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**CCNP
and CCIE
Collaboration
Core
CLCOR 350-801
Official Cert Guide
2nd Edition**

JASON BALL
CCSI No. 33717

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Jason Ball

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About the Author

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 currently works for Cisco on the Learning & Certifications team, helping manage all the collaboration certification learning content. He has been operating as a collaboration engineer since 2009 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.

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Dedications

I would like to dedicate this book to my wife, whom I married in May, 1997. 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.

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Special thanks must be awarded to my technical editor. I asked my brother, Daniel Ball, to do this for me because he has all the right expertise to keep me on my toes. He was an English major but worked in a technical position while he was going to school. Back then he was more of a programmer, but later he got into the Cisco Collaboration Solution when Cisco Spark (now Webex) was taking off. Since most of the changes to this edition of the book are related to Webex, it made perfect sense to have him come behind me and check my work. Plus, since he's my brother, he doesn't mind telling me when I'm wrong. So, thank you, Daniel, for having my back and doing such a great job with the technical editing.

I would also like to express my gratitude to Chris Cleveland, development editor of this book. I was so incredibly lucky to work with him again on this project. He is another truly exceptional example of excellence in the workplace. He is the top 1 percent. I'd like to thank Nancy Davis, Mandie Frank, and Brett Bartow. They each have worked patiently alongside me to help make this book a reality.

I dedicated the first edition of this book to the memory of a friend, colleague, and mentor of mine who passed away in March of 2020, so I would like to keep this dedication in this edition as well. When I first started with Tandberg, many years ago, James Lehto was one of the first mentors I had. He was always tough. He had a great depth of knowledge, and he expected others he worked with to have the same depth of knowledge. James also exhibited fairness. If you lacked knowledge, he would help guide you to understanding. This quality made him a great instructor. After Tandberg was acquired by Cisco, James continued to work for Cisco, and as opportunity presented itself, he would use me to develop content or act as a subject matter expert. Through this peer work relationship, we also developed a friendship that I valued to the day he was laid to rest. James was the one who suggested I write a book for Cisco Press and recommended me for the CIVND book years ago. If it wasn't for James, I wouldn't have written this book either. A professor I had in college once said, "What good is knowledge if you never share it?" James lived by that motto, and I live by that motto as well. So, as you read this book, remember James Lehto. For the knowledge shared in this book is not just from me, but from him and others who have shared their knowledge with me over the years.

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Command Syntax Conventions

The conventions used to present command syntax in this book are the same conventions used in the IOS Command Reference. The Command Reference describes these conventions as follows:

- **Boldface** indicates commands and keywords that are entered literally as shown. In actual configuration examples and output (not general command syntax), boldface indicates commands that are manually input by the user (such as a **show** command).
- *Italic* indicates arguments for which you supply actual values.
- Vertical bars (|) separate alternative, mutually exclusive elements.
- Square brackets ([]) indicate an optional element.
- Braces ({ }) indicate a required choice.
- Braces within brackets ({[]}) indicate a required choice within an optional element.

Other Features

In addition to the features in each of the core chapters, this book has supplementary study resources on the companion website, including the following:

- **Practice exams:** The companion website contains an exam engine that enables you to review practice exam questions. Use these to prepare with a sample exam and to pinpoint topics where you need more study.

To access this additional content, simply register your product. To start the registration process, go to www.ciscopress.com/register and log in or create an account.* Enter the product ISBN 9780138200947 and click **Submit**. After the process is complete, you will find any available bonus content under Registered Products.

*Be sure to check the box that you would like to hear from us to receive exclusive discounts on future editions of this product.

Introduction

The Implementing Cisco Collaboration Core Technologies (CLCOR 350-801) exam is the required “core” exam for the CCNP Collaboration and CCIE Collaboration certifications. If you pass the CLCOR 350-801 exam, you also obtain the Cisco Certified Specialist–Collaboration Core certification. This exam covers core Collaboration technologies, including infrastructure and design; protocols, codecs, and endpoints; Cisco IOS XE gateways and media resources; call control; QoS; and Collaboration applications.

TIP You can review the exam blueprint from the Cisco website at <https://learningnetwork.cisco.com/s/clcor-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 this book (which covers core Collaboration technologies) 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)
- 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 Cisco Collaboration Solutions (CLAUTO 300-835) exam, the 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 3 to 5 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
- Basic knowledge 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 CLCOR 350-801 exam and an 8-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 5 to 7 years of experience with designing, deploying, operating, and optimizing Collaboration technologies and solutions prior to taking the exam. Additionally, candidates will need to do 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 Core Technologies v1.1 (CLCOR 350-801) exam is broken down into six major domains. The contents of this book cover each of the domains and the subtopics included in them, as described next.

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

Domain	Percentage of Representation in Exam
1: Infrastructure and Design	20%
2: Protocols, Codecs, and Endpoints	20%
3: Cisco IOS XE Gateway and Media Resources	15%

Domain	Percentage of Representation in Exam
4: Call Control	25%
5: QoS	10%
6: Collaboration Applications	10%

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: Infrastructure and Design	Chapter(s) Where This Is Covered
1.1 Describe the Cisco on-premises, hybrid, and cloud collaboration solution design elements described in the SRND/PA	Chapters 6, 9, 13
<i>1.1.a Licensing (Smart, Flex)</i>	Chapter 6
<i>1.1.b Sizing</i>	Chapter 6
<i>1.1.c Bandwidth</i>	Chapter 6
<i>1.1.d High availability</i>	Chapter 6
<i>1.1.e Disaster recovery</i>	Chapter 6
<i>1.1.f Dial plan</i>	Chapter 6
<i>1.1.g Security (certificates, SRTP, TLS)</i>	Chapters 6, 9
<i>1.1.h QoS</i>	Chapters 6, 13
1.2 Describe the purpose of Edge devices in the Cisco Collaboration architecture such as Expressway and Cisco Unified Border Element	Chapters 20, 21
1.3 Configure these network components to support Cisco Collaboration solutions	Chapters 12, 13, 14
<i>1.3.a DHCP</i>	Chapters 5, 6
<i>1.3.b NTP</i>	Chapters 6, 14
<i>1.3.c CDP</i>	Chapters 5, 6
<i>1.3.d LLDP</i>	Chapters 5, 6
<i>1.3.e LDAP</i>	Chapters 5, 6
<i>1.3.f TFTP</i>	Chapters 5, 6
<i>1.3.g Certificates</i>	Chapters 6, 9
1.4 Troubleshoot these network components in a Cisco Collaboration solution	Chapters 30–34
<i>1.4.a DNS (A/AAA, SRV, Reverse Pointer Record (PTR))</i>	Chapter 30
<i>1.4.b NTP</i>	Chapter 30

Domain 1: Infrastructure and Design	Chapter(s) Where This Is Covered
<i>1.4.c LDAP integration on Cisco UCM</i>	Chapters 16, 31, 32
1.5 Explain these components to support Cisco Collaboration solutions	Chapter 14
<i>1.5.a SNMP</i>	Chapter 14
<i>1.5.b DNS</i>	Chapter 14
<i>1.5.c Directory Connector</i>	Chapter 22, 23
1.6 Describe Webex Control Hub features	Chapter 6, 23
Domain 2: Protocols, Codecs, and Endpoints	Chapter(s) Where This Is Covered
2.1 Troubleshoot these elements of a SIP conversation	Chapters 15, 30
<i>2.1.a Call set up and tear down</i>	Chapter 30
<i>2.1.b SDP</i>	Chapter 30
<i>2.1.c DTMF</i>	Chapter 15
2.2 Identify the collaboration codecs for a given scenario	Chapters 2, 3, 15
2.3 Deploy SIP endpoints	Chapters 5, 9, 17
<i>2.3.a Manual</i>	Chapter 17
<i>2.3.b Self provisioning</i>	Chapter 17
<i>2.3.c Bulk Administration Tool (BAT)</i>	Chapter 17
<i>2.3.d Onboarding cloud devices</i>	Chapter 22, 23
<i>2.3.e Device onboarding via activation codes (MRA/ on-premises)</i>	Chapter 17, 21
2.4 Troubleshoot SIP endpoints	Chapter 30
2.5 Describe SIP OAuth on Cisco UCM	Chapter 6
Domain 3: Cisco IOS XE Gateway and Media Resources	Chapter(s) Where This Is Covered
3.1 Configure voice gateway elements	Chapters 15
<i>3.1.a DTMF</i>	Chapters 15
<i>3.1.b Voice translation rules and profiles</i>	
<i>3.1.c Codec preference list</i>	
<i>3.1.d Dial peers</i>	
3.2 Troubleshoot ISDN PRI/BRI	
3.3 Identify the appropriate IOS XE media resources	Chapter 15
3.4 Describe cloud calling hybrid local gateway	Chapter 22, 24
Domain 4: Call Control	Chapter(s) Where This Is Covered
4.1 Describe the Cisco UCM digit analysis process	Chapter 18
4.2 Implement toll fraud prevention on Cisco UCM	Chapter 18
4.3 Configure globalized call routing in Cisco UCM	Chapter 18

Domain 1: Infrastructure and Design	Chapter(s) Where This Is Covered
<i>4.3.a Route patterns (traditional and +E.164)</i>	Chapters 18, 19
<i>4.3.b Translation patterns</i>	Chapter 19
<i>4.3.c Standard local route group</i>	Chapter 19
<i>4.3.d Transforms</i>	Chapter 19
<i>4.3.e SIP route patterns</i>	Chapters 18, 19
4.4 Describe Mobile and Remote Access (MRA)	Chapters 20, 21
4.5 Describe Webex Calling dial plan features	Chapter 22, 25, 26
<i>4.5.a Locations and numbers</i>	Chapter 22, 26
<i>4.5.b Outgoing and incoming permissions</i>	Chapter 22, 26
<i>4.5.c Transfer and forwarding restrictions</i>	Chapter 22
Domain 5: QoS	Chapter(s) Where This Is Covered
5.1 Describe problems that can lead to poor voice and video quality	Chapter 13
<i>5.1.a Latency</i>	Chapter 13
<i>5.1.b Jitter</i>	Chapter 13
<i>5.1.c Packet loss</i>	Chapter 13
<i>5.1.d Bandwidth</i>	Chapter 13
5.2 Describe the QoS requirements for voice and video	Chapter 13
5.3 Describe the class models for providing QoS on a network	Chapter 13
<i>5.3.a 4/5 Class model</i>	Chapter 13
<i>5.3.b 8 Class model</i>	Chapter 13
<i>5.3.c QoS Baseline model (11 Class)</i>	Chapter 13
5.4 Describe the purpose and function of these DiffServ values as it pertains to collaboration	Chapter 13
<i>5.4.a EF</i>	Chapter 13
<i>5.4.b AF41</i>	Chapter 13
<i>5.4.c AF42</i>	Chapter 13
<i>5.4.d CS3</i>	Chapter 13
<i>5.4.e CS4</i>	Chapter 13
5.5 Describe QoS trust boundaries and their significance in LAN-based classification and marking	Chapter 13
5.6 Describe and determine location-based CAC bandwidth requirements	Chapter 13
5.7 Configure LLQ (class map, policy map, service policy)	Chapter 13

Domain 1: Infrastructure and Design	Chapter(s) Where This Is Covered
Domain 6: Collaboration Applications	Chapter(s) Where This Is Covered
6.1 Configure Cisco Unity Connection mailbox and MWI	Chapters 27, 28
6.2 Configure Cisco Unity Connection SIP integration options to call control	Chapters 27, 28
6.3 Describe Cisco Unity Connection call handlers	Chapters 27, 28
6.4 Deploy Webex App	Chapter 29

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 Core 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 and CCIE Collaboration Core (CLCOR) 350-801 exam are as follows:

1. Navigate to <https://home.pearsonvue.com/>, select the **For Test Takers** drop-down list, and then select **Schedule an Exam**.
2. In the Start Here: Select Your Program box, enter **Cisco** and then select the **Cisco Systems** option that appears.
3. 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.
4. Two types of exams are available: proctored exams and unproctored online exams. All Cisco certifications use only proctored exams. After logging in, click the **Proctored Exams** button.
5. In the Find an Exam box, enter **350-801** and then click the **350-801: Implementing Cisco Collaboration Core Technologies** name when it appears. Click **Go** to proceed to the next screen.
6. Continue to follow the steps on the screen. You will need to select a testing center, date, and time to take the exam. A schedule of available times for the testing center you select is visible from this site. You will also need to provide payment for the exam you're scheduling. The CLCOR 350-801 exam costs US \$400.

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, and 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 CLCOR 350-801 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 my 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; instead, it seeks to help you to truly learn and understand the topics. This book is designed to help you pass the CCNP CLCOR 350-801 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 CLCOR exam may be unlikely to ask a question that asks you to define a 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, “Memory Tables Answer Key,” from the book’s website and print the entire thing or print the tables by major part. Then complete the tables.
- **Review Command References:** For some of the chapters that are a little more CLI-intensive, it’s useful to have a working familiarity with some of the related command functions and generated output so that you don’t have to hesitate too much during the exam when encountering a question related to commands.
- **Review Questions:** Confirm that you understand the content 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 exams. 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 34 core chapters. Chapter 35, “Final Preparation,” includes preparation tips and suggestions for how to approach the exam. Each core chapter covers a subset of the topics on the CCNP CLCOR 350-801 exam. The core chapters map to the CCNP CLCOR 350-801 exam topic areas and cover the concepts and technologies you will encounter on the exam. Refer back to the exam objective/chapter mapping table as a reference to see which objectives are covered in which chapters.

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 www.ciscopress.com and register your book.

To do so, simply go to www.ciscopress.com/register and enter the ISBN of the print book: **9780138200947**. 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 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 (PTP) App

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

- You can get your access code by registering the print ISBN (9780138200947) on ciscopress.com/register. Make sure to use the print book ISBN, regardless of whether you purchased an eBook or the print book. After you register the book, your access code will be populated on your account page under the Registered Products tab. Instructions for how to redeem the code are available on the book's companion website by clicking the Access Bonus Content link.
- 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 ciscopress.com, click Account to see details of your account, and click the digital purchases tab.

NOTE After you register your book, your code can always be found in your account under the Registered Products tab.

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 for both installing the desktop app and using the web app.

Note that if you want to use the web app only at this point, just navigate to pearsonstest-prep.com, log in using the same credentials used to register your book or purchase the Premium Edition, and register this book's practice tests using the registration code you just found. The process should take only a couple of minutes.

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.

Credits

Figure 3.3a: Anoneditor

Figure 3.3b: Cburnett

Figures 4.5a, 4.12b-4.12g: Evan-Amos

Figures 4.5b, 4.5d: Shaddack

Figure 4.5c: Michael Piotrowski

Figure 4.12a: Meggar

Figures 6.5, 26.1a: Google LLC

Figure 11.5: PuTTY

Figures 14.1-14.3: Microsoft Corporation



CHAPTER 24

Webex Calling Options

This chapter covers the following topics:

PSTN Options for Webex Calling: This topic will identify the PSTN options available for the Webex Calling solution.

Routers Supporting Local Gateway: This topic will review the different routers that can be used to support the Local Gateway functions for Webex Calling.

Deployment Scenarios for the Local Gateway: This topic will overview the various deployment scenarios for how a Local Gateway can be deployed both with and without a Cisco Unified Communications Manager.

Up to this point, we have established that Webex is a cloud-based solution designed to support any company, regardless of size. Webex Calling revolves around the ability to call out across the public switched telephone network (PSTN) from IP-based devices registered to Webex Control Hub. The size of the company and the options you choose with your Webex subscription will affect the complexity level required to deploy Webex Calling. For small and medium businesses (SMBs) there is a very affordable and simple Webex Calling option. Larger enterprises will need to deploy the more complex solution using the Local Gateway. Before Webex Calling is deployed, you should understand each of the topics discussed in this chapter:

- PSTN options for Webex Calling
 - Cloud-connected PSTN (CCP)
 - Cisco PSTN
 - Premises-based PSTN
- Routers supporting local gateway
 - Cisco routers
 - Third-party routers
 - Registration- and certificate-based local gateway
- Deployment scenarios for the local gateway

This chapter covers the following objectives from the Cisco Collaboration Core Technologies v1.1 (CLCOR 350-801) exam:

- 3.4 Describe cloud calling hybrid local gateway

“Do I Know This Already?” Quiz

The “Do I Know This Already?” quiz allows 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 24-1 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.”

Table 24-1 “Do I Know This Already?” Section-to-Question Mapping

Foundation Topics Section	Questions
PSTN Options for Webex Calling	1–4
Routers Supporting Local Gateway	5–7
Deployment Scenarios for the Local Gateway	8–10

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 the 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. An administrator is setting up Webex Calling for their organization. They currently use the Cisco Unified Communications Manager for on-premises call control. They plan to use Webex also for hybrid communication. Which of the following PSTN options should the administrator choose?
 - a. Hybrid-based PSTN
 - b. Cisco PSTN
 - c. Cloud Connected PSTN
 - d. Premises-based PSTN
2. Which of the following statements is true regarding Webex Calling using Cisco PSTN?
 - a. Toll-free numbers are supported with the Cisco Calling Plan.
 - b. Existing Webex Calling locations can transition to the Cisco Calling Plan.
 - c. The Cisco Calling Plan does support Webex Contact Center.
 - d. The Cisco Calling Plan allows you to order up to 100 new phone numbers at a time.
3. Which of the following components must be configured in Webex Control Hub before Webex Calling will work using Premises-based PSTN?
 - a. Virtual Lines
 - b. Service Settings
 - c. Locations
 - d. PSTN

4. Which of the following SBC products can function as a Local Gateway with Webex Calling? (Select all that apply.)
- a. Catalyst 8000v
 - b. AP 1100v
 - c. Mediant 8000B/C Gateway & E-SBC
 - d. ISR880
 - e. AP 1100
 - f. Mediant 4000/B SBC

5. Which of the following Cisco routers can be deployed on Amazon AWS to support 3000 concurrent calls?
- a. C1000v – 1vcpu (4GB)
 - b. C1000v – 4vcpu (8GB)
 - c. C8000v-M (4GB)
 - d. C8000v-L (8GB)

The correct answer is **C8000v-M (4GB)**.

6. Which of the following devices are considered Edge Platforms? (Select all that apply.)
- a. ISR1100
 - b. C8200
 - c. ISR 4461
 - d. CSR1000v
 - e. C8300
 - f. C8000v
7. Which of the following connection types for Webex Calling allows the greatest number of concurrent calls?
- a. SCCP-based
 - b. Certificate-based
 - c. MMP-based
 - d. Registration-based
 - e. SIP-based
8. When considering which Local Gateway deployment option to implement, which of the following items should you consider? (Select all that apply.)
- a. Ownership of PSTN gateway
 - b. Desired call throughput of the site PSTN connection
 - c. TDM vs. IP gateway connections
 - d. Age of gateways
 - e. Cisco router type
9. Which of the following is a recommended deployment option for the Local Gateway when deploying Webex Calling using the Premises-based PSTN method?
- a. Local Gateway and PSTN Connection Co-located
 - b. Dedicated Local Gateway and PSTN Connections

- c. Cisco Unified Communications Manager with Co-located PSTN Gateway/SBC and Local Gateway
 - d. Partner Hosted Local Gateways
10. Which of the following is the correct call flow in a Webex Calling deployment using Premises-based PSTN?
- a. PSTN Gateway > Local Gateway > Cisco Unified Communications Manager > Webex
 - b. PSTN Gateway > Webex > Local Gateway > Cisco Unified Communications Manager
 - c. Cisco Unified Communications Manager > PSTN Gateway > Webex > Local Gateway
 - d. PSTN Gateway > Cisco Unified Communications Manager > Local Gateway > Webex

Foundation Topics

PSTN Options for Webex Calling

Webex Calling Plans, Trunks, and Route Groups provide you with the ability to configure Webex Calling to manage calls between Webex Calling–hosted users and on-premises IP public branch exchange (PBX) users. This solution lets you configure hosted users to use Cloud PSTN (Cloud Connected PSTN [CCP] or Cisco PSTN) or Premises-based PSTN. Once your location is enabled, you must set up PSTN connectivity for Webex Calling users within that location. The following PSTN options are available:

Key Topic

- **Cisco PSTN:** Choose this option if you'd like a bundled solution that allows you to order new PSTN numbers and port existing numbers to Cisco. The Cisco PSTN option is only available under the following conditions:
 - You have purchased and enabled the Cisco Calling Plan.
 - The location is in a country where Cisco Calling Plan is supported.
- **Cloud Connected PSTN:** Choose this option if you're looking for a cloud solution that doesn't require deployment of local hardware and then select your CCP provider of choice. Cloud PSTN (Cisco PSTN or CCP) can only be used to provide PSTN access for Webex Calling users. Calls originating from on-premises users can't access cloud PSTN.
- **Premises-based PSTN (Local Gateway):** Choose this option if you want to keep your current PSTN provider. Trunks for Premises-based PSTN through Local Gateway can also be used to connect to on-premises PBXs. You can retain existing Local Gateway functionality without making any configuration changes. Locations using Local Gateway are set to Premises-based PSTN and Local Gateways become Trunks.

Configure your selected PSTN connection within Control Hub by selecting **Management > Locations** and clicking the **Calling** tab. In the **Calling Connection** section, click **Manage** and then select your PSTN connection of choice.

Cloud Connected PSTN (CCP)

CCP enables global cloud PSTN calling options for Webex Calling Dedicated Instance (DI). Dedicated Instance leverages existing CCP partner peering with Webex Calling for this feature. To enable this feature for DI, Webex Calling introduces a new call routing construct called Route Lists. Route Lists in Webex Calling are lists of numbers reachable through a Route Group. Each Route List is exclusively assigned to a Location that supplies up to 40,000 unassigned numbers from the hosted pool. Only customers with DI entitlements can see or configure Route Lists in Control Hub. Figure 24-1 illustrates a Webex Calling organization with two Route Lists in their respective locations, each of them pointing to the same Route Group/Trunk, which in turn routes to a single Dedicated Instance cluster.

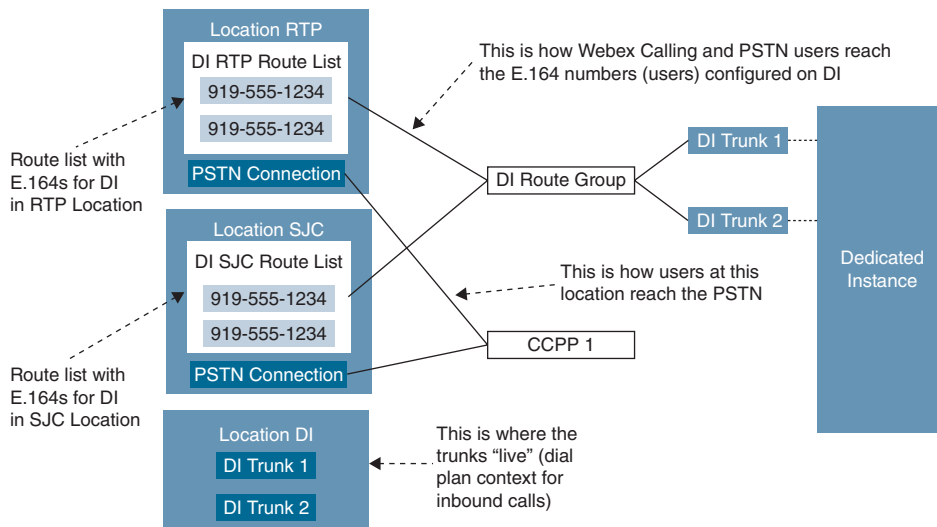


Figure 24-1 Route Lists for Cloud Connected PSTN

For E911 locations, all emergency calls should use the built-in Dedicated Instance E911 capability. E911 calls should not be sent to the Webex Calling Organization.

For non-E911 Dedicated Instance locations that use Cloud Connected PSTN, emergency calls can be sent to the Webex Calling Organization. The calling number of the emergency call must match a PSTN number in a Route List. The Route List will identify the Webex Calling location that the emergency call belongs to and overwrite the calling number with the Emergency Callback Number (ECBN) for that Webex Calling location.

If the calling device on Dedicated Instance does not have valid Direct Inward Dialing (DID), then it should be configured to send the correct ECBN as the calling number for all emergency calls. This will then match the correct Route List in the Webex Calling Organization and send the call appropriately.



Use the following steps to enable CCP for DI:

- Step 1.** Provision Location(s) in Control Hub.
 - a.** Select **Cloud Connected PSTN** as the connection type for the location and select the corresponding CCP provider.

- b. Order PSTN numbers from a CCP provider (integrated or non-integrated). Integrated providers will supply numbers directly to Control Hub, where they will appear automatically. For non-integrated providers, import the PSTN numbers as follows:
 - i. Sign in to Control Hub and go to the **Calling > Numbers** menu. Click the **Manage** drop-down menu on the right side of the table and select **Add**.
 - ii. Select **Location** from the drop-down menu on the **Selection** page. The PSTN connection associated with the location is listed against the location.
 - iii. Add the PSTN numbers purchased in the fields on the **Select Numbers** page. You may add up to 1000 numbers and choose to activate them immediately or later. Click **Save** after all numbers have been added. The confirmation page displays the PSTN numbers that have been added to the location.
- c. Perform the following steps for each Location to create a Route List, assign it to an appropriate Route Group, and select which numbers will be assigned to DI:
 - i. Navigate to **Calling > Route Lists** and choose an option from the list to view its properties.
 - ii. Select a Route Group from the **Routing Choice** menu.
 - iii. Click **Add Numbers** and enter the numbers associated with the Route List.
 - iv. Select the PSTN numbers in the Route List that are designated for Dedicated Instance (in/out) and then click **Add**. As part of Dedicated Instance service activation, SIP Trunks to Dedicated Instance and the Route Groups are created in Control Hub (the name starts with “WxC-DI”).
- d. Configure Dial Plans in Webex Calling with patterns pointing to Dedicated Instance and associate them with a Route Group.

Step 2. Configure Dedicated Instance:

- a. Configure the PSTN DIDs and assign them to phones, users, hunt pilot, and so on.
- b. Configure the dial plan on Dedicated Instance to route PSTN calls to Webex Calling, using the Route Group, Route List, and SIP Trunks configured during Dedicated Instance service activation.
- c. To enable international calling, select the relevant location in the Control Hub **Calling** page. Navigate to **Advanced > Outgoing and Incoming Permissions > Outgoing Calls > International** and select **Allow** from the drop-down menu.

Cisco PSTN

The Cisco Calling Plan offers a bundled solution to simplify your cloud calling experience. As a Webex Calling customer, you can order new PSTN numbers or port existing numbers to Cisco easily and with the full support of Cisco and its partners.

You can select varied connections for multi-site applications. For example, you can select Cisco PSTN for one location, Cloud-Connected PSTN (CCP) for a second location, and Premises-based PSTN for the third location. When choosing the Cisco Calling Plan, the following applies:

Key Topic

- **Requirements:**
 - Your partner must be an authorized Webex Calling partner and have accepted the new Webex Calling addendum through enrollment into the Webex Calling PSTN program.
 - Your partner places an order with Cisco Calling Plan licenses (Outbound Calling Plan and Telephone Numbers) within the Cisco Commerce Workspace (CCW).
- **Limitations:**
 - Cisco Calling Plan service is currently available to specified countries and regions. As this list is constantly changing, you will need to inquire what countries are participating at the time you sign up.
 - Existing Webex Calling locations can't transition to the Cisco Calling Plan.
 - Toll-free numbers aren't currently available. You can't order new toll-free numbers or port existing toll-free numbers to the Cisco Calling Plan.
 - You can order a maximum of 100 new phone numbers at a time. Additional numbers can be placed as a separate order.
 - Cisco Calling Plan is available with the free Webex Calling trial offer. When using the Cisco Calling Plan with a Webex Calling trial, you can create a maximum of 10 new phone numbers.
 - Number porting isn't available with a Webex Calling trial.
 - Cisco Calling Plan isn't supported with Webex Contact Center or other use in which high-concurrent calls or high-volume calls are frequently made.

Key Topic

Use the following steps to enable Webex Calling using Cisco PSTN.

- Step 1.** From the customer view in <https://admin.webex.com>, go to **Management > Locations** and select the location you want to update.
- Step 2.** Select the **Calling** tab and click **Manage** next to **PSTN Connection**.
- Step 3.** Select **Cisco PSTN** and click **Next**.
- Step 4.** Enter the contact information and click **Next**. This field is for the contact information of the person who will sign the legal contract with Cisco.
- Step 5.** Enter the **Emergency Services Address (ESA)** and click **Save**. By default, the ESA entered here is applied to all phone numbers for this location. You can

change the ESA for an individual user if needed. For example, you may need to change the ESA if you have a remote employee who works from home.

Step 6. On the summary screen, do one of the following:

- Click **Add numbers**.
- Click **Done**.

You can add numbers to your calling plan later.

Premises-Based PSTN

Premises-based PSTN allows organizations to bring their own carrier by interconnecting any service provider's PSTN with a Premises-based Local Gateway that tightly integrates to Cisco's Webex Calling cloud. This service is provided through existing enterprise routing infrastructure that uses a trunk for the Local Gateway either without an on-premises IP PBX or with an existing Cisco Unified Communications Manager call environment. The PSTN connection can be accessed using Cisco Unified Border Element (UBE) or through an IOS gateway with Primary Rate Interface (PRI) cards. Cisco UBE is the recommended deployment option for Premises-based PSTN and will be the sole focus throughout the rest of Part VI, "Webex Calling."

The Webex Control Hub was discussed extensively in Chapter 23, "Adding Users and Devices in Webex Control Hub." As a review, the Webex Control Hub is a management portal that integrates with Webex Calling to streamline your orders and configuration as well as to centralize your management of the bundled offer: Webex Calling, Webex Messaging, and Webex Meeting. Webex Control Hub is the central point for provisioning all services, devices, and users. You can do first-time setup of your calling service, register MPP phones to the cloud, and configure users by associating devices and adding numbers, services, calling features, and so on. Also, from Control Hub, you can cross-launch to the Calling Admin Portal, which is used to initially configure Webex Calling and to manage it once everything is set up. Important components that need to be configured to enable Webex Calling include Numbers, Locations, Call Routing, and Managed Gateways. These components will be discussed further in Chapter 26, "Webex Calling Using a Local Gateway." Other configuration options include Virtual Lines, Features, PSTN (used for managing cloud PSTN orders), Service Settings, and Client Settings.

The Local Gateway is an enterprise or partner-managed edge device for PSTN interworking and legacy PBX interworking, including Cisco Unified Communications Manager. You can use Webex Control Hub to assign a local gateway to a location, after which Control Hub provides parameters that you can configure on a router. These steps register the Local Gateway with the cloud, and then PSTN service is provided through the gateway to Webex Calling users in a specific location. All communication to and from the cloud is secured using TLS transport for SIP and SRTP for media.

Key Topic

Cisco UBE can be used to connect an enterprise to a telephony service provider over SIP, who will interconnect calls out to the PSTN, and vice versa. If an existing Cisco UBE enterprise deployment is being modified to also utilize the local gateway function for Cisco Webex Calling, Cisco UBE High Availability (HA) can be deployed to ensure call flows and functionalities are not interrupted. Cisco UBE HA Layer 2 box-to-box redundancy uses the Redundancy Group (RG) infrastructure protocol to form an active/standby pair of

routers. This pair shares the same virtual IP address (VIP) across their respective interfaces and continually exchange status messages. Cisco UBE session information is check-pointed across the pair of routers, enabling the standby router to take all Cisco UBE call processing responsibilities over immediately if the active router goes out of service, resulting in stateful preservation of signaling and media. As of IOS-XE 16.12.2, Cisco UBE HA can be deployed as a Local Gateway for Cisco Webex Calling Trunk Premises-based PSTN deployments. The purpose of this chapter is to provide an introduction to Webex Calling options, so we will not be diving any deeper into Cisco UBE HA in this book.

Routers Supporting Local Gateway

Webex Local Gateway can be hosted on a variety of Cisco IOS-XE routers and a select group of third-party routers. This topic will cover the platforms, capacities, and software versions required to support Local Gateway functionality on Cisco routes and third-party routers. This chapter will also cover the differences between the registration-based Local Gateway and certificate-based Local Gateway settings.

Cisco Routers

The 1100 and 4000 series of IOS-XE devices are the entry point for Local Gateways and the oldest devices supported to function as Local Gateways. These are the same devices that function today as branch gateways in an on-premises-based VoIP system. This allows the rapid conversion from on-premises to cloud-based or a hybrid calling model without requiring router upgrades.

The smallest supported router for Local Gateway is the ISR 1100 series. These small devices are capable of handling 500 calls with up to five calls per second (CPS). The routers are available with different amounts of memory, WAN, and Ethernet interfaces to suit the needs of small sites. Since telephone ports are not supported with the ISR 1100 series, these routers could only be used as a Cisco UBE using SIP trunks. The ISR 1100 series products went end of sale (EOS) on May 9, 2023 and have an end of support date of May 31, 2028.

The 4000 series of Integrated Services Routers are able to handle the demands of most branch office needs. A wide range of interface choice for WAN, Ethernet, and Telephony allow the user to customize the router to suit their needs. The router can be used as a Cisco UBE for full SIP-based communications but also as a Time Division Multiplexing (TDM) gateway using older circuits such as T1/E1 PRI. The product line supports 500 calls with four CPS on the smallest ISR 4321, up to 10,000 calls and 55 CPS on the largest ISR 4461. This product line eases the process of finding a router with the right mix of interfaces and performance needed for the branch site in your organization. The ISR 4300/4400 line is set to go end of sale (EOS) on November 7, 2023. The product will be supported for several more years, but the latest IOS XE release will be either 17.9 or 17.12, depending on the software train you are utilizing. Table 24-2 identifies all the 1100 and 4000 series routers that support Local Gateway.



Table 24-2 Local Gateway Support on 1100 and 4000 Series Routers

Platform	Cisco UBE SIP-SIP Audio Session (Flow-thru) RTP G.711-RTP G.711	Sustainable CPS IOS-XE 16.1.2+
1100	500 (IOS-XE 16.2+)	5
4321	500	4
4331	1000	10

Platform	Cisco UBE SIP-SIP Audio Session (Flow-thru) RTP G.711-RTP G.711	Sustainable CPS IOS-XE 16.1.2+
4351	2000	13
4431	3000	15
4451	6000	40
4461	10,000 (IOS-XE 17.2.1r+)	55

The replacements for the ISR 1000 and 4000 routers are the Catalyst 8000 Edge Platforms. The Cisco Catalyst 8300 Series Edge Platforms are best-of-breed, 5G-ready, cloud edge platforms designed for accelerated services, multi-layer security, cloud-native agility, and edge intelligence to accelerate your journey to cloud. The C8000 line is broken into two series similar to the 4000 series lineup. The smaller 8200 series provides multi-core processors, up to 32GB of DRAM, up to four Ethernet ports (two support SFP), and one Network Interface Module, which can support various WAN and Telephony interfaces.

The C8300 products contain multicore processors, expandable memory, and up to six Ethernet ports. Two of those ports can support Small Form Factor Pluggable adapters to allow copper or fiber connections. The Edge Platforms also come with dual power supplies for greater redundancy. Numerous WAN and Telephony interface cards allow you to tailor the product to the site's voice and data services, which require support at a branch site.

When the C8000 line is used as a Local Gateway, its performance is upgraded from the ISR 4000 series it replaces. Call throughput ranges from 1500 (middle of the pack for ISR 4000) on the small end to 10,000 on the higher end. Sustainable CPS rates of nine on the C8200L to 55 on the C8300L-1N2S-4T2X meet the needs of most branch locations. Table 24-3 identifies all the 1100 and 4000 series routers that support Local Gateway.

Key Topic
Table 24-3 Local Gateway Support on Catalyst 8000 Edge Routers

Platform	Cisco UBE SIP-SIP Audio Session (Flow-thru) RTP G.711-RTP G.711	Sustainable CPS IOS-XE 16.1.2+
C8200L-1N-4T (4GB)	1500 (IOS XE 17.5.1+)	9
C8200L-1N-4T (8GB)	2500 (IOS XE 17.4.1a+)	14
C8300L-1N1S-6T (8GB)	7000 (IOS-XE 17.3.2)	40
C8300L-1N2S-6T (8GB)	7500 (IOS-XE 17.3.2)	42
C8300L-1N1S-4T2X (8GB)	8000 (IOS-XE 17.3.2)	45
C8300L-1N2S-4T2X (8GB)	10,000 (IOS-XE 17.3.2)	55

NOTE The following key can be used to help understand the differences between the routers in Table 24-3.

xN = Network Interface Module

xT = 1GB Ethernet Port

xS = Service Modules

xX = 10GB Ethernet Port

A third option for Local Gateways is either the CSR1000v or the C8000v. Both products are virtual machines that can run in a variety of virtual environments. The Cloud Services Router 1000v is a virtual IOS-XE router that can run in VMware ESXi, Citrix XenServer, Microsoft Hyper-V, SuSE KVM, or Red Hat KVM virtual environments. The CSR1000v can also be deployed in Microsoft Azure, Amazon EC2, and Google Cloud Platform. The CSR1000v can support up to IOS-XE version 17.3 software. After that version, the branding and licensing was changed to reflect the new product name of Catalyst 8000v.

The Catalyst 8000v is a continuation of the CSR1000v. The C8000v is a software-based virtual router that combines the functionalities of Cisco Cloud Services Router (Cisco CSR1000V) and Cisco Integrated Services Virtual Router (Cisco ISRV) into a single image that is intended for deployment in cloud and virtual data centers. It is supported in ESXi, KVM, NFVIS hypervisors. Further, you can deploy this router on public cloud providers such as Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP), and Alibaba Cloud.

The router can be deployed as a virtual machine in your virtual environment, and it can be created as a small, medium, or large virtual machine using increasing amounts of vCPU, memory, and other resources. The number of concurrent and sustained CPS also increases. If the C8000v is deployed in a cloud environment such as Microsoft Azure or Amazon AWS, the medium VM is deployed with 3000 concurrent calls and 20 CPS. Table 24-4 identifies the 1000v and 8000v virtual routers that support Local Gateway.

Key Topic
Table 24-4 Local Gateway Support on 1000v and 8000v Virtual Routers

Platform	Cisco UBE SIP-SIP Audio Session (Flow-thru) RTP G.711-RTP G.711	Sustainable CPS IOS-XE 16.1.2+
C8000v-S / C1000v – 1vcpu (4GB)	1000	5
C8000v-M / C1000v – 2vcpu (4GB)	3000	20
Azure / AWS C8000v-M / C1000v – 2vcpu (4GB)	3000	20
C8000v-L / C1000v – 4vcpu (8GB)	6000	30

Key Topic
Third-Party Routers

A relatively new addition to the supported Session Border Controller area are third-party Session Border Controllers (SBCs). The following products running Oracle SBC version 9.0 software are supported as a Local Gateway with Webex Calling:

- AP 1100
- AP3900
- AP 4600
- AP 6300
- AP 6350

- AP 3950 (Starting from SBC 9.0)
- AP 4900 (Starting from SBC 9.0)
- VME
- Oracle SBC on Public Cloud

The following AudioCodes SBCs running software version 7.40A.250.440 or later are supported as Local Gateway with Webex Calling:

- Mediant 500 Gateway and E-SBC
- Mediant 800B/C Gateway and E-SBC
- Mediant 1000B Gateway and E-SBC
- Mediant 2600 E-SBC
- Mediant 4000/B SBC
- Mediant 9000, 9030, 9080 SBC
- Mediant Software SBC (VE/SE/CE)

Finally, the Ribbon line of SBCs has also received approval to function as Local Gateways with Webex Calling. The following Ribbon SBCs running Ribbon Code version 10.1.0 or higher are supported as Local Gateways:

- SBC 5000
- SBC 7000
- SBC SWe

Registration- and Certificate-Based Local Gateway

While it is true that an ISR 4461 can handle 10,000 concurrent calls, that capacity can be restricted to as low as 250 if the connection to the Webex cloud is not chosen correctly. To understand this issue, it is important to understand that there are two ways to connect to the Webex Calling system:

- Registration-based Local Gateway
- Certificate-based Local Gateway

In the registration-based Local Gateway connection, you create the connection in Control Hub and you are provided with the elements needed to allow your Local Gateway to create a TCP connection to the cloud. This is a one-way connection from the Local Gateway to the cloud. One of the big benefits of this connection type is that a technician with limited IOS skills can successfully deploy a Local Gateway behind a NAT/firewall without requiring changes to the NAT or firewall. The connection does not require CA signed certificates, which reduces complexity and cost. However, since the registration consists of a single TCP connection, the link has a lower capacity and is not as durable if there are network issues such as high latency and packet loss. This means that no matter what SBC platform you are

using, you are limited to 250 concurrent calls per trunk built on that device. It is possible to build multiple trunks on a single Local Gateway. Careful configuration of outbound interfaces, SIP listening ports, dial-peers, and load balancing for the on-premises Cisco Unified Communications Manager can allow you to exceed the 250-call limit. Figure 24-2 illustrates the connection flow for Webex Calling using registration-based Local Gateway.

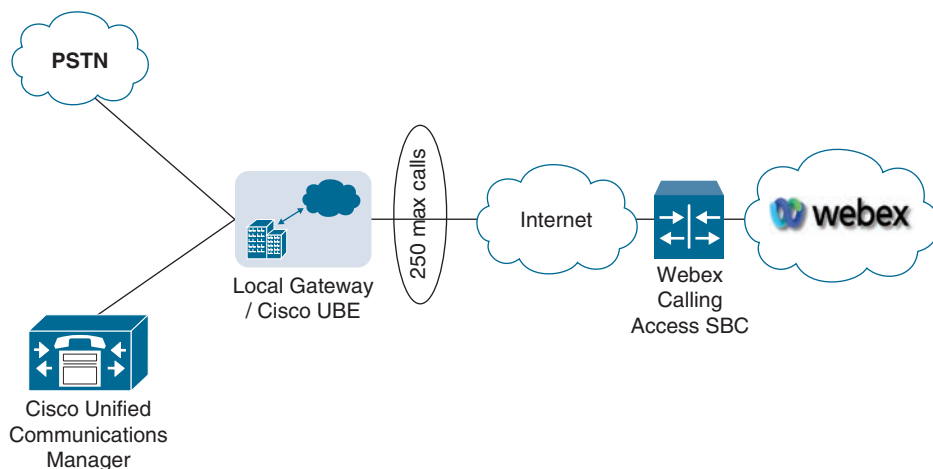


Figure 24-2 *Registration-Based Local Gateway*

The certificate-based method of connecting a Local Gateway fixes the capacity issue by using Mutual TLS as the connection type. This method also uses four bi-directional connections rather than a single one-way connection, as with the registration-based connection. This connection type requires CA signed certificates in the Local Gateway. The engineer also needs to add the Webex Calling trust bundle into the Local Gateway so that the SBC trusts the certificates of Webex Calling.

A connection is configured to endure four fully qualified domain names (FQDNs) or a DNS Service Record (SRV) that points to the Access SBCs of Webex Calling. If configured correctly, four bi-directional TLS connections will be created to carry traffic to and from the Local Gateway and Webex Calling. NAT/firewall traversal is possible with the certificate-based connection method using Session Traversal Using NAT (STUN). Figure 24-3 illustrates the connection flow for Webex Calling using certificate-based Local Gateway.

As you can see from these two descriptions, if you are looking for an easy installation and only have a capacity need below 250 concurrent calls over the public Internet, it is recommended that you use the registration-based connection method. If you require up to 2000 concurrent calls over the public Internet, the solution will be certificate-based. It is possible to reach up to 6500 concurrent calls with the certificate-based connection method, but this will require a dedicated Interconnect connection to Webex Edge Connect. If you wish to use any of the newly supported third-party SBCs, you will need to use the certificate-based connection method as well. Table 24-5 identifies sizing parameters for a Local Gateway based on registration type.

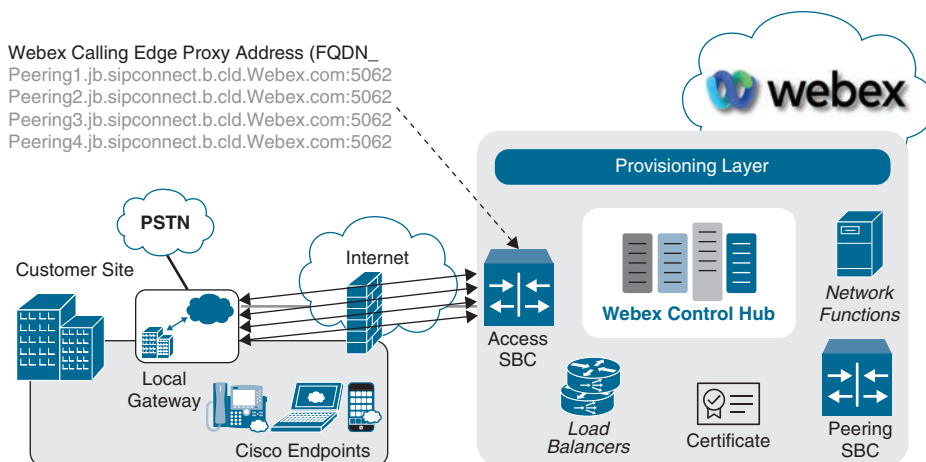


Figure 24-3 Certificate-Based Local Gateway

**Key
Topic**

Table 24-5 Local Gateway Sizing Parameters Based on Registration Type

Sizing by Concurrent Calls per Local Gateway	Sizing by Number of Users Behind a Local Gateway	Trunk Type Preferred	Minimum Link Quality
~ 2000–6500	65,000	Certificate-based	Interconnect
250–~2000	20,000	Certificate-based	Over the Internet
Up to 250	2500	Registration-based	Over the Internet

Deployment Scenarios for the Local Gateway

Webex Local Gateways can be deployed in different configurations to adapt to the needs of individual customers, depending on several factors. Does the Local Gateway and the PSTN connection share the same physical or virtual hardware? Does the site contain an IP PBX such as Cisco Unified Communications Manager? Is the Local Gateway hosted offsite from the customer through a service provider (SP) or value-added reseller (VAR)? Each of these factors will be address in the following scenarios. The two biggest factors you should you consider when deploying a Local Gateway are who owns the PSTN gateway and what is your desired throughput of the site PSTN connection?

The first scenario to consider is a company that uses all Webex endpoints but wishes to use its local PSTN's circuits. If the customer doesn't already have a device to handle the connection to the PSTN, a single router supporting Local Gateway and PSTN services is a good solution. The router or edge device will supply the Local Gateway functionality as well as the connection to the PSTN. In this scenario, the Webex dial plan routes all non-Webex calls to the trunk pointing to the Local Gateway. The Local Gateway configuration provides the secure connection to the Webex cloud and contains dial-peers, which route calls to the PSTN. Figure 24-4 illustrates a single site deployment for Webex Calling where the PSTN connection and Local Gateway are co-located.

The second scenario separates the Local Gateway function from the PSTN gateway using separate routers. The most common reason for this deployment type is to increase capacity.

The Local Gateway handles all calls to and from the Webex cloud. Any call not destined for Webex is passed to the PSTN gateway. The PSTN gateway uses similar logic to send any calls not designated for the PSTN to the Local Gateway. This simplifies the configuration of each device and allows higher call capacity through each router. Figure 24-5 illustrates a single site deployment for Webex Calling where the PSTN connection and Local Gateway use dedicated routers for each service. This is the recommended deployment option for Webex Calling when an IP PBX is not being used.

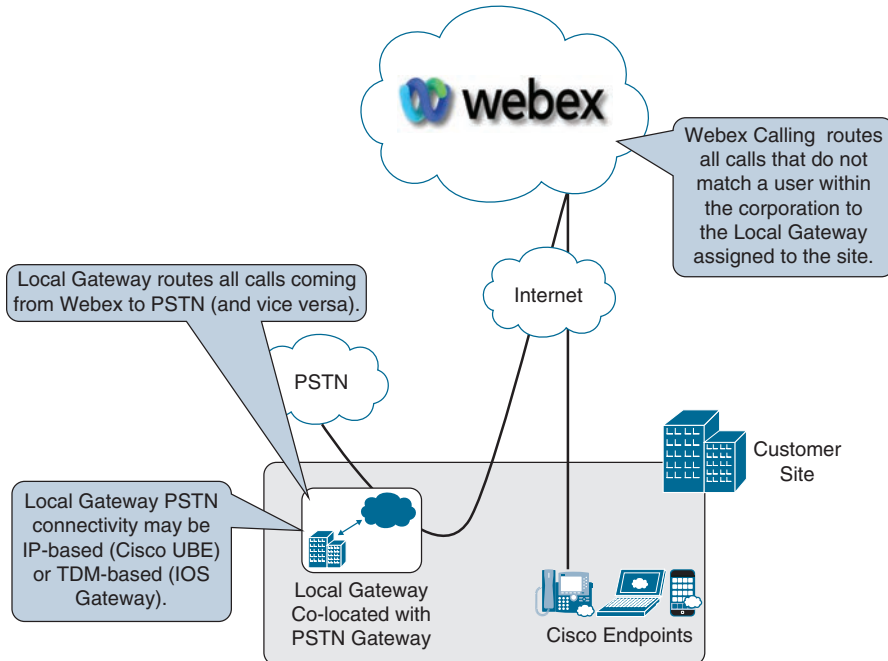


Figure 24-4 *Single Site Deployment with Local Gateway and PSTN Connection Co-located*

Another reason to use this deployment model would be if the customer does not control the PSTN device. The customer configures the Local Gateway to hand off all incoming calls from Webex to the PSTN device. Similarly, the PSTN device sends all incoming calls to the Local Gateway.

Adding Cisco Unified Communications Manager to the customer site creates a new scenario because it changes the configuration a bit. In this case, the customer will want the calls from Webex to go to Cisco Unified Communications Manager since there will be an existing dial plan for both on-premises endpoints and the PSTN. Similar to the example of a location with a single router providing both Local Gateway and PSTN functions, the same type of router configuration can be used in this environment. The largest drawback would be the router's capacity to handle sufficient traffic for Cisco Unified Communications Manager, Webex, and PSTN.

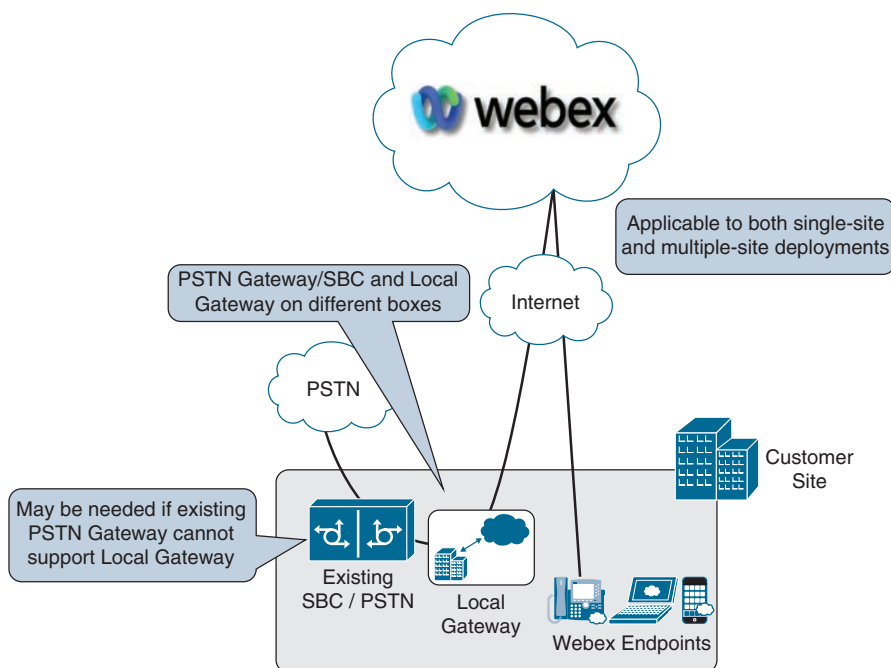


Figure 24-5 *Single-Site Deployment with Dedicated Local Gateway and PSTN Connections*

When calls are made from a Webex endpoint, any call not matching the Webex dial plan would be routed to the Local Gateway. The Local Gateway would pass the call to the Cisco Unified Communications Manager. The Cisco Unified Communications Manager dial plan would be leveraged to send calls to either a Cisco Unified Communications Manager–controlled endpoints or routed back the Local Gateway/PSTN device to hand the calls off to the PSTN.

Inbound calls to Webex from the PSTN would route to the PSTN gateway function of the router and onward to the Cisco Unified Communications Manager. The dial plan of the Cisco Unified Communications Manager will be used to determine if the call should be routed to a locally registered device or to a Webex-registered device. When the call is destined for a Webex-registered device, the Cisco Unified Communications Manager will route the call to the Local Gateway function of the router, which forwards the call to the Webex cloud, which will in turn route to the endpoint or phone. Figure 24-6 illustrates a single-site deployment for Webex Calling where the PSTN connection and Local Gateway are co-located on the same router and Cisco Unified Communications Manager is used for on-premises call control.

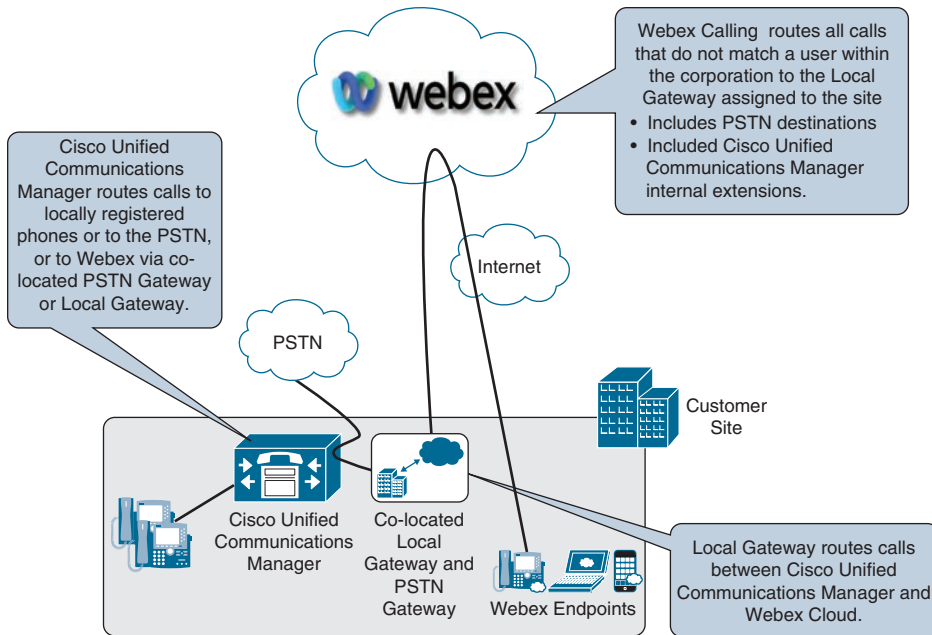


Figure 24-6 Cisco Unified Communications Manager with Co-located PSTN Gateway/ SBC and Local Gateway

As you might have guessed, the fourth scenario deals with using Cisco Unified Communications Manager and a dedicated router for the PSTN gateway function and Local Gateway function. This is the recommended option for Webex Calling using Cisco Unified Communications Manager. You will benefit from increased call capacity and more granular call control. This scenario is best suited for customers that have an existing on-premises call control solution that utilizes high call volume. The call flow for this scenario remains the same as the previously discussed scenario using a Cisco Unified Communications Manager, as shown next. Figure 24-7 illustrates a single-site deployment for Webex Calling where dedicated routers are used for the PSTN connection and Local Gateway, and Cisco Unified Communications Manager is used for on-premises call control.

- Webex > Local Gateway > Cisco Unified Communications Manager > PSTN Gateway
- PSTN Gateway > Cisco Unified Communications Manager > Local Gateway > Webex

Any of the scenarios outlined previously are acceptable deployments. However, when planning for future expansion or growth, it is recommended that you separate the Local Gateway and PSTN gateway functions to gain the highest capacity. In addition, the ownership of the devices (customer vs. PSTN provider) might play a role in the decision.

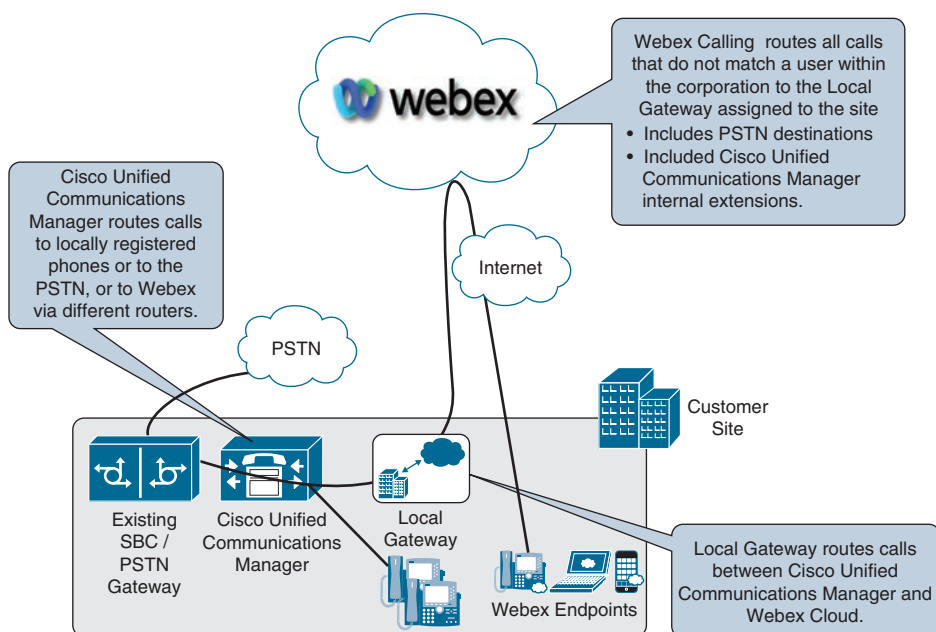


Figure 24-7 Cisco Unified Communications Manager with dedicated PSTN Gateway/SBC and Local Gateway

This brings us to the next scenario. Only one Local Gateway needs to be configured for each organization, but multiple Local Gateways can be configured as well by creating multiple locations in the Webex Control Hub. There are a couple rules that should be followed when creating multiple locations:

Key Topic

- You cannot assign multiple Local Gateways to a single location. Only one Local Gateway can be assigned per locations.
- You can assign a single Local Gateway to multiple locations.

Picture an organization that has three locations configured: Washington, DC, New York, NY, and London, UK. Washington and London have a Local Gateway assigned to them. New York simply uses the same Local Gateway as Washington. If a device registered to New York needs to place a call out the PSTN, the call will traverse from the New York location to Webex, back to Washington, then out the Local Gateway to the PSTN. This is how two or more locations can use the same Local Gateway. However, New York cannot use both the Washington and London local gateways because of the second rule outlined previously. Figure 24-8 illustrates how multiple Local Gateways can be used over multiple locations.

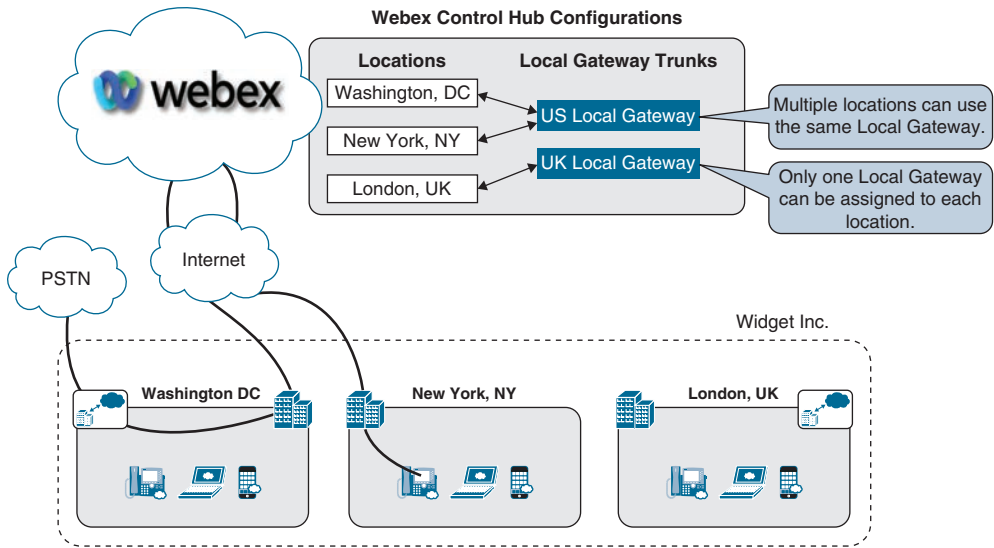


Figure 24-8 Call Routing Across Multiple Local Gateways

There is one final scenario you need to understand. Endpoints registered to the Webex Control Hub will communicate directly with Webex in the cloud. They do not have to route calls through the Local Gateway first. That connection is over the Internet, just as you would connect to a website like Cisco.com. In this manner, these endpoints do not have to be co-located with the Local Gateway. Therefore, partners can provide Local Gateway services hosted within their own data centers on behalf of their customers. This could be an official SP or a VAR. In fact, many Cisco VAR partners offer this type of service today. Figure 24-9 illustrates how customers can use the on-premises PSTN Webex Calling option through a hosted Local Gateway within a Cisco Partner environment.

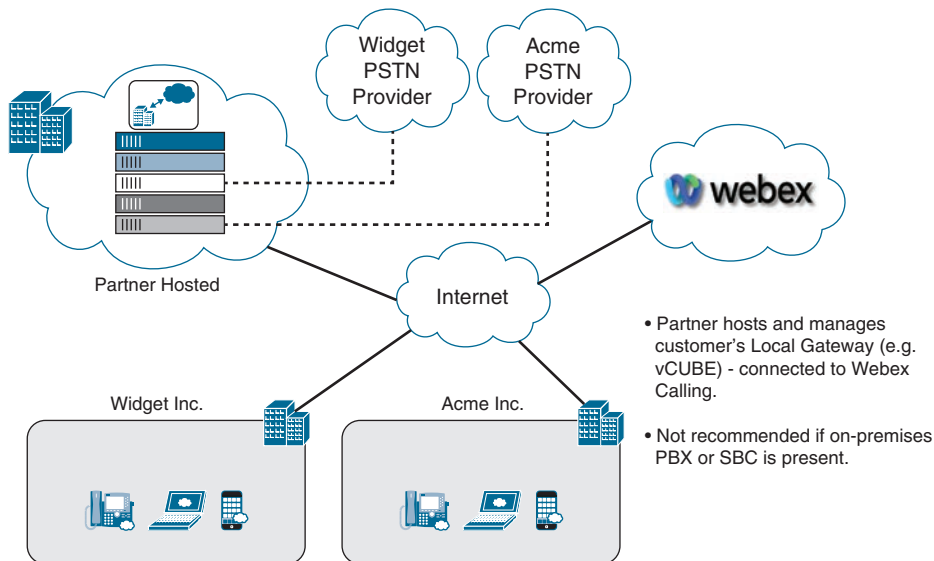


Figure 24-9 Partner Hosted Local Gateways

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 35, “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 24-6 lists a reference of these key topics and the page numbers on which each is found.



Table 24-6 Key Topics for Chapter 24

Key Topic Element	Description	Page Number
List	PSTN options for Webex Calling	583
Steps	Steps to enable Dedicated Instance for CCP	584
List	Cisco PSTN Requirements and Limitations	586
Steps	Enable Webex Calling using Cisco PSTN	586
Paragraph	Cisco UBE High Availability (HA)	587
Table 24-2	Local Gateway Support on 1100 and 4000 Series Routers	588
Table 24-3	Local Gateway Support on Catalyst 8000 Edge Routers	589
Table 24-4	Local Gateway Support on 1000v and 8000v Virtual Routers	590
Sub-Topic	Third-Party Routers	590
Table 24-5	Local Gateway Sizing Parameters Based on Registration Type	593
List	Rules when creating multiple locations	597

Define Key Terms

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

CCP, Cisco PSTN, Premises-based PSTN, Webex Calling DI, Webex Calling Route Lists, Local Gateway, Cisco UBE HA, Branch Gateways, Catalyst 8000 Edge Platforms, CSR1000v, C8000v, Registration-based Local Gateway, Certificate-based Local Gateway

Q&A

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

1. List the three PSTN options for Webex Calling.
2. List the five series of Cisco routers that support the Local Gateway.
3. What are the four companies that offer third-party routers to support the Local Gateway?
4. What are the two rules you must follow when creating multiple locations in the Webex Control Hub for Webex Calling?

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