate my contribution in this book to my wife of 24 years. The love, encouragement, and support she has offered have been the strength that has sustained me throughout this endeavor. Every accomplishment I have achieved has been encouraged by her cheering for me from the sidelines. She is the best partner and friend anyone could ask for.

—*Jason*

I would like to dedicate my half of this book to my wife of 8 years as she has been through deployments, heavy travel for work, and the strain of working on her own career on top of that. Jessica has always been a best friend and has grown into a partner in the journey of life.

—*TJ*

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We would also like to express our gratitude to Eleanor Bru, development editor of this book. We were so incredibly lucky to work with her on this text. She has always been a strong professional who takes the time to ensure the job gets done correctly the first time. Without her, this book would not have been possible, as she worked patiently with us to make this book a reality.

The perceptiveness and expertise of project editor, Tonya Simpson, were integral and vital to this book. Her keenness of insight, understanding, and intuition enabled us to produce quality material. We are thankful for her expertise as we could not accomplish this without her.

Finally, we would like to acknowledge Nancy Davis. You, too, have been a huge part of the success of this book. You constantly had to stay on top of TJ and me to ensure we met our deadlines, and you offered great feedback in the chapters that helped shape the final version of this book. You were always professional, yet gentle and easy to work with. We have enjoyed working with you and would love the opportunity to work with you again.

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Online Elements

Introduction

The Implementing Cisco Collaboration Cloud and Edge Solutions v1.0 (CLCEI 300-820) exam is a 90-minute exam associated with the CCNP Collaboration and Cisco Certified Specialist – Collaboration Cloud & Edge Implementation certifications. This exam tests a candidate's knowledge of collaboration cloud and edge solutions, Expressway configurations, and Cisco Webex Teams hybrid and emerging technologies. The course, Implementing Cisco Collaboration Cloud and Edge Solutions, helps candidates to prepare for this exam.

TIP You can review the exam blueprint from the Cisco website at https://learningnetwork.cisco.com/s/clcei-exam-topics.

This book gives you the foundation and covers the topics necessary to start your CCNP Collaboration or CCIE Collaboration journey.

The CCNP Collaboration Certification

The CCNP Collaboration certification is one of the industry's most-respected certifications. To earn the CCNP Collaboration certification, you must pass two exams: the CLCOR exam covered in *CCNP and CCIE Collaboration Core CLCOR 350-801 Official Cert Guide*, and one Collaboration concentration exam of your choice, so you can customize your certification to your technical area of focus.

TIP The CLCOR core exam is also the qualifying exam for the CCIE Collaboration certification. Passing this exam is the first step toward earning both of these certifications.

The following are the CCNP Collaboration concentration exams:

- Implementing Cisco Collaboration Applications (CLICA 300-810)
- Implementing Cisco Advanced Call Control and Mobility Services (CLACCM 300-815)
- Implementing Cisco Collaboration Cloud and Edge Solutions (CLCEI 300-820)
- Implementing Cisco Collaboration Conferencing (CLCNF 300-825)
- Automating and Programming Cisco Collaboration Solutions (CLAUTO 300-835)

TIP CCNP Collaboration now includes automation and programmability to help you scale and customize your Collaboration infrastructure. If you pass the Automating and Programming for Cisco Collaboration Solutions (CLAUTO 300-835) exam, the Implementing and Operating Cisco Collaboration Core Technologies (CLCOR 350-801) exam, and the Developing Applications Using Cisco Core Platforms and APIs (DEVCOR 350-901) exam, you will achieve the CCNP Collaboration and DevNet Professional certifications with only three exams. Every exam earns an individual Specialist certification, allowing you to get recognized for each of your accomplishments, instead of waiting until you pass all the exams.

There are no formal prerequisites for CCNP Collaboration. In other words, you do not have to pass the CCNA Collaboration or any other certifications in order to take CCNP-level exams. The same goes for the CCIE exams. On the other hand, CCNP candidates often have three to five years of experience in IT and Collaboration.

Cisco considers ideal candidates to be those who possess the following:

- Working knowledge of fundamental terms of computer networking, including LANs, WANs, switching, and routing
- Basics of digital interfaces, public switched telephone networks (PSTNs), and Voice over IP (VoIP)
- Fundamental knowledge of converged voice and data networks and Cisco Unified Communications Manager deployment

The CCIE Collaboration Certification

The CCIE Collaboration certification is one of the most admired and elite certifications in the industry. The CCIE Collaboration program prepares you to be a recognized technical leader. To earn the CCIE Collaboration certification, you must pass the Implementing and Operating Cisco Collaboration Core Technologies (CLCOR 350-801) exam and an eight-hour, hands-on lab exam. The lab exam covers very complex Collaboration network scenarios. These scenarios range from designing through deploying, operating, and optimizing Collaboration solutions.

Cisco considers ideal candidates to be those who have five to seven years of experience with designing, deploying, operating, and optimizing Collaboration technologies and solutions prior to taking the exam. Additionally, candidates will need to possess the following:

- Understand capabilities of different technologies, solutions, and services
- Translate customer requirements into solutions
- Assess readiness to support proposed solutions
- Deploy a Cisco Collaboration solution
- Operate and optimize a Cisco Collaboration solution

The Exam Objectives (Domains)

The Implementing Cisco Collaboration Cloud and Edge Solutions v1.0 (CLCEI 300-820) exam is broken down into four major domains. The contents of this book cover each of the domains and the subtopics included in them as illustrated in the following descriptions.

The following table breaks down each of the domains represented in the exam:

Domain	Percentage of Representation in Exam
1: Key Concepts	25%
2: Initial Expressway Configurations	25%
3: Mobile and Remote Access	25%
4: Cisco Webex Technologies	25%

The following topics are general guidelines for the content likely to be included on the exam; however, other related topics may also appear on any specific delivery of the exam. To better reflect the contents of the exam and for clarity purposes, the following guidelines might change at any time without notice. Here are the details of each domain and where the exam objectives are covered in the book:

Domain 1: Key Concepts		Chapter Where This Is Covered
1.1	Describe the complications of NAT in a Collaboration environment	Chapter 10
1.2	Describe the purpose of ICE, TURN, and STUN	Chapter 10
1.3	Describe Expressway media traversal	Chapter 10
1.4	Describe protocol interworking on the Expressway	Chapter 3
1.4.a	*SIP < > H.323*	Chapter 3
1.4.b	*IPv4 and IPv6*	Chapter 3
1.5	Describe Expressway Licensing	Chapter 1
1.5.a	*Option keys*	Chapter 1
1.5.b	*Release key*	Chapter 1
1.5.c	*License consumption*	Chapter 1
1.6	Describe SIP media encryption mode	Chapter 5
1.6.a	*Auto*	Chapter 5
1.6.b	*Force encrypted*	Chapter 5
1.6.c	*Force unencrypted*	Chapter 5
1.6.d	*Best effort*	Chapter 5
1.7	Describe Expressway Core dial plan elements	Chapter 7
1.7.a	*Transforms*	Chapter 7
1.7.b	*Search rules*	Chapter 9
1.7.c	*Zones*	Chapter 9
1.7.d	*Regular expressions*	Chapter 4
1.7.e	*Pipes and links*	Chapter 8
1.8	Describe key Expressway settings	Chapter 2
1.8.a	*DNS*	Chapter 2
1.8.b	*Network interfaces*	Chapter 2

Domain 1: Key Concepts		Chapter Where This Is Covered
1.8.c	*Certificates*	Chapter 5
1.8.d	*QoS*	**Chapter 2**
1.8.e	*Clustering*	Chapter 11
1.8.f	*Network firewall rules*	Chapter 2
1.9	Describe Expressway backup and restore procedure (standalone and cluster)	Chapter 2
Domain 2: Initial Expressway Configurations		
2.1	Configure key Expressway settings	Chapter 2
2.1.a	*DNS*	Chapter 2
2.1.b	*Network interfaces*	Chapter 2
2.1.c	*Certificates*	Chapter 5
2.1.d	*QoS*	Chapter 2
2.1.e	*Clustering*	Chapter 11
2.1.f	*Network firewall rules*	Chapter 2
2.2	Configure Expressway Core dial plan elements	Chapter 7
2.2.a	*Transforms*	Chapter 7
2.2.b	*Search rules*	Chapter 4
2.2.c	*Zones*	Chapter 9
2.2.d	*Regular expressions*	Chapter 4
2.2.e	*Pipes and links*	Chapter 8
2.3	Configure toll fraud prevention on Expressway series (no custom CPL scripts)	Chapter 7
2.4	Configure a Business to Business (B2B) collaboration solution	Chapter 12
2.4.a	*DNS records (focus on Microsoft DNS)*	Chapter 10
2.4.b	*Certificates (focus on Microsoft CA)*	Chapter 5
2.4.c	*Traversal Zones*	Chapter 10
2.4.d	*Neighbor Zones*	Chapter 9
2.4.e	*Transforms*	Chapter 7
2.4.f	*Search rules*	Chapter 9
2.4.g	*SIP trunk integration with Cisco Unified Communications Manager*	Chapter 9
2.5	Troubleshoot a Business to Business (B2B) collaboration solution	Chapter 12
2.5.a	*DNS records (focus on Microsoft DNS)*	Chapter 12
2.5.b	*Certificates (focus on Microsoft CA)*	Chapter 12
2.5.c	*Traversal Zones*	Chapter 12
2.5.d	*Neighbor Zones*	Chapter 12

Domain 1: Key Concepts		Chapter Where This Is Covered
2.5.e	*Transforms*	Chapter 12
2.5.f	*Search rules*	Chapter 12
2.5.g	*SIP trunk integration with Cisco Unified Communications Manager*	Chapter 12
Domain 3: Mobile and Remote Access		
3.1	Configure a Mobile and Remote Access (MRA) solution	Chapter 14
3.1.a	*DNS records types (not platform-specific)*	Chapter 14
3.1.b	*Certificates (not platform specific, covers Unified Communications Manager, IM&P, Expressways, Unity Connection)*	Chapter 14
3.1.c	*Unified Communications traversal zones*	Chapter 14
3.1.d	*Unified Communications configuration on Expressway*	Chapter 14
3.1.e	*HTTP allow list*	Chapter 14
3.1.f	*SIP trunk security profile on Cisco Unified Communications Manager*	Chapter 14
3.2	Troubleshoot a Mobile and Remote Access (MRA) solution	Chapter 15
3.2.a	*DNS records (focus on Microsoft DNS)*	Chapter 15
3.2.b	*Certificates (focus on Microsoft CA, covers Unified Communications Manager, IM&P, Expressways, Unity Connection)*	Chapter 15
3.2.c	*Unified Communications traversal zones*	Chapter 15
3.2.d	*Unified Communications configuration on Expressway*	Chapter 15
3.2.e	*HTTP allow list*	Chapter 15
3.2.f	*SIP trunk security profile on Cisco Unified Communications Manager*	Chapter 15
Domain 4: Cisco Webex Technologies		
4.1	Describe the signaling and media flows used in a Cisco Webex Video Mesh deployment	Chapter 20
4.2	Configure Webex Hybrid Services/Connector	Chapter 16
4.2.a	*Calendar Service (Office 365, Microsoft Exchange, One Button to Push)*	Chapters 16 and 18
4.2.b	*Message Service (Deployment requirements; Expressway requirements, certificates, CallManager prerequisites, IM&P prerequisites, deployment models)*	Chapters 16 and 19

Domain 1: Key Concepts		Chapter Where This Is Covered
4.2c	*Directory Services (Deployment requirements; deployment models, infrastructure requirements, active directory configuration, synchronization, Webex user service assignment)*	Chapters 16 and 17
4.2.d	*Video Mesh (Deployment requirements including: bandwidth, clustering, endpoint support, video call capacity, ports and protocols, deployment models)*	Chapters 16 and 20
4.3	Describe Cisco Jabber for Cloud and Hybrid deployments with Cisco Webex Messenger	Chapter 21

Steps to Becoming a CCNP Collaboration Certified Engineer

To become a CCNP Collaboration Certified Engineer, you must first take and pass the CLCOR 350-801 exam. Passing this exam alone will automatically earn the Cisco Certified Specialist – Collaboration certification. You will then need to pass one of the collaboration specialization exams of your choosing, such as the CLCEI 300-820 exam. Passing these two exams will earn you the CCNP Collaboration certification. All Cisco certification exams are managed by the Pearson Vue testing organization. Use the following steps to sign up for your Cisco exam.

Signing Up for the Exam

The steps required to sign up for the CCNP Collaboration CLCEI 300-820 exam are as follows:

1. Navigate to **https://home.pearsonvue.com/cisco**.
2. To schedule a Cisco exam, you must first have a CCO ID you created on the Cisco website. Then you must create a Pearson VUE login and link it to the CCO ID. After all this is created, you must sign in to the Pearson VUE site to schedule the exam. Click **Sign In** from the column on the right side of the screen and enter your login credentials.
3. Once signed in click on the View exams button.
4. In the Find an Exam box, enter **300-820** and then click the **300-820: Implementing Cisco Collaboration Cloud and Edge Solutions** name when it appears. Click **Go** to proceed to the next screen.
5. Select either the **At a test center** or the **Online at my home or office** option for where you want to take the exam, read through the information on the screen related to your choice, then click on the next button at the bottom of the screen.
6. Continue to follow the steps on the screen. The options will vary based on your selection from the previous step. You will also need to provide payment for the exam you're scheduling. The CLCEI 300-820 exam costs $300 USD.

Facts About the Exam

The exam is a computer-based test. It consists of multiple-choice questions only. To take the test, you must bring two forms of ID; one must be a government-issued identification card with a photo. The second can be any official ID with your name on it, such as a Social Security card, employee ID card, or credit card, as long as it has your signature on it.

About the CCNP CLCEI 300-820 Official Cert Guide

Although this book does not map sequentially to the topic areas of the exam, all topic areas on the exam are covered in this book. This book cannot contain the personal experience and hands-on exposure to the equipment needed to answer some of the questions that may be asked in the exam. However, it was our intent to write this book in a manner that provides a slow buildup to the technologies that are being tested so that you will not only be better prepared to pass the test but also develop a solid understanding of the underlying technologies examined in this book. This book also uses a number of features to help you understand the topics and prepare for the exam.

Objectives and Methods

This book uses several key methodologies to help you discover the exam topics on which you need more review, help you fully understand and remember those details, and help you prove to yourself that you have retained your knowledge of those topics. This book does not try to help you pass the exam only by memorization; it seeks to help you to truly learn and understand the topics. This book is designed to help you pass the CCNP CLCEI 300-820 exam by using the following methods:

- Helping you discover which exam topics you have not mastered
- Providing explanations and information to fill in your knowledge gaps
- Supplying exercises that enhance your ability to recall and deduce the answers to test questions
- Providing practice exercises on the topics and the testing process via test questions on the companion website

Book Features

To help you customize your study time using this book, the core chapters have several features that help you make the best use of your time:

- **Foundation Topics:** These are the core sections of each chapter. They explain the concepts for the topics in that chapter.
- **Exam Preparation Tasks:** After the "Foundation Topics" section of each chapter, the "Exam Preparation Tasks" section lists a series of study activities that you should do at the end of the chapter:
  - **Review All Key Topics:** The Key Topic icon appears next to the most important items in the "Foundation Topics" section of the chapter. The Review All Key

Topics activity lists the key topics from the chapter, along with their page numbers. Although the contents of the entire chapter could be on the exam, you should definitely know the information listed in each key topic, so you should review these areas.

- **Define Key Terms:** Although the CCLEI exam may be unlikely to ask a question such as "Define this term," the exam does require that you learn and know a lot of terminology. This section lists the most important terms from the chapter, asking you to write a short definition and compare your answer to the glossary at the end of the book.
- **Complete Memory Tables:** Open Appendix C from the book's website and print the entire thing or print the tables by major part. Then complete the tables.
- **Review Questions:** Confirm that you understand the content that you just covered by answering these questions and reading the answer explanations.

- **Web-Based Practice Exam:** The companion website includes the Pearson Test Prep practice test engine that enables you to take practice exam questions. Use it to prepare with a sample exam and to pinpoint topics where you need more study.

How This Book Is Organized

This book contains 21 core chapters. Chapter 22 includes preparation tips and suggestions for how to approach the exam. Each core chapter covers a subset of the topics on the CLCEI 300-820 exam. The core chapters map to the CLCEI 300-820 exam topic areas and cover the concepts and technologies that you will encounter on the exam. Refer to the exam objective/chapter mapping table as a reference to see which objectives are covered in which chapters. Also, each chapter includes a list of objectives covered in that chapter for easy reference.

The Companion Website for Online Content Review

All the electronic review elements, as well as other electronic components of the book, exist on this book's companion website.

To access the companion website, which gives you access to the electronic content with this book, start by establishing a login at the Cisco Press website and registering your book. To do so, simply go to https://www.ciscopress.com/register and enter the ISBN of the print book: **9780136733720**. After you have registered your book, go to your account page and click the **Registered Products** tab. From there, click the **Access Bonus Content** link to get access to the book's companion website.

Note that if you buy the Premium Edition eBook and Practice Test version of this book from Cisco Press, your book will automatically be registered on your account page. Simply go to your account page, click the **Registered Products** tab, and select **Access Bonus Content** to access the book's companion website.

Please note that many of our companion content files can be very large, especially image and video files.

If you are unable to locate the files for this title by following the preceding steps, please visit https://www.pearsonITcertification.com/contact and select the **Site Problems/ Comments** option. Our customer service representatives will assist you.

How to Access the Pearson Test Prep Practice Test Software

You have two options for installing and using the Pearson Test Prep software: a web app and a desktop app. To use the Pearson Test Prep software, start by finding the registration code that comes with the book. You can find the code in these ways:

- **Print book:** Look in the cardboard sleeve in the back of the book for a piece of paper with your book's unique PTP code.
- **Premium Edition:** If you purchase the Premium Edition eBook and Practice Test directly from the Cisco Press website, the code will be populated on your account page after purchase. Just log in at https://www.ciscopress.com, click **Account** to see details of your account, and click the **Digital Purchases** tab.
- **Amazon Kindle:** For those who purchase a Kindle edition from Amazon, the access code will be supplied directly from Amazon.
- **Other Bookseller eBooks:** Note that if you purchase an eBook version from any other source, the practice test is not included because other vendors to date have not chosen to vend the required unique access code.

NOTE Do not lose the activation code, because it is the only means with which you can access the QA content with the book.

Once you have the access code, to find instructions about both the PTP web app and the desktop app, follow these steps:

Step 1. Open this book's companion website, as shown earlier in this Introduction under the heading "The Companion Website for Online Content Review."

Step 2. Click the **Practice Exams** button.

Step 3. Follow the instructions listed there both for installing the desktop app and for using the web app.

Note that if you want to use the web app only at this point, just navigate to https://www.pearsontestprep.com, establish a free login if you do not already have one, and register this book's practice tests using the registration code you just found. The process should take only a couple of minutes.

NOTE Amazon eBook (Kindle) customers: It is easy to miss Amazon's email that lists your PTP access code. Soon after you purchase the Kindle eBook, Amazon should send an email. However, the email uses very generic text and makes no specific mention of PTP or practice exams. To find your code, read every email from Amazon after you purchase the book. Also do the usual checks for ensuring your email arrives, such as checking your spam folder.

NOTE Other eBook customers: As of the time of publication, only the publisher and Amazon supply PTP access codes when you purchase their eBook editions of this book.

Customizing Your Exams

Once you are in the exam settings screen, you can choose to take exams in one of three modes:

- **Study mode:** Allows you to fully customize your exams and review answers as you are taking the exam. This is typically the mode you would use first to assess your knowledge and identify information gaps.
- **Practice Exam mode:** Locks certain customization options, as it is presenting a realistic exam experience. Use this mode when you are preparing to test your exam readiness.
- **Flash Card mode:** Strips out the answers and presents you with only the question stem. This mode is great for late-stage preparation when you really want to challenge yourself to provide answers without the benefit of seeing multiple-choice options. This mode does not provide the detailed score reports that the other two modes do, so you should not use it if you are trying to identify knowledge gaps.

In addition to these three modes, you will be able to select the source of your questions. You can choose to take exams that cover all of the chapters, or you can narrow your selection to just a single chapter or the chapters that make up specific parts in the book. All chapters are selected by default. If you want to narrow your focus to individual chapters, simply deselect all the chapters and then select only those on which you wish to focus in the Objectives area.

You can also select the exam banks on which to focus. Each exam bank comes complete with a full exam of questions that cover topics in every chapter. You can have the test engine serve up exams from all test banks or just from one individual bank by selecting the desired banks in the exam bank area.

There are several other customizations you can make to your exam from the exam settings screen, such as the time of the exam, the number of questions served up, whether to randomize questions and answers, whether to show the number of correct answers for

multiple-answer questions, and whether to serve up only specific types of questions. You can also create custom test banks by selecting only questions that you have marked or questions on which you have added notes.

Updating Your Exams

If you are using the online version of the Pearson Test Prep practice test software, you should always have access to the latest version of the software as well as the exam data. If you are using the Windows desktop version, every time you launch the software while connected to the Internet, it checks whether there are any updates to your exam data and automatically downloads any changes that were made since the last time you used the software.

Sometimes, due to many factors, the exam data may not fully download when you activate your exam. If you find that figures or exhibits are missing, you may need to manually update your exams. To update a particular exam you have already activated and downloaded, simply click the **Tools** tab and click the **Update Products** button. Again, this is an issue only with the desktop Windows application.

If you wish to check for updates to the Pearson Test Prep exam engine software, Windows desktop version, simply click the **Tools** tab and click the **Update Application** button. This ensures that you are running the latest version of the software engine.

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CHAPTER 3

Initial Configuration Settings on the Cisco Expressway

This chapter covers the following topics:

H.323 Settings: Explains the H.323 settings for the Cisco Expressway.

SIP and Domain Settings: Explains how to apply required SIP and domain settings for the Cisco Expressway.

Protocol Interworking on the Cisco Expressway: Focuses on interworking of H.323 and SIP signaling protocols via the Cisco Expressway.

Verifying Registration on the Cisco Expressway: Spotlights the registration process and verification of registration to the Cisco Expressway.

This chapter focuses on the initial configurations needed for the Cisco Expressway. It covers both the H.323 and SIP settings and includes interworking on the Expressway. You will also confirm these settings with the verification of registration.

This chapter covers the following objectives from the Implementing Cisco Collaboration Cloud and Edge Solutions (CLCEI) exam 300-820:

- 1.4.a Describe protocol interworking on the Expressway: SIP <-> H.323
- 1.4.b Describe protocol interworking on the Expressway: IPv4 and IPv6

"Do I Know This Already?" Quiz

The "Do I Know This Already?" quiz enables you to assess whether you should read this entire chapter thoroughly or jump to the "Exam Preparation Tasks" section. If you are in doubt about your answers to these questions or your own assessment of your knowledge of the topics, read the entire chapter. Table 3-1 lists the major headings in this chapter and their corresponding "Do I Know This Already?" quiz questions. You can find the answers in Appendix A, "Answers to the 'Do I Know This Already?' Quizzes and Review Questions."

Table 3-1 "Do I Know This Already?" Section-to-Question Mapping

Foundation Topics Section	Questions
H.323 Settings	1
SIP and Domain Settings	2
Protocol Interworking on the Cisco Expressway	3–4
Verifying Registration on the Cisco Expressway	5–6

CAUTION The goal of self-assessment is to gauge your mastery of the topics in this chapter. If you do not know the answer to a question or are only partially sure of the answer, you should mark that question as wrong for purposes of the self-assessment. Giving yourself credit for an answer you correctly guess skews your self-assessment results and might provide you with a false sense of security.

1. Registration, Admission, and Status (RAS), which is used between an H.323 endpoint and a gatekeeper to provide address resolution and admission control services, uses which ITU-T recommendation?
   - **a.** H.320
   - **b.** H.225.0
   - **c.** H.245
   - **d.** H.264
2. Which of the following is considered a SIP URI? (Choose three.)
   - **a.** username@domain
   - **b.** 123username
   - **c.** username @domain.com
   - **d.** 8088675309
   - **e.** +18088675309
   - **f.** username@172.16.0.50
3. Which of the following is *not* an H.323 <-> SIP Interworking Mode setting on the Cisco Expressway?
   - **a.** Off
   - **b.** On
   - **c.** Registered only
   - **d.** Gateway
4. Calls that utilize the interworking functionality are considered what type of call?
   - **a.** Registered
   - **b.** Rich Media Session
   - **c.** B2B
   - **d.** Audio-only
5. When registering an endpoint to the Cisco Expressway, what functions are the devices registering to? (Choose two.)
   - **a.** SIP registrar
   - **b.** SIP AOR
   - **c.** H.323 gateway
   - **d.** H.323 gatekeeper
   - **e.** H.320 gatekeeper

6. Which of the following are able to register to the Cisco Expressway? (Choose three.)
   a. H.323 ID
   b. SIP ZRTP
   c. E.164 number
   d. SIP URI
   e. H.320 URI

Foundation Topics

H.323 Settings

As we move into the essential functions of the Cisco Expressway, we begin with the multimedia communications over the packet-based network. Deriving from the ITU Telecommunication Standardization Sector (ITU-T) **H.320** that was utilized over **Integrated Services Digital Network (ISDN)**-based networks, **H.323** was published by the **International Telecommunications Union (ITU)** in November 1996 with an emphasis on enabling videoconferencing capabilities over a local-area network (LAN), but was quickly adopted by the industry as a means of transmitting voice communication over a variety of IP networks, including wide-area networks (WANs) and the Internet. H.323 also provides a framework that uses other protocols to describe the actual protocol:

- **H.225.0: Registration, Admission, and Status (RAS)**, which is used between an H.323 **endpoint** and a **gatekeeper** to provide address resolution and admission control services
- **H.225.0:** Call signaling, which is used between any two H.323 entities to establish communication based on Q.931
- **H.245:** Control protocol for multimedia communication, describes the messages and procedures used for capability exchange, opening and closing logical channels for audio, video, data, and various control and indication signals
- **Real-time Transport Protocol (RTP)/Real-time Transport Control Protocol (RTCP):** Protocols for sending or receiving multimedia information (voice, video, or text) between any two entities

The Cisco Expressway supports the H.323 protocol and it is also an H.323 gatekeeper. As an H.323 gatekeeper, the Expressway accepts registrations from H.323 endpoints and provides call control functions such as address translation and admission control. For an endpoint to use the Expressway as its H.323 gatekeeper or **SIP registrar**, the endpoint must first register with the Expressway.

To enable the Expressway as an H.323 gatekeeper, ensure that the H.323 Mode setting is set to On (**Configuration > Protocols > H.323**), as shown in Figure 3-1. H.323 mode is a powerful option that enables or disables functionality of the Cisco Expressway as an H.323 gatekeeper.

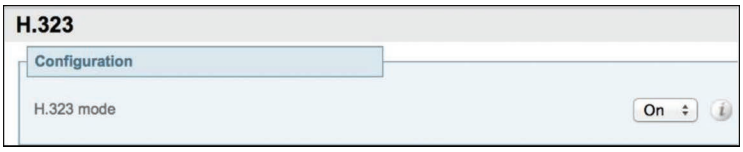

Figure 3-1 *H.323 Mode*

There are two ways an H.323 endpoint can locate an Expressway with which to register: manually or automatically. The option is configured on the endpoint itself under the Gatekeeper Discovery setting:

- If the mode is set to automatic, the endpoint tries to register with any Expressway it can find. It does this by sending out a Gatekeeper Discovery Request, to which eligible Expressways will respond.
- If the mode is set to manual, you must specify the IP address or the **fully qualified domain name (FQDN)** of the Expressway with which you want your endpoint to register, and the endpoint will attempt to register with that Expressway only.

You can prevent H.323 endpoints from being able to register automatically with the Expressway by disabling Auto Discovery on the Expressway (**Configuration > Protocols > H.323**).

While you are on the Configuration > Protocols > H.323 page, you can also configure the H.323 settings on the Expressway to fit your organization by utilizing Table 3-2 as a reference.

Table 3-2 H.323 Settings

Field	Description	Usage Tips
H.323 mode	Enables or disables H.323 on the Expressway. H.323 support is set to Off by default.	You must enable H.323 mode if you are clustering the Expressway, even if there are no H.323 endpoints in your deployment.
Registration UDP port	The listening port for H.323 UDP registrations.	The default Expressway configuration uses standard port numbers so you can use H.323 services out of the box without having to first set these up. The default port is 1719.
Registration conflict mode	Determines how the system behaves if an endpoint attempts to register an alias currently registered from another IP address. Reject: Denies the new registration. This is the default.	An H.323 endpoint may attempt to register with the Expressway using an alias that has already been registered on the Expressway from another IP address. The reasons for this could include: Two endpoints at different IP addresses are attempting to register using the same alias.

Field	Description	Usage Tips
	Overwrite: Deletes the original registration and replaces it with the new registration.	A single endpoint has previously registered using a particular alias. The IP address allocated to the endpoint then changes, and the endpoint attempts to re-register using the same alias. Reject is useful if your priority is to prevent two users registering with the same alias. Overwrite is useful if your network is such that endpoints are often allocated new IP addresses, because it will prevent unwanted registration rejections. Note that in a cluster, a registration conflict is only detected if the registration requests are received by the same peer.
Call signaling TCP port	The listening port for H.323 call signaling.	Default port: 1720.
Call signaling port range start and end	Specifies the port range used by H.323 calls after they are established.	The call signaling port range must be great enough to support all the required concurrent calls. Default start and end: 15000–19999.
Time to live	The interval (in seconds) at which an H.323 endpoint must re-register with the Expressway to confirm that it is still functioning. The default is 1800.	Some older endpoints do not support the ability to periodically re-register with the system. In this case, and in any other situation where the system has not had a confirmation from the endpoint within the specified period, it will send an IRQ to the endpoint to verify that it is still functioning. Note that by reducing the registration time to live too much, you risk flooding the Expressway with registration requests, which will severely impact performance. This impact is proportional to the number of endpoints, so you should balance the need for occasional quick failover against the need for continuous good performance.

Field	Description	Usage Tips
Call time to live	The interval (in seconds) at which the Expressway polls the endpoints in a call to verify that they are still in the call. The default is 120.	If the endpoint does not respond, the call is disconnected. The system polls endpoints in a call, whether the call type is traversal or non-traversal.
Auto discover	Determines whether the Expressway responds to Gatekeeper Discovery Requests sent out by endpoints. The default is On.	To prevent H.323 endpoints being able to register automatically with the Expressway, set Auto Discover to Off. This means that endpoints can only register with the Expressway if their Gatekeeper Discovery setting is Manual and they have been configured with the Expressway's IP address or FQDN.
Caller ID	Specifies whether the prefix of the ISDN gateway is inserted into the caller's **E.164** number presented on the destination endpoint.	Including the prefix allows the recipient to directly return the call.

SIP and Domain Settings

Session Initiation Protocol (SIP) is an ASCII-based, application-layer control protocol that can be used to establish, maintain, and terminate calls between two or more endpoints. SIP is an alternative protocol developed by the Internet Engineering Task Force (IETF) for multimedia conferencing over IP. SIP was originally standardized with IETF **Request for Comments (RFC)** 2543, "SIP: Session Initiation Protocol," published in March 1999. The current RFC 3261 (July 2002) makes the original RFC 2543 obsolete and has had many updates. The Cisco SIP implementation enables supported Cisco platforms to signal the setup of voice and multimedia calls over IP networks. SIP can be carried by several transport layer protocols including **Transmission Control Protocol (TCP)** and **User Datagram Protocol (UDP)**. SIP clients typically use TCP or UDP on port numbers 5060 or 5061 for SIP traffic to servers and other endpoints. Port 5060 is commonly used for nonencrypted signaling traffic, whereas port 5061 is typically used for traffic encrypted with Transport Layer Security (TLS). Normally SIP over UDP is not recommended because SIP messages for video systems are too large to be carried on a packet-based (rather than stream-based) transport.

Like other **Voice over IP (VoIP)** protocols, SIP is designed to address the functions of signaling and session management within a packet telephony network. Signaling allows call information to be carried across network boundaries. Session management provides the ability to control the attributes of an end-to-end call.

The Cisco Expressway supports SIP. It can act as a SIP registrar, as a SIP proxy, and as a SIP Presence Server. The Expressway can also provide **interworking** between SIP and H.323, translating between the two protocols to enable endpoints that only support one of the protocols to call each other.

To support SIP:

- SIP mode must be enabled.
- At least one of the SIP transport protocols (UDP, TCP, or TLS) must be active. Note that the use of UDP is not recommended for video because SIP message sizes are frequently larger than a single UDP packet.

For a SIP endpoint to be contactable via its alias, it must register its Address of Record (AOR) and its location with a SIP registrar. The SIP registrar maintains a record of the endpoint's details against the endpoint's AOR. The AOR is the alias through which the endpoint can be contacted; it is a SIP Uniform Resource Indicator (URI) and always takes the form *username@domain*. When a call is received for that AOR, the SIP registrar refers to the record to find its corresponding endpoint. (Note that the same AOR can be used by more than one SIP endpoint at the same time, although to ensure that all endpoints are found, they must all register with the same Expressway or Expressway cluster.)

A SIP registrar only accepts registrations for domains for which it is authoritative. The Expressway can act as a SIP registrar for up to 200 domains. To make the Expressway act as a SIP registrar, you must configure it with the SIP domains for which it will be authoritative. It will then handle registration requests for any endpoints attempting to register against that domain. Note that the Expressway will also accept registration requests where the domain portion of the AOR is either the FQDN or the IP address of the Expressway. Whether or not the Expressway accepts a registration request depends on its registration control settings.

In a Cisco Unified Communications deployment, endpoint registration for SIP devices may be provided by **Cisco Unified Communications Manager (Unified CM)**. In this scenario, the Expressway provides secure firewall traversal and line-side support for Unified CM registrations. When configuring a domain, you can select whether Unified CM or Expressway provides registration and provisioning services for the domain.

There are two ways a SIP endpoint can locate a registrar with which to register: manually or automatically. The option is configured on the endpoint itself under the SIP Server Discovery option (consult your endpoint user guide for how to access this setting; it may also be referred to as Proxy Discovery).

- If the Server Discovery mode is set to automatic, the endpoint sends a REGISTER message to the SIP server that is authoritative for the domain with which the endpoint is attempting to register. For example, if an endpoint is attempting to register with a URI of *john.smith@example.com*, the request will be sent to the registrar that is authoritative for the domain *example.com*. The endpoint can discover the appropriate server through a variety of methods including DHCP, Domain Name System (DNS), or provisioning, depending upon how the video communications network has been implemented.
- If the Server Discovery mode is set to manual, the user must specify the IP address or FQDN of the registrar (Expressway or Expressway cluster) with which the user wants to register, and the endpoint will attempt to register with that registrar only.

The Expressway is a SIP server and a SIP registrar:

- If an endpoint is registered to the Expressway, the Expressway will be able to forward inbound calls to that endpoint.
- If the Expressway is not configured with any SIP domains, the Expressway will act as a SIP server. It may proxy registration requests to another registrar, depending upon the SIP Registration Proxy Mode setting.

The Expressway acts as a SIP proxy server when SIP mode is enabled. The role of a proxy server is to forward requests (such as REGISTER and INVITE) from endpoints or other proxy servers on to further proxy servers or to the destination endpoint. If the Expressway receives a registration request for a domain for which it is not acting as a registrar (the Expressway does not have that SIP domain configured), then the Expressway may proxy the registration request onwards. This depends on the SIP Registration Proxy Mode setting, as follows:

- **Off:** The Expressway does not proxy any registration requests. They are rejected with a "403 Forbidden" message.
- **Proxy to known only:** The Expressway proxies the request in accordance with existing call processing rules, but only to known neighbor, traversal client, and traversal server zones.
- **Proxy to any:** This is the same as Proxy to Known Only but for all zone types (i.e., it also includes ENUM and DNS zones).

If the Expressway receives a proxied registration request, in addition to the Expressway's standard registration controls, you can also control whether the Expressway accepts the registration depending upon the zone through which the request was received. You do this through the Accept Proxied Registrations setting when configuring a zone. Proxied registrations are classified as belonging to the zone they were last proxied from. This is different from non-proxied registration requests, which are assigned to a subzone within the Expressway.

The Expressway, as a SIP Presence Server, supports the SIP-based SIMPLE protocol. It can act as a Presence Server and Presence User Agent for any of the SIP domains for which it is authoritative. The Presence Server can manage the presence information for locally registered endpoints whose information has been received via a SIP proxy (such as another Expressway).

The SIP page (**Configuration > Protocols > SIP**) is used to configure SIP settings on the Expressway, including:

- SIP functionality and SIP-specific transport modes and ports
- Certificate revocation checking modes for TLS connections
- Registration controls for standard and outbound registrations

Table 3-3 outlines the configurable settings for enabling SIP functionality and for configuring the various SIP-specific transport modes and ports.

Table 3-3 SIP Settings

Field	Description	Usage Tips
SIP mode	Enables and disables SIP functionality (SIP registrar and SIP proxy services) on the Expressway. The default is Off.	This mode must be enabled to use either the Presence Server or the Presence User Agent.
SIP protocols and ports	The Expressway supports SIP over UDP, TCP, and TLS transport protocols. Use the Mode and Port settings for each protocol to configure whether incoming and outgoing connections using that protocol are supported and, if so, the ports on which the Expressway listens for such connections. The default modes are ■ UDP mode: Off ■ TCP mode: Off ■ TLS mode: On ■ Mutual TLS mode: Off	At least one of the transport protocol modes must be set to On to enable SIP functionality. If you use both TLS and MTLS, Cisco recommends that you enable them on different ports. If you must use port 5061 for MTLS, you should avoid engaging the B2BUA, by switching Media Encryption mode to Auto on all zones in the call path.
TCP outbound port start/end	The range of ports the Expressway uses when TCP and TLS connections are established.	The range must be sufficient to support all required concurrent connections.
Session refresh interval	The maximum time allowed between session refresh requests for SIP calls. The default is 1800 seconds.	This is the time period after processing a request for which any session-stateful proxy must retain its state for this session.
Minimum session refresh interval	The minimum value the Expressway will negotiate for the session refresh interval for SIP calls. Default is 500 seconds.	This is the time period after processing a request for which any session-stateful proxy must retain its state for this session.
TLS handshake timeout	The timeout period for TLS socket handshake. The default is 5 seconds.	You might want to increase this value if TLS server certificate validation is slow (e.g., if OCSP servers do not provide timely responses) and thus cause connection attempts to timeout.
Certificate revocation checking mode	Controls whether revocation checking is performed for certificates exchanged during SIP TLS connection establishment.	Cisco recommends enabling revocation checking.

The Domains page (**Configuration > Domains**) lists the SIP domains managed by this Expressway. A domain name can comprise multiple levels. Each level's name can only contain letters, digits, and hyphens, with each level separated by a period (dot). A level name cannot start or end with a hyphen, and the final level name must start with a letter. An example valid domain name is *100.example-name.com*. You can configure up to 200 domains. (Note that you cannot configure domains on an Expressway-E.)

When the Expressway-C has been enabled for Unified Communications mobile and remote access, you must select the services that each domain will support. The options are as follows:

- **SIP registrations and provisioning on Expressway:** The Expressway is authoritative for this SIP domain. The Expressway acts as a SIP registrar for the domain (and Presence Server in the case of Video Communication Server (VCS) systems) and accepts registration requests for any SIP endpoints attempting to register with an alias that includes this domain. The default is On.
- **SIP registrations and provisioning on Unified CM:** Endpoint registration, call control, and provisioning for this SIP domain are serviced by Unified CM. The Expressway acts as a Unified Communications gateway to provide secure firewall traversal and line-side support for Unified CM registrations. The default is Off.
- **IM and Presence Service:** Instant messaging and presence services for this SIP domain are provided by the Unified CM **Instant Messaging and Presence (IMP)** service. The default is Off.
- **XMPP federation:** Enables **Extensible Messaging and Presence Protocol (XMPP)** federation between this domain and partner domains. The default is Off.
- **Deployment:** Associates the domain with the selected deployment, if there are multiple deployments. This setting is absent if there is only one deployment (there is always at least one).

Any domain configuration changes, when one or more existing domains are configured for IM and Presence services on Unified CM or XMPP federation, will result in an automatic restart of the **Universal Measurement and Calibration Protocol (XCP)** router on both Expressway-C and Expressway-E.

Protocol Interworking on the Cisco Expressway

The Interworking page (**Configuration > Protocols > Interworking**) lets you configure whether or not the Expressway acts as a gateway between SIP and H.323 calls. The translation of calls from one protocol to the other is known as *interworking*.

By default, the Expressway acts as a SIP–H.323 and H.323–SIP gateway but only if at least one of the endpoints that are involved in the call is locally registered. You can change this setting so that the Expressway acts as a SIP–H.323 gateway regardless of whether the endpoints involved are locally registered. You also have the option to disable interworking completely.

The options for the H.323 <-> SIP Interworking Mode setting are as follows:

Key Topic

- **Off:** The Expressway does not act as a SIP–H.323 gateway.
- **Registered only:** The Expressway acts as a SIP–H.323 gateway but only if at least one of the endpoints is locally registered.
- **On:** The Expressway acts as a SIP–H.323 gateway regardless of whether the endpoints are locally registered.

Cisco recommends that you leave this setting as Registered Only. Unless your network is correctly configured, setting it to On (where all calls can be interworked) may result in unnecessary interworking, for example, where a call between two H.323 endpoints is made over SIP, or vice versa.

Calls for which the Expressway acts as a SIP to H.323 gateway are **Rich Media Session (RMS)** calls. The Expressway always takes the media for SIP–H.323 interworked calls so that it can independently negotiate payload types on the SIP and H.323 sides, and Expressway will rewrite these as the media passes. Also, in a SIP SDP negotiation, multiple codec capabilities can be agreed (more than one video codec can be accepted) and the SIP device is at liberty to change the codec it uses at any time within the call. If this happens, because Expressway is in the media path, it will close and open logical channels to the H.323 device as the media changes (as required) so that media is passed correctly.

When searching a zone, the Expressway first performs the search using the protocol of the incoming call. If the search is unsuccessful, the Expressway may then search the zone again using the alternative protocol, depending on where the search came from and the H.323 <-> SIP Interworking Mode setting. Note that the zone must also be configured with the relevant protocols enabled (SIP and H.323 are enabled on a zone by default).

- If the request has come from a neighboring system and Interworking Mode is set to Registered Only, the Expressway searches the Local Zone using both protocols, and all other zones using the native protocol only (because it will interwork the call only if one of the endpoints is locally registered).
- If Interworking Mode is set to On, or the request has come from a locally registered endpoint, the Expressway searches the Local Zone and all external zones using both protocols.

SIP endpoints can only make calls in the form of URIs, such as *name@domain*. If the caller does not specify a domain when placing the call, the SIP endpoint automatically appends its own domain to the number that is dialed. If you dial 123 from a SIP endpoint, the search will be placed for 123@*domain*. If the H.323 endpoint being dialed is just registered as 123, the Expressway will not be able to locate the alias 123@*domain* and the call will fail. The solution is to do either of the following:

- Ensure all your endpoints, both H.323 and SIP, register with an alias in the form *name@domain*.
- Create a pre-search transform on the Expressway that strips the @*domain* portion of the alias for those URIs that are in the form of *number@domain*.

You will dive into pre-search Transforms in Chapter 7, "Cisco Expressway Call Processing Order," for more depth on how to accomplish this.

For SIP calls, the Expressway implements RFC 4733 (obsoletes RFC 2833) for **dual-tone multifrequency (DTMF)** signaling in RTP payloads. For H.323 calls, the Expressway implements H.245 **UserInputIndication** for DTMF signaling. **dtmf** is the only supported **UserInputCapability**. Expressway does not support any other H.245 user input capabilities (e.g., **basicString**, **generalString**). When the Expressway is interworking a call between SIP and

H.323, it also interworks the DTMF signaling, but only between RFC 4733 DTMF and the H.245 user input indicators **dtmf** and **basicString**.

Key Topic

The Expressway can also act as a gateway for calls between IPv4 and IPv6 devices. To enable this feature, select Both for the IP protocol on the IP page (**System > Network Interfaces > IP**). Calls for which the Expressway is acting as an IPv4 to IPv6 gateway are traversal calls and require a Rich Media Session license.

Verifying Registration on the Cisco Expressway

For an endpoint to use the Expressway as its H.323 gatekeeper or SIP registrar, the endpoint must first register with the Expressway. The Expressway can be configured to control which devices are allowed to register with it by using the following mechanisms:

- A device authentication process based on the username and password supplied by the endpoint
- A registration restriction policy that uses either Allow Lists or Deny Lists or an external policy service to specify which aliases can and cannot register with the Expressway
- Restrictions based on IP addresses and subnet ranges through the specification of subzone membership rules and subzone registration policies

You can use these mechanisms together. For example, you can use authentication to verify an endpoint's identity from a corporate directory and use registration restriction to control which of those authenticated endpoints may register with a particular Expressway. You can also control some protocol-specific behavior, including:

- The Registration Conflict Mode and Auto Discover settings for H.323 registrations
- The SIP registration proxy mode for SIP registrations

In a Cisco Unified CM deployment, endpoint registration for SIP devices may be provided by Unified CM. In this scenario, the Expressway provides secure firewall traversal and line-side support for Unified CM registrations. When configuring a domain, you can select whether Unified CM or Expressway provides registration and provisioning services for the domain.

H.323 systems such as gateways, multipoint control units (MCUs), and content servers can also register with an Expressway. They are known as locally registered services. These systems are configured with their own prefix, which they provide to the Expressway when registering. The Expressway then knows to route all calls that begin with that prefix to the gateway, MCU, or content server as appropriate. These prefixes can also be used to control registrations. SIP devices cannot register prefixes. If your dial plan dictates that a SIP device should be reached via a particular prefix, then you should add the device as a neighbor zone with an associated Search Rule using a pattern match equal to the prefix to be used.

When registering, the H.323 endpoint presents the Expressway with one or more of the following:

- **H.323 IDs**
- E.164 aliases
- URIs

Users of other registered endpoints can then call the endpoint by dialing any of these aliases. Note the following recommendations:

- Register your H.323 endpoints using a URI. This facilitates interworking between SIP and H.323, as SIP endpoints register using a URI as standard.
- Do not use aliases that reveal sensitive information. Due to the nature of H.323, call setup information is exchanged in an unencrypted form.

When registering, the SIP endpoint presents the Expressway with its contact address (IP address) and logical address (Address of Record). The logical address is considered to be its alias and generally is in the form of a URI.

An endpoint may attempt to register with the Expressway using an alias that is already registered to the system. How this is managed depends on how the Expressway is configured and whether the endpoint is SIP or H.323:

- **H.323:** An H.323 endpoint may attempt to register with the Expressway using an alias that has already been registered on the Expressway from another IP address. You can control how the Expressway behaves in this situation by configuring the Registration Conflict Mode setting on the H.323 page (**Configuration > Protocols > H.323**).
- **SIP:** A SIP endpoint will always be allowed to register using an alias that is already in use from another IP address. When a call is received for this alias, all endpoints registered using that alias will be called simultaneously. This SIP feature is known as *forking*.

All endpoints must periodically re-register with the Expressway to keep their registration active. If you do not manually delete the registration, the registration could be removed when the endpoint attempts to re-register, but this depends on the protocol being used by the endpoint:

- H.323 endpoints may use "light" re-registrations that do not contain all the aliases presented in the initial registration, so the re-registration may not get filtered by the restriction policy. If this is the case, the registration will not expire at the end of the registration timeout period and must be removed manually.
- SIP re-registrations contain the same information as the initial registrations, so they will be filtered by the restriction policy. This means that, after the list has been activated, all SIP registrations will disappear at the end of their registration timeout period.

The frequency of re-registrations is determined by the Registration Controls setting for SIP (**Configuration > Protocols > SIP**) and the Time to Live setting for H.323 (**Configuration > Protocols > H.323**).

Check that all endpoints that are expected to be registered are actually registered to the relevant Expressway and that they are registering the expected aliases. All successfully registered endpoints are listed on **Status > Registrations > By Device**. If the expected endpoints are not registered, review the following items:

- The endpoint's registration configuration. Is it configured to register with the Expressway-E if located on the external network/Internet, and to register with the Expressway-C if located on the internal network?
- The SIP domains.
- Any registration restriction configuration applied to the Expressway.

In some cases, home endpoints may fail to register when using **Service (SRV) records**. This can happen if the endpoint uses the home router for its DNS server and the router's DNS server software doesn't support SRV records lookup. (This also applies to the DNS server being used by a PC when Jabber Video is running on it.) If registration failure occurs, do either of the following:

- Change the DNS server on the endpoint to use a publicly available DNS server that can resolve SRV record lookups; for example, Google - 8.8.8.8.
- Change the SIP server address on the endpoint to use the FQDN of a node in the Expressway cluster and not the cluster SRV record, so that the device performs an AAAA or A record lookup.

Exam Preparation Tasks

As mentioned in the section "How to Use This Book" in the Introduction, you have a couple of choices for exam preparation: the exercises here, Chapter 22, "Final Preparation," and the exam simulation questions in the Pearson Test Prep Software Online.

Review All Key Topics

Review the most important topics in this chapter, noted with the Key Topics icon in the outer margin of the page. Table 3-4 lists a reference of these key topics and the page number on which each is found.

Key Topic

Table 3-4 Key Topics for Chapter 3

Key Topic Element	Description	Page Number
List	Interworking modes	55
Paragraph	IPv4 to IPv6 interworking	57
List	Registration aliases	58

Complete Tables and Lists from Memory

There are no memory tables or lists for this chapter.

Define Key Terms

Define the following key terms from this chapter and check your answers in the glossary:

Cisco Unified Communications Manager (Unified CM), dual-tone multifrequency (DTMF), E.164, endpoint, Extensible Messaging and Presence Protocol (XMPP), fully qualified domain name (FQDN), gatekeeper, H.225.0, H.245, H.320, H.323, H.323 ID, Instant Messaging and Presence (IMP), Integrated Services Digital Network (ISDN), International Telecommunications Union (ITU), interworking, Registration, Admission, and Status (RAS), Request for Comments (RFC), Rich Media Session (RMS), Service record (SRV), SIP registrar, Transmission Control Protocol (TCP), Universal Measurement and Calibration Protocol (XCP), User Datagram Protocol (UDP), Voice over IP (VoIP)

Q&A

The answers to these questions appear in Appendix A. For more practice with exam format questions, use the Pearson Test Prep practice test software.

1. Define the ITU-T H.323 standard and its core protocols.
2. What are the option modes of interworking on the Cisco Expressway and what do they imply?

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