



Collaboration Technical Information Site for CSR 10.6(1)

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Home

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- [About This Release, page 2](#)
- [Using This Information System, page 2](#)
- [Cisco Documentation, page 4](#)

Welcome to IP Telephony Technical Information Site

This information site describes the Cisco Collaboration Systems Release 10.6(1) for Collaboration (formerly known as IP telephony). Cisco Collaboration solutions integrates voice, data, and video communications together into a single network, thereby making it simple, scalable, and cost-effective solutions.

This site contains system documentation that is presented in the network lifecycle process: Prepare, Plan, Design, Implement, Operate, and Optimize (PPDIOO). PPDIOO is a Cisco methodology that defines the continuous lifecycle of services required by the customer.

Each part of the network lifecycle process has a chapter the in left navigation panel. When you click a chapter, the table of contents (TOC) on the left navigation panel changes to show only the TOC for that chapter. The opening page in each chapter describes what is covered in that phase. You can also use the index link at the bottom of every TOC. To learn more about how to navigate through this site, see [Using This Information System, on page 2](#).

You can also quickly access additional resources in the Resource Library and Training Library.

The Critical Path to Successful Deployment

The PPDIOO process is the critical path to launch and complete a successful customer deployment, from the request for information (RFI) proposal to successful training of operations personnel. The Cisco Collaboration Systems documentation is designed to be used along with the PPDIOO methodology. Each chapter contains a complete task flow for each phase of the PPDIOO process.

Audience

This technical information site is designed for people who are implementing the Cisco Collaboration Systems:

- Cisco partners
- Cisco system engineers (SEs)
- Cisco Technical Assistance Center (TAC) engineers
- Cisco customers, especially decision makers, network designers, and operations personnel

About This Release

This documentation covers a Cisco Collaboration Systems for IP telephony Release 10.6(1). If you are upgrading an existing Cisco Collaboration Systems application, begin by reading the https://www.cisco.com/c/en/us/td/docs/voice_ip_comm/uc_system/V10-6-1/VTGS_BK_C2DB5BDB_00_collaboration-system-release-notes-ip-telephony.html to familiarize yourself with functionality in this new release.

There are two technical information sites for Cisco Collaboration Systems Release 10.6(1). This site for Collaboration Systems, and the site for Contact Center Systems Release 10.6(1).

Using This Information System

This information system is designed to give you an easily navigable framework for accessing all documentation for your system, solution, or product. The following topics describe using the information system:

- [Types of Topics](#), on page 2
- [Graphics with Hotspots and Popup Text \(Image Maps\)](#), on page 3
- [Where Information Is Located](#), on page 3
- [Tips on Navigating the Information Site](#), on page 3



Note

Make sure your browser does not block popup windows for this site. If a popup link fails to open, check your browser settings. Alternatively, press **Ctrl** when you click the link to override your browser's settings.

Types of Topics

When you see a reference to a topic, you can tell what type of topic it is by its name:

- "Doing" topics, such as "Performing a System Upgrade," are task topics, and provide instructions for doing something.
- "Overview" or "About" topics are *concept topics* to help you understand and plan your deployment and carry out tasks knowledgeably.

Some tabs may group topics under headings such as "Planning Concepts" and "Planning Tasks."

Graphics with Hotspots and Popup Text (Image Maps)

Some graphics may be image maps. An image map may have hotspots that you can run your pointer over to view a popup description or that you can click to open a linked topic in a secondary window.

Where Information Is Located

Cisco systems and solutions encompass a range of products and technologies, and their documentation encompasses information that may reside in several locations:

- Overviews and high-level process and procedure information specific to your solution or system are included directly in the information site.
- Product and technology overviews, detailed requirements, task details, and other more generic topics are located outside the site. These topics have the appearance of standard Cisco documentation with which you may already be familiar. Links to these topics appear with a popup icon appended. Clicking the link opens the topic in a new, secondary browser window offset from the current window, rather than replacing the current topic in the content pane. You can click the link to view the information when you need it, and then return to your place in the information site.
- Links with a padlock symbol are available only to people with a Cisco sign in, such as Cisco partners or registered Cisco.com users with a [Cisco service contract](#). After clicking the link, sign in when prompted. A secondary browser window opens. Keep the secondary window open in order to open other links without having to sign in again.
- Links with **[Internal]** are available only to Cisco employees.

Tips on Navigating the Information Site

- Use the TOC at the left of the site window to navigate to major topics in a chapter.
- In a secondary popup window:
 - When you are done with the window, click the **Close** button to close it. (It does not close automatically.)
 - You can go back to a previous topic by right-clicking and clicking **Back**.
 - You can view normal browser toolbars, the address bar, and any other browser items that you do not see by using commands on the View menu.
- Use the Index (click the link at the bottom of any TOC) if you are not sure where to find a topic.

Cisco Documentation

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at: <http://www.cisco.com/c/en/us/td/docs/general/whatsnew/whatsnew.html>

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS version 2.0.



CHAPTER 2

Prepare

- [Introduction to Prepare, page 5](#)
- [Cisco Collaboration Systems Description, page 6](#)
- [Collaboration Overview, page 6](#)

Introduction to Prepare

In the Prepare phase, you evaluate Cisco technologies that address your business needs. Gather information about your business and technical environment that will feed into the high-level design. Then, create a business case for the IP telephony system that provides the best return on your investment.

Before You Begin

Understand the features and functions of IP telephony applications. Start with the high-level information in the [Cisco Collaboration Systems Description](#) and [Collaboration Overview](#), and then proceed to the more detailed and Collaboration release-specific information in the [System Release Notes](#).

When You Are Done

You have defined and created the following:

- Your business and system requirements
- A basic list of components and applications that match the requirements

Major Concepts and Tasks in This Process

- [Cisco Collaboration Systems Description, on page 6](#)
- [Collaboration Overview, on page 6](#)

Cisco Collaboration Systems Description

Cisco Collaboration Systems offer many features and solutions that allow people to collaborate effectively. It offers a coherent experience that connects people with people in familiar, intuitive, natural, simple ways using any media or device, at any time, while integrated with business processes. This integrated collaboration architecture with a converged voice, video and data network includes many products from Cisco's Collaboration portfolio.

Enterprise, mid-market or small and medium businesses can implement various system deployment models such as single site, multiple sites or cloud. Cisco Collaboration Systems Release 10.6(1) is backwards compatible with Collaboration Systems Release 10.5(1).

Collaboration Overview

The Cisco IP telephony system includes a wide array of hardware and software components, such as call processing products, communications endpoints (Unified IP phones and video devices), and special applications, all deployed over a converged network infrastructure. The network infrastructure for Cisco IP telephony includes PSTN gateways, analog phone support, and digital signal processor (DSP) farms.

The following topics are described:

- [Market Descriptions](#), on page 6
- [Product Categories](#), on page 6
- [Deployment Models](#), on page 7
- [System Features in This Release](#), on page 8

Market Descriptions

Cisco provides Unified Communications solutions for small businesses through large enterprise networks. For more information on applying Unified Communications solutions to different size markets, see the following:

- [Cisco Unified Communications Solutions for Enterprise](#)
- [Cisco Unified Communications Solutions for Small Business](#)

Product Categories

IP telephony system components are grouped in the following categories:

- Call control components, such as Cisco Unified Communications Manager, Cisco Unified Communications Manager Express, Cisco Unified Survivable Remote Site Telephony (Unified SRST), Cisco TelePresence Video Communication Server, Cisco Business Edition 7000 and Cisco Business Edition 6000.

- Server applications, such as Cisco Unified Communications Manager IM and Presence Service, Cisco Emergency Responder, Cisco Paging Server, Cisco Unified Attendant Console Standard, and Cisco Unified Attendant Console Advanced.
- Conferencing components, such as Cisco TelePresence Server, Cisco TelePresence MCU, Cisco TelePresence Conductor, Cisco WebEx Meetings Server, and Cisco TelePresence Management Suite.
- Voicemail and unified messaging components, such as Cisco Unity Connection.
- Devices (endpoints) and clients, such as Cisco IP Phone 7821, 7841, 7861, Cisco Unified IP Phones 6900, 7800, 7900, 8900, and 9900 Series, Cisco TelePresence SpeakerTrack 60, Cisco Desktop Collaboration Experience DX650, Cisco TelePresence SX10, and Cisco TelePresence MX200 G2.
- Client applications such as Cisco Jabber for Android, Cisco Jabber for Mac, Cisco Jabber for iOS, and Cisco Jabber for Windows.
- Network Management devices, such as Cisco Prime Collaboration Provisioning, Cisco Prime Collaboration Assurance, and Cisco Prime Collaboration Deployment.
- Communications infrastructure devices, such as Cisco IOS Extended Maintenance Deployment, Cisco 4451-X Integrated Services Router (ISR), and Cisco SRE 910 Service Module.

Deployment Models

The Cisco Collaboration System supports the deployment models in the following table.

Table 1: Deployment Models

Deployment Models	Description
Single-Site Model	This model is designed for autonomous offices in which most or all employees are IPC users. This model can support up to 30,000 users.
Multisite Centralized Call Processing Model	This model is designed for distributed operations with a large central or headquarters site and multiple remote or branch sites. This model can support up to a total of 30,000 phones distributed among up to a maximum of 1000 sites. Based upon the bandwidth available, each site can support any number of users up to the overall total of 30,000 phones.
Multisite Distributed Call Processing Model	This model is designed for organizations with large user populations or large numbers of geographically distributed sites resulting in the need for more than a single call processing entity. This model is suited for deployments that require multiple Cisco Unified Communications Manager clusters or Cisco Unified Communications Manager Express platforms. Each call processing entity in this model is configured as a single-site model or multisite centralized call processing model and each has a common dial plan and feature set.

Clustering Over IP WAN Call Processing Model	This model is designed for organizations with large user populations across multiple sites that are connected by an IP WAN with the QoS features enabled. It supports the Local Failover Deployment Model and the Remote Failover Deployment Model.
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System Features in This Release

Cisco Collaboration Systems integrate telephony, conferencing, messaging, and security products for IP customers who have a variety of deployment models. For detailed Cisco IP telephony feature information, see the [System Release Notes: Cisco Collaboration Systems, Release 10.6.1](#).

Additional Product Information

[Cisco Unified Enterprise Solution](#)



Plan

- [Introduction to Plan, page 9](#)
- [Planning Concepts, page 10](#)
- [Planning Tasks, page 14](#)
- [Additional Sites and Services, page 18](#)

Introduction to Plan

In the Plan phase, you assess your readiness to support a proposed solution. Planning continues the needs analysis begun in the Prepare phase, with the goal of producing a high-level project plan and the initial site survey.

Before You Begin

Understand the features and functions of IP telephony applications. Start with the [Planning Concepts](#) and the [System Release Notes](#).

When You Are Done

You have defined and created the following:

- A comprehensive list of components and applications that match the requirements
- A project plan based on those requirements including a proposed, high-level design

Major Concepts and Tasks in This Process

- [Planning Concepts](#)
- [Planning Tasks](#)

Planning Concepts

This topic presents planning concepts. It is assumed that your network will be a converged network that combines voice, data, and video and that you have decided on one of network types discussed in the [Market Descriptions](#) in the [Internetwork Design Guide](#). You should also review the information contained in the [Market Descriptions](#) topic.

The primary planning considerations that drive the planning stage are: types of deployment, whether it will be a new installation or migration to new installation with existing equipment; application availability based on your networking needs for multimedia and voice, security, redundancy, fault tolerance, and the costs associated with your needs.

Your goal is to minimize costs while delivering service that does not compromise established availability and performance requirements. These issues are essentially at odds. Any increase in availability and performance must generally be reflected as an increase in cost. As a result, you must carefully weigh the relative importance of resource availability, performance constraints, variables, and overall cost.

**Note**

The concepts discussed in this topic are meant to be a high-level overview of considerations and not meant to be a definitive set of rules.

The concepts that you should review are as follows:

- [Deployment Types](#)
- [Cost of Ownership](#)
- [Redundancy](#)
- [Capacity and QoS](#)
- [Security](#)

Deployment Types

The deployment types to consider are as follows:

- New installation
 - Greenfield—Completely new installation of the Cisco Collaboration system, using no existing equipment.
 - Legacy—New installation of the Cisco Collaboration system combined with existing legacy equipment, such as TDM PBXs and third-party adjuncts, which may require long-term co-existence and integration or eventual migration to the new installation.
 - Brownfield—Existing Cisco Collaboration system, which requires an upgrade and migration from a previous system release to the current system release.
- Single-Stage Upgrade
 - Using existing hardware—All components in the network start at the base release set and all components can be upgraded to the target release set within a single maintenance window.

- Using new hardware (flash-cut or shrink-and-grow)—A parallel network should be built using new hardware and pre-staged with configuration to support the existing production network.
- Multistage System Upgrade
 - Using existing hardware (hybrid system)—The components in individual sites can be upgraded from the base release set to the target release set in stages, during separate maintenance windows.
- Multisite Migration with Independent Site Upgrade
 - Using a hybrid network with interworking release sets—Components are upgraded on a site-by-site basis during separate maintenance windows. At the completion of each maintenance window, a hybrid network exists within the multiple sites that have components operating on the base release set; or components that are operating on the target release set; or components that are a hybrid system.

Cost of Ownership

Information system budgets can run into millions of dollars. As large organizations increasingly rely on electronic data for managing business activities, the associated costs of computing resources continue to rise. With this in mind, your basic network plan should include the following:

- Environmental consideration—Include the location of hosts, servers, terminals, and other end nodes; the projected traffic for the environment; and the projected costs for delivering different service levels.
- Performance constraints—Consider network reliability, traffic throughput, and host and client computer speeds. For example, network interface cards and hard drive access speeds
- Internetworking variables—Include the network topology, line capacities, packet flow assignments, redundancy and fault tolerance factors, backward compatibility (co-existence and interoperability), and security.

Redundancy

Redundancy is critical considering the number of vital business applications running on the network. If you have a distributed network with several access layers to remote offices, and you have a failure from the distribution layer to the core without redundancy, you have loss of network service for a large number of people. If you have redundancy in the distribution layer and the core, you can potentially lose one or more circuits without disturbing service to any particular group of users. Depending on the application, you may also need some redundancy from the access layer to the distribution layer.

Because of redundancy, if you drop a link at any one point in the network, every remote group or user still has a path to get back to the core. Even if you cut off the connection from one of the distribution switches back to the core, you still have access to the core for every user.

For more information on redundancy planning, see the [Redundancy and Load Sharing Design Guide](#).

Capacity and QoS

Capacity and QoS are major considerations in a converged network and effect one another. QoS is needed to prevent applications from using more than a fair share of bandwidth and degrading the performance of other applications. At the WAN interface, QoS is needed to allocate expensive wide area capacity among applications.

Bandwidth and QoS requirements are easy to figure in a multilayered design because the traffic flow is fairly predictable. You can also have end-to-end QoS in a multilayered design. End-to-end QoS is critical when you have real-time applications, such as a voice conversation or video presentation, and you have non-real time applications that can interfere with the real-time applications. For example, if the real-time and non-real time applications arrive at the same layer at the same time, the network must pass the real-time packets first, as well as keep latency and jitter low. QoS end-to-end is the answer.

Consider Call Admission Control (CAC) as an alternative to QoS. CAC limits the amount of traffic allowed onto the network at the ingress point. Because you know that the network will be congested at various times during the day, you can disallow additional traffic by using CAC. Also consider using traffic-shaping techniques using a traffic-shaping devices. A combination of QoS, CAC and traffic shaping will provide optimal performance for applications on a converged network.

Managing link speed mismatches is the last element of traffic management. The mismatches, called chokepoints or bottlenecks, are a basic design issue whenever a large capacity link generates traffic destined for a low capacity link. To avoid the mismatches, carefully analyze the traffic and the device capabilities, then upgrade the interface (if needed) and apply a combination of CAC and QoS.

For more information on QoS, see the [Enterprise QoS Solution Reference Network Design Guide](#).

Security

Cisco recommends multiple layers of security technologies to prevent a single configuration error from jeopardizing the security of the network. Cisco also recommends operational processes that ensure prompt application of software patches, timely installation of new security technologies, and performance of regular security audits and assessments.

As you begin to design your network, rank the importance of your network assets and services by considering these factors:

- What keeps you in business?
- How do you make money?
- Does loss of data or privacy equal lost money?
- What about regulatory compliance?
- How do you protect your critical data?
- Where does voice fit?

Then consider the potential threats to your business, which may include

- Toll fraud
- Eavesdropping
- Address spoofing

- Fake caller identity
- Media tampering
- Denial of service
- SPAM, SPIT (SPAM over IP telephony), and SPIM (SPAM over Instant Messaging)

In addition to the operational processes, advanced security technologies should be reviewed and considered. Security technologies can be categorized as follows:

- Network security
 - Virtual LANs (VLANs)
 - Access control lists (ACLs)
 - Stateful firewalls with protocol aware inspection
 - Virtual Private Networks (VPNs)
 - QoS
 - Dynamic Address Resolution Protocol (ARP) inspection
 - Dynamic Host Configuration Protocol (DHCP) snooping
 - Port security
 - Network intrusion prevention
- Host security
 - Cisco Security Agent
 - Third-party anti-virus software
 - Host-based firewalls
 - Hardened operating systems
- User authentication, authorization, and accounting security
 - Phone image authentication
 - Multilevel administration privileges
 - Call detail reporting

For more information about Cisco end-to-end security designs, see the Cisco SAFE guidelines at http://www.cisco.com/c/en/us/solutions/enterprise/design-zone-security/landing_safe.html. For more details about Cisco integrated network security solutions, see the following resources:

- [Security Products and Solutions](#)
- [Secure Unified Communications](#)
- [Cisco Support Community for Security](#)

Planning Tasks

The following overview shows the high-level tasks of the planning process:

- [Determine Your Business Requirements](#), on page 14
- [Use Planning Tools and Templates](#), on page 15
- [Deployment Models](#), on page 15
- [Identify System Components](#), on page 16
- [Review Compatibility Matrix](#), on page 16
- [Collect and Analyze Data](#), on page 17
- [Create High-Level Design](#), on page 17

Determine Your Business Requirements

Two important factors that drive your business requirements are:

- Size of your business. For more information, see [Market Descriptions](#)
- Requirements for installation and upgrade. For more information, see:
 - [Install and Configure System Components](#)
 - [Additional Sites and Services](#)

Review the [Deployment Models](#), on page 15 topic for more details.

Collecting Requirements

The following are suggested methods to use in gathering information to plan your network:

- **Assess User Requirements**—Users want applications to be available on demand in the network. The chief components of application availability are response time, throughput, and reliability. You can assess user requirements as follows:
 - Develop community profiles of what different user groups require. Although many users have roughly the same requirements of an electronic mail system, engineering groups using Windows terminals and Sun workstations in an NFS environment have different needs from PC users sharing print servers in a finance department.
 - Build a baseline for implementing an internetwork by interviewing groups, forming focus groups, or using surveys. Some groups might require access to common servers, while others might want to allow external access to specific internal computing resources. Formal surveys can be used to get a statistically valid reading of user sentiment regarding a particular service level or proposed internetworking architecture.
 - Conduct a test involving representative users in a lab environment. This is most applicable when evaluating response time requirements. As an example, you might set up working systems and have users perform normal remote host activities from the lab network. By evaluating user reactions

to variations in host responsiveness, you can create benchmark thresholds for acceptable performance.

- **Identify Functionality Requirements**—After you understand your internetworking requirements, you can select the specific functionality that fits your environment, such as the level of application availability and the implementation costs for that availability. Fault tolerance and redundancy should be considered also.

Use Planning Tools and Templates

This topic includes planning tools and links to documents that provide guidelines for designing and configuring your Cisco Collaboration Systems. It also includes information on quoting and ordering Cisco Collaboration Systems products.

Solution Reference Network Design Documents

Solution Reference Network Design (SRND) documents provide guidelines, recommendations, and best practices for implementing IP telephony network solutions. The following SRNDs are recommended for designing Cisco Collaboration Systems:

- [Cisco Collaboration Systems SRND Based on Cisco Unified Communications Manager 10.x](#)
- [Cisco Unified Communications SRND Based on Cisco Unified Communications Manager 9.x](#)
- [Cisco Unified Communications SRND Based on Cisco Unified Communications Manager 8.x](#)
- [Cisco Unified Communications SRND Based on Cisco Unified Communications Manager 7.x](#)
- [Cisco Unified Communications SRND Based on Cisco Unified Communications Manager 6.x](#)
- [Cisco Unified Contact Center Express SRND Release 9.0](#)
- [Enterprise QoS System Reference Network Design](#)



Note

Additional SRND resources are available at <http://www.cisco.com/go/srnd>.

Ordering Guides

Deployment Models

With Cisco Collaboration Systems you can choose from many deployment options, including cloud computing, hybrid, and on-premises. The following sections provide deployment model examples and information.

Cisco Preferred Architecture and Cisco Validated Designs

Cisco Preferred Architectures and Cisco Validated Designs (CVDs) help you design and deploy powerful, comprehensive, and scalable collaboration architectures with collaboration services, such as Cisco Unified

Communications, Video Collaboration, and Contact Center. Cisco Preferred Architectures and CVDs guides provide the framework for systems design based on common use cases or current engineering system priorities. Cisco engineers have tested and documented each CVD to help ensure a faster, more reliable, and more predictable deployment.

- Cisco Preferred Architecture design overviews provide a prescriptive, end-to-end architecture, an understanding of the individual products and their role in the overall architecture, along with basic design best practices and a sample Bill of Materials
- CVDs provide detailed design and step-by-step deployment information for collaboration deployments and are based on Preferred Architectures.

For samples of Cisco Preferred Architecture and CVDs see [Cisco Validated Designs for Collaboration](#).

Tested Deployment Models

Cisco has developed a variety of site models as standard architectures. These models were tested and optimized for maximum efficiency and performance. You can derive your network design by choosing the deployment model that most closely matches your business and then adding the specific features and applications that meet your business needs.

For information about Contact Center deployment Unified Contact Center Enterprise models tested by the Collaboration Systems Validation team for this release, go to https://www.cisco.com/c/en/us/td/docs/voice_ip_comm/uc_system/V10-6-1/VTGS_BK_T6C916AE_00_test-bed-unified-cce.html.

For information about Contact Center deployment Unified Contact Center Express models tested by the Collaboration Systems Validation team for this release, go to https://www.cisco.com/c/en/us/td/docs/voice_ip_comm/uc_system/V10-6-1/VTGS_BK_T13FBE9C_00_test-bed-unified-ccx.html.

For information about Collaboration tested deployments and site models for this release, go to https://www.cisco.com/c/en/us/td/docs/voice_ip_comm/uc_system/V10-6-1/VTGS_BK_TCEB367A_00_tested-deployment-and-site-models.html.

Cisco Collaboration Systems Solution Reference Network Designs (SRND)

For additional guidelines, recommendations, and best practices for implementing Collaborations networking solutions, go to [Cisco Collaboration Systems 10.x Solution Reference Network Designs \(SRND\)](#).

Identify System Components

For a brief description of all the components that are available with Cisco Collaboration Systems Release 10.6(1), see the [Install and Configure System Components](#) topics in the Implement chapter for links to information that describe components that are specific to the IP telephony system.

The [Cisco Collaboration Systems Compatibility Matrix](#) lists all the components and their versions for a particular release. This is the recommended set of components and specific software versions that have been tested and verified for interoperability within a specific system release. For compatibility information prior to Collaboration Systems Release 10.6, refer to the [Compatibility Tool](#).

Review Compatibility Matrix

The [Compatibility Matrix](#) lists all the components and their versions for a particular release. This is the recommended set of components and specific software versions that have been tested and verified for

interoperability within a specific system release. For compatibility information prior to Collaboration Systems Release 10.6, refer to the [Compatibility Tool](#).

Collect and Analyze Data

Using available tools, collect data on the network to assess network readiness. Tasks for data collection and analysis include:

- Perform an infrastructure analysis—Obtain floor plans and campus maps, including utilities and conduit systems, to identify deficiencies in infrastructure.
- Perform a software gap analysis—Do a software gap analysis to address network management tools for the IP network.
- Perform an initial traffic analysis—Collect data on all potential converged infrastructure traffic flows. Use station message detail recording (SMDR) and billing records to determine legacy call volumes and use network management tools to collect key statistics on your IP data network.

Create High-Level Design

When data is collected and analyzed, record the results in the site survey and high-level design documents.

Preparing for Your System Installation

This topic provides links to documentation for you to review before you install the Cisco Collaboration System. It lists the components in the release set and provides information regarding the deployment of various components.

For more information, see:

- [Cisco Collaboration Systems Compatibility Matrix](#)
- [Limitations and restrictions](#)

When your installation plans are complete and you are ready to install components, go to [Performing Your System Installation](#), on page 31.

**Note**

There may be more than one upgrade path available based on the software deployed in your specific environment.

When your upgrade plan is in place and you are ready to upgrade, go to [Preparing for Your System Upgrade](#), on page 17

Preparing for Your System Upgrade

This topic discusses information to review before the actual upgrade process, such as the different IP telephony components, upgrade release versions of components involved in the upgrade, and release version compatibility. This topic contains the following sections:

- [Upgrade Paths](#)
- [Compatibility Matrix](#)

When your upgrade plan is in place and you are ready to upgrade, go to [Performing Your System Upgrade](#).

**Note**

There may be more than one upgrade path available based on the software deployed in your specific environment.

Additional Sites and Services

Steps to Success is a Cisco methodology that outlines the tasks required to complete a successful customer engagement. Registered users can visit the [Steps to Success](#) resource site for Cisco Unified Communications process flows.

Cisco Unified Communications Services is a Cisco service offering that provides engineering expertise and best practices.

- Registered users can visit the [Cisco Unified Communications Services](#) partner site.
- Non registered users can visit the [Cisco Unified Communications Services](#) site.

Cisco Unified Communications System Demos

Tools are available to demonstrate the collaboration features of a Cisco Collaboration System:

- For Cisco partners: [dCloud: The Cisco Demo Cloud](#)
- For Cisco sales teams: [Global Demonstrations](#) [Internal]



Design

- [Introduction to Design, page 19](#)
- [Design Concepts, page 20](#)
- [Using SRND Documents, page 20](#)
- [Using Design Tools and Templates, page 21](#)
- [Design Tasks, page 21](#)
- [Additional Sites and Services, page 27](#)

Introduction to Design

Using the project plan that was developed in the Plan phase, your team should have enough information to develop a detailed design for each site and the entire network. The network design should contain, at a minimum:

- Routing and switching component connectivity
- Software applications and configurations for routers and switches
- Power and environment

For each site, in addition to the above, your design should include telephone circuitry, equipment racks with cabinet locations, and layouts. Each site should have a design that encompasses your network call processing, conferencing, and messaging requirements. The design should be scalable for future growth.

For an overview of the deployment options, see [Deployment Types, on page 10](#) in the Cisco Collaboration Systems Description Release 10.6(1).

Before You Begin

Review Solution Reference Network Design (SRND) documents and design tools. Gather requirements and data, which can include:

- Business and system requirements
- Service-level agreements

- Capacity (bandwidth) requirements
- Site survey and proposal from the project plan

When You Are Done

The main deliverable of the Design phase is the detailed design:

- Network diagrams (see [Network Topology Diagrams](#) for editable Microsoft Visio network drawings)
- Routing strategy
- Redundancy
- Call flows
- Traffic flows
- Equipment list
- Bill of materials

Major Concepts and Tasks in This Process

Go directly to the main design concepts and tasks:

- [Design Concepts](#)
- [Design Tasks](#)

Design Concepts

Read these conceptual, overview topics for the background knowledge you need to build an intelligent design.

- [Using SRND Documents, on page 20](#)
- [Using Design Tools and Templates, on page 21](#)

Using SRND Documents

Solution Reference Network Design (SRND) documents provide guidelines, recommendations, and best practices for implementing IP telephony network solutions. The following SRNDs are recommended for designing Cisco Collaboration Systems:

- [Cisco Collaboration Systems SRND Based on Cisco Unified Communications Manager 10.x](#)
- [Cisco Unified Communications SRND Based on Cisco Unified Communications Manager 9.x](#)
- [Cisco Unified Communications SRND Based on Cisco Unified Communications Manager 8.x](#)
- [Cisco Unified Communications SRND Based on Cisco Unified Communications Manager 7.x](#)
- [Cisco Unified Communications SRND Based on Cisco Unified Communications Manager 6.x](#)
- [Cisco Unified Contact Center Express SRND Release 9.0](#)

- [Enterprise QoS System Reference Network Design](#)

**Note**

Additional SRND resources are available at [Design Zone](#).

Using Design Tools and Templates

Use these design tools to assist you in sizing your network.

- Tools such as the IPC Resource Calculators, are intended to simplify and automate the process of sizing contact center resources that are required for specific contact center business operations. The tools are also useful for verifying and troubleshooting existing installations. The output from these tools can also be used as input to the [Cisco Unified Contact Center Express Configuration and Ordering Tool](#).

- [Cisco Collaboration Sizing Tool](#)

A web-based tool that assists users with hardware sizing of large or complex Cisco Collaboration Systems solutions by calculating the call processing requirements for products that have a major impact on performance and scalability. With the Cisco Unified Communications Sizing Tool, system engineers with Cisco Collaboration Systems solution experience or individuals with equivalent abilities can design and model solutions for existing and prospective customers. The tool requires various types of information to calculate the minimum size and type of devices required for a solution, such as the type and quantity of IP phones, gateways, and media resources. For most device types, the tool also requires the average number of call attempts per hour per device during the busy hour (known as busy hour call average or BHCA) and the average utilization time. The resulting calculations produced by the tool can be saved, copied, and sent to other users.

The output from the Cisco Collaboration Sizing Tool includes the count and size mix of Virtual Machines, which can be used with the Cisco Collaboration Virtual Machine Placement Tool.

- [Cisco Collaboration Virtual Machine Placement Tool](#)

A web-based tool that assists users determine the placement of virtual machines and the hardware design for virtualized Collaboration solutions.

The tool requires the user to have sized the applications and know which Virtual Machines and how many are to be used. So use the Cisco Collaboration Sizing Tool before you use the Cisco Collaboration Virtual Machine Placement Tool.

For additional information on design tools such as the Cisco Unified Communications Sizing Tool, as well as other system design topics, see the documentation wiki (DocWiki) at: http://docwiki.cisco.com/wiki/Unified_Communications_System_Design

Design Tasks

The following list is an overview of tasks for designing IP Telephony systems and is not meant to represent an ordered sequence of tasks.

- Identify the Components That You Need
- Review Tested Site Models

- Review System Caveats
- Review System Test Results
- Develop Traffic Engineering Specifications
- Define Security Policies
- Design for High Availability

Identify the Components That You Need

This topic provides links to descriptions of components, component documentation, and matrices.

- [Collaboration Overview](#)- Describes the primary Cisco software components in Collaboration systems.
- [Component Resources Documentation for Collaboration, on page 80](#)—Lists the component documentation.
- [Cisco Collaboration Compatibility Tool](#)—Provides tables that identify the compatible software release versions for each product in each Cisco Collaboration release.
- [Cisco Interoperability Portal](#)—Provides information about configuring Cisco technologies with third-party products and lists features that interoperate between Cisco solutions and other vendors.

The components that can be installed and configured in Collaboration environments are divided in categories as described in the table.

Table 2: Component Categories and Descriptions

Category	Description
Call Control Components	<p>Call control components extend enterprise and midmarket telephony features and capabilities to packet telephony network devices such as IP phones, media processing devices, voice over IP (VoIP) gateways, and multimedia applications. Additional services, such as unified messaging, multimedia conferencing, collaborative contact centers, and interactive multimedia response systems, are made possible through open telephony APIs.</p> <p>Cisco Unified Communications Manager is an example of call control component.</p>

Server Application Components	<p>Server Application components are customized applications that help you streamline business processes and drive productivity through Internet Protocol (IP)-based Unified Communications. These components enable the rapid development, reliable execution and automated management of applications that integrate voice and video with enterprise and midmarket applications and data.</p> <p>Some examples of these components are Cisco Emergency Responder, Cisco Unified Attendant Consoles, and Cisco Unified Communications Manager IM and Presence Service.</p>
Conferencing Components	<p>Conferencing components provide integrated voice, video, and Web conferencing capabilities to enable remote meetings that are natural and effective with face-to-face quality, such as meetings, training sessions, and presentations.</p> <p>Some examples of these components are Cisco TelePresence Server and Cisco WebEx Meetings.</p>
Voice Mail and Unified Messaging Components	<p>Voice mail and unified messaging components deliver powerful voice, integrated, and unified messaging options that transparently integrate with Microsoft Exchange, Lotus Domino, and Novell GroupWise. They scale to meet the needs of large, multisite organizations and offers extensive personalization options, a broad range of productivity enhancing features, and powerful migration tools, including:</p> <ul style="list-style-type: none"> • Interoperability with existing voice messaging and telephony systems • Custom keypad mapping of the telephony interfaces • Integrated context-sensitive help <p>An example of these components is Cisco Unity Connection.</p>
Endpoints and Clients Components	<p>Endpoint and client components integrate the management capabilities of IP-based networks with phones, pagers, and computers and use these for signaling, voice communications, and data communications.</p> <p>Some examples of these components are Cisco Desktop Collaboration Experience DX650 and Cisco TelePresence SX20 Quick Set.</p>

Security Components	Security components are processes and technologies designed to quickly adapt to new threats to your network by using proactive, automated, real-time threat management.
Network Management Components	<p>Network management components provide an integrated view of the entire Cisco Collaboration Systems and present the current operational status of each element of the IP communications network. In addition these components provide a low-cost, reliable method of monitoring and evaluating the quality of calls and diagnosing issues.</p> <p>Some examples of these components are Cisco Prime Collaboration Provisioning, Cisco Prime Collaboration Assurance, and Cisco Prime Collaboration Deployment.</p>
Communications Infrastructure Components	Infrastructure components are network routers, switches, software, and other standards-based networking components that provide reliable connectivity that is more resilient and enables all the latest network services.

Ordering Tools

- [Ordering guides](#) for most Cisco Collaboration Systems products for Cisco partners, Cisco sales staff, and service providers
- [Cisco Unified Contact Center Express Ordering tool](#)

Review Tested Site Models

Cisco has developed a variety of site models as standard architectures. These models were tested and optimized for maximum efficiency and performance. You can derive your network design by choosing the deployment model that most closely matches your business and then adding the specific features and applications that meet your business needs. Review the following information:

- [IP Telephony Tested Deployments and Site Models](#)

Review System Caveats

System caveats describe unexpected behavior, defects, and product limitations discovered during system-level testing of Unified Communications components.

Check the latest release notes to make sure that your design has taken all system caveats into consideration. System caveats are listed under the [Limitations and Restrictions](#) section of the release notes.

Develop Traffic Engineering Specifications

For background information on various traffic analysis concepts and features that are applicable to Voice over IP (VoIP), see [Traffic Analysis for Voice over IP](#). This document presents fundamental traffic theory, several statistical traffic models, application of traffic analysis to VoIP networks, and an end-to-end traffic analysis example.

Use the [Collaboration Sizing Tool](#) to calculate the minimum number of active subscribers that are required to support a given installation. Inputs consist primarily of quantity and usage information on the various device types that are supported in a Cisco Unified Communications Manager system.

The following third-party traffic engineering tools are provided for your reference:

- [VoIP Bandwidth Calculator](#)
- [Online Erlang Traffic Calculators](#)

Define Security Policies

Refer to security policies in these guides:

- [Cisco Unified Communications Manager Security Guide](#)
- Specific component documents available in [Component Resources Documentation](#), on page 80 in the Resource Library.

Additional IP security information is included here for your reference:

- [Cisco Self-Defending Network](#)
- [Design Zone for Security](#)
- [Security Intelligence Operations](#)

Design for High Availability

Cisco Enterprise systems are designed for high availability. In order to achieve this, the design must include redundancy for failover and rapid recovery.

For recommendations and design assistance from Cisco Advanced Services, see [Navigating the Road to Five Nines](#).

The Unified Communications Manager plays the key role in maintaining call processing following a failure in an Enterprise environment. This topic describes the following high-availability features that are built into Unified Communications Manager:

- [Unified Communications Manager Clusters](#)
- [Unified Communications Manager Redundancy Groups](#)
- [Keepalive Mechanism](#)

**Note**

The information in this topic applies to multiple Unified Communications Manager server clusters in a large enterprise environment and does not apply to Cisco Business Edition. Cisco Business Edition is a single-server solution designed for medium businesses up to a maximum of 500 employees and does not offer redundancy.

Unified Communications Manager Clusters

A cluster comprises a set of Unified Communications Manager servers (or nodes) that share the same database and resources. Unified Communications Manager servers can be configured to perform the following functions: database server, TFTP server, or application software server. You can dedicate a particular server to one function or combine several functions on one server, depending on the size of your network and the level of redundancy desired.

Each cluster can have only one database server (also called the first node) and usually one TFTP server (either separate or combined with another function). Cisco Systems recommends that large enterprise networks contain a dedicated Unified Communications Manager database server with other servers (called subsequent nodes) running the Unified Communications Manager application software. The Unified Communications Manager application software performs all call control, including signaling of endpoints, feature invocation, and calling restrictions. Large-scale networks typically use paired redundant application software servers, running in an active-active configuration, with endpoints evenly distributed across the two servers. The TFTP server provides configuration files for the endpoint devices and the associated firmware loads. Large enterprise networks typically use redundant TFTP servers.

Unified Communications Manager Redundancy Groups

A redundancy group comprises a prioritized list of up to three Unified Communications Manager servers. You can associate each group with one or more device pools to provide call processing redundancy. Each group must contain a primary Unified Communications Manager, and it may contain one or two backup Unified Communications Manager servers. If the primary Unified Communications Manager fails for any reason, the first backup Unified Communications Manager in the group takes control of the devices that were registered with the primary Unified Communications Manager. If you specify a second backup Unified Communications Manager for the group, it takes control of the devices if both the primary and the first backup Unified Communications Manager servers fail.

When a failed primary Unified Communications Manager comes back into service, it takes control of the group again, and the devices in that group automatically reregister with the primary Unified Communications Manager.

Keepalive Mechanism

A keepalive mechanism is an essential part of an Enterprise solution. Keepalives ensure that endpoints (typically phones and gateways) retain their communications path to a Unified Communications Manager server. Keepalives not only determine when the primary Unified Communications Manager server is no longer available, they also determine when the site has become completely isolated from a centralized call control system and must revert to some form of remote survivability capability such as Cisco Unified SRST. Keepalives avoid delays in establishing a call caused by searching for an available Unified Communications Manager server.

Additional Sites and Services

Steps to Success is a Cisco methodology that outlines the tasks required to complete a successful customer engagement. Registered users can visit the [Steps to Success](#) resource site for Cisco Collaboration process flows.

Cisco Collaboration Systems Services is a Cisco service offering that provides engineering expertise and best practices.

- Registered users can visit the [Cisco Unified Communications Services](#) partner site.
- Nonregistered users can visit the [Services for Unified Communications](#) site.

For a solution that may fit your network design requirements, see Industry Solutions at <http://www.cisco.com/web/strategy/index.html>.



Implement

- [Introduction to Implementation, page 29](#)
- [Order Equipment, page 30](#)
- [Install and Configure System Components, page 30](#)
- [Introduction to Troubleshooting, page 40](#)
- [Conduct User Acceptance Test, page 52](#)
- [Additional Sites and References, page 53](#)

Introduction to Implementation

The goal of implementation is to introduce the new system into the network with the least amount of disruption and the highest level of interoperability with the existing network. To minimize downtime, an essential component of this process is the implementation plan.

Before You Begin

You should understand how to implement Cisco Unified Communications. For more information, see [Cisco Unified Communications Implementation](#).

Before you begin installing components, you should have a completed implementation plan from the detailed design. Use the equipment list and site specification from the detailed design to do the following:

- Order and stage equipment
- Perform detailed site survey
- Create site-specific installation guidelines

Your implementation plan should include:

- Deployment strategy
- Network maps and topology diagrams
- Installation and commissioning tests
- Site survey results

- List of all devices to be implemented
- Installation guidelines
- Configuration worksheets
- Test and turn-up plan

When You Are Done

All components are installed and ready to configure.

Major Tasks in This Process

- [Order Equipment](#)
- [Install and Configure System Components](#)
- [Conduct User Acceptance Test](#)
- [Preparing Your Network for Troubleshooting and Recovery](#)

Order Equipment

This topic includes links to ordering guides and descriptions of tools that you need to choose your ordering options.

Quote Builder Tool

The Quote Builder tool is a solutions quoting application for Cisco Unified Communications products. Quote Builder is available to specialized partners and Cisco employees.

With Quote Builder, users can build a system quote with design documents to aid in the implementation of the solution. Quote Builder also validates designs for common deployments. Quote Builder generates a bill of materials, a network diagram, and design guides for deployment. To access Quote Builder, go to the following URL:

<http://www.cisco.com/web/partners/index.html>

This site contains many resources for Channel and Solution partners.

Ordering Guides

[Ordering guides](#) for most Cisco Collaboration Systems products are available for Cisco partners, Cisco sales staff, and Cisco service providers.

Install and Configure System Components

When implementing a Cisco Collaboration system, create a site-specific plan for your team. Describe what needs to be installed and configured. Your plan should list the referenced product-specific installation guides in the [Component Installation and Configuration Guides](#), on page 31.

Your plan will help you manage timelines for implementing equipment and scheduling outages. Include an installation schedule, as well as a test plan that will verify that the operation conforms to the design objectives.

This section provides information about the components of the Cisco Collaboration Systems for IP Telephony Release 10.6(1) deployment. It does not describe installation procedures for individual components. For links to the complete documentation set for each system component, see the [Component Resources Documentation for Collaboration](#), on page 80 topic in the Resource Library chapter.

Performing Your System Installation

Before You Begin

See [Preparing for Your System Installation](#) in the Chapter Plan to plan your overall strategy.

Install IP Telephony Software Components

Once you have your installation plan and preparations in place, perform your system installation by following the guidelines and sequence in the individual product installation and configuration guides.

See [Component Installation and Configuration Guides](#) for links to component installation and upgrade documentation.

For system configuration examples, as well as other system implementation topics, see the documentation wiki (docwiki) at http://docwiki.cisco.com/wiki/Unified_Communications_System_Implementation.

Component Installation and Configuration Guides

The following table provides references to installation and configuration documents for the software and hardware components that are part of the Cisco Collaboration Systems Release 10.6(1) solution. This information includes component names and related documentation.

Table 3: Component Installation and Configuration Documentation

Product Category	Product Technology	Components	Documentation Title
Call Control	Cisco Unified Communications Manager	<ul style="list-style-type: none"> • Cisco Unified Communications Manager • Cisco Real-Time Monitoring Tool • Music on Hold • Cisco Security Agent (only as a standalone agent) • Third-party Antivirus 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate
	Cisco Unified Communications Manager IM and Presence Service	<ul style="list-style-type: none"> • Cisco Unified Communications Manager IM and Presence Service 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate
	Cisco Unified Communications Manager Express	<ul style="list-style-type: none"> • Cisco Unified Communications Manager Express 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate

Product Category	Product Technology	Components	Documentation Title
Conferencing	Cisco TelePresence Management Suite	<ul style="list-style-type: none"> • Cisco TelePresence Management Suite 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate
	Cisco TelePresence Management Suite Extension	<ul style="list-style-type: none"> • Cisco TelePresence Management Suite Extension • Cisco TelePresence Management Suite Extension for Microsoft Exchange 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate
	Cisco TelePresence Server	<ul style="list-style-type: none"> • Cisco TelePresence Server • Cisco TelePresence Server on Virtual Machine • Cisco Multiparty Media 400v • Cisco TelePresence Content Server 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate
	Cisco TelePresence Conductor	<ul style="list-style-type: none"> • Cisco TelePresence Conductor 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate

Product Category	Product Technology	Components	Documentation Title
	Cisco TelePresence MCU	<ul style="list-style-type: none"> <li data-bbox="743 338 956 428">• Cisco TelePresence MCU 4200 Series <li data-bbox="743 449 956 539">• Cisco TelePresence MCU MSE 8420 <li data-bbox="743 560 956 651">• Cisco TelePresence MCU MSE 8510 	<ul style="list-style-type: none"> <li data-bbox="1011 338 1206 525">• Install and Upgrade Guides for Cisco TelePresence MCU 4200 Series <li data-bbox="1011 546 1206 699">• Configuration Guides for Cisco TelePresence MCU 4200 Series <li data-bbox="1011 720 1206 907">• Maintain and Operate Guides for Cisco TelePresence MCU 4200 Series <li data-bbox="1011 928 1206 1115">• Install and Upgrade Guides for Cisco TelePresence MCU MSE Series <li data-bbox="1011 1136 1206 1289">• Configuration Guides for Cisco TelePresence MCU MSE Series <li data-bbox="1011 1310 1206 1497">• Maintain and Operate Guides for Cisco TelePresence MCU MSE Series
	Cisco Collaboration Meeting Rooms (CMR)	<ul style="list-style-type: none"> <li data-bbox="743 1591 938 1709">• Cisco Collaboration Meeting Rooms (CMR) Cloud <li data-bbox="743 1730 938 1848">• Cisco Collaboration Meeting Rooms (CMR) Hybrid 	<ul style="list-style-type: none"> <li data-bbox="1011 1591 1182 1646">• Configuration Guides

Product Category	Product Technology	Components	Documentation Title
Enterprise Edge	Cisco TelePresence Video Communication Server	<ul style="list-style-type: none"> • Cisco TelePresence Video Communication Server Control • Cisco TelePresence Video Communication Server Expressway 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate
	Cisco Expressway Series	<ul style="list-style-type: none"> • Cisco Expressway Series 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate
Server Applications	Cisco Emergency Responder	<ul style="list-style-type: none"> • Cisco Emergency Responder 	<ul style="list-style-type: none"> • Configuration Guides • Maintain and Operate
	Cisco Unified Attendant Consoles	<ul style="list-style-type: none"> • Cisco Unified Attendant Console Standard • Cisco Unified Attendant Console Advanced 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Maintain and Operate

Product Category	Product Technology	Components	Documentation Title
Cloud Applications	Cisco WebEx Meetings Server	<ul style="list-style-type: none"> • Cisco WebEx Meetings Server 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate
	Cisco WebEx Meeting Center	<ul style="list-style-type: none"> • Cisco WebEx Meeting Center 	<ul style="list-style-type: none"> • Configuration Guides • Maintain and Operate
	Cisco Show and Share	<ul style="list-style-type: none"> • Cisco Show and Share 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate

Product Category	Product Technology	Components	Documentation Title
Voicemail and Messaging	Cisco Unity Connection	<ul style="list-style-type: none">• Cisco Unity Connection	<ul style="list-style-type: none">• Cisco Unity Connection Install and Upgrade Guides• Cisco Unity Connection Configuration Guides• Cisco Unity Connection Maintain and Operate Guides• Cisco Unity Connection End-User Guides
	Cisco Unity Express	<ul style="list-style-type: none">• Cisco Unity Express	<ul style="list-style-type: none">• Install and Upgrade Guides• Configuration Guides• Maintain and Operate

Product Category	Product Technology	Components	Documentation Title
Devices (Endpoints)	Cisco DX Series	<ul style="list-style-type: none"> • Cisco Desktop Collaboration Experience DX650 • DX70 • DX80 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Maintain and Operate
	Cisco TelePresence System EX Series	<ul style="list-style-type: none"> • TelePresence EX60 • TelePresence System EX90 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Maintain and Operate
	Cisco TelePresence System 500	<ul style="list-style-type: none"> • TelePresence System 500-32 • TelePresence System 500-37 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides
	Cisco TelePresence IX 5000	Cisco TelePresence IX 5000	<ul style="list-style-type: none"> • Install and Upgrade Guides • Maintain and Guides
	Cisco TelePresence MX Series	<ul style="list-style-type: none"> • Cisco TelePresence MX Series 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate
	Cisco TelePresence SX Series	<ul style="list-style-type: none"> • Cisco TelePresence SX Series 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate

Product Category	Product Technology	Components	Documentation Title
	Cisco TelePresence Integrator C Series	<ul style="list-style-type: none"> • Cisco TelePresence Integrator C Series 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Configuration Guides • Maintain and Operate
	Cisco TelePresence Precision 60 Camera	<ul style="list-style-type: none"> • Cisco TelePresence Precision 60 Camera 	<ul style="list-style-type: none"> • Install and Upgrade Guides • Maintain and Operate
Service Management	Cisco Prime Collaboration Provisioning, Assurance and Deployment	<ul style="list-style-type: none"> • Cisco Prime Collaboration Provisioning • Cisco Prime Collaboration Assurance • Cisco Prime Collaboration Deployment 	<ul style="list-style-type: none"> • Install and Upgrade • Configure • Maintain and Operate • Cisco Prime Collaboration Deployment Administration Guide
	Cisco Prime License Manager	<ul style="list-style-type: none"> • Cisco Prime License Manager 	<ul style="list-style-type: none"> • Maintain and Operate
Communications Gateways	Cisco Unified Survivable Remote Site Telephony	<ul style="list-style-type: none"> • Cisco Unified Survivable Remote Site Telephony 	<ul style="list-style-type: none"> • Install and Upgrade • Configuration Guides
	Cisco Unified SIP Proxy	<ul style="list-style-type: none"> • Cisco Unified SIP Proxy 	<ul style="list-style-type: none"> • Install and Upgrade

Software Versions and System Caveats

For specific information on product software versions used, see [Cisco Collaboration Systems Compatibility Matrix](#). For compatibility information prior to Collaboration Systems Release 10.6, refer to the [Compatibility Tool](#).

For specific information on system limitations and known caveats, see the [Collaboration System Release Notes for Cisco Collaboration Systems Release 10.6\(1\)](#).

Configuration Examples

Sample configuration commands for infrastructure components that are involved in the call flows are in downloadable zip files for all test bed components in [Configuration Command Files for Collaboration Systems](#) in the Resource Library.

System-level configuration examples are available on the Cisco DocWiki at http://docwiki.cisco.com/wiki/Category:IP_Telephony_System_Configurations.

Introduction to Troubleshooting

This topic describes how to develop a system-level troubleshooting methodology as you install and configure a Cisco Unified Communications network for the first time. It also provides recommendations for preparing and documenting the network that may assist you in diagnosing and isolating problems when they occur. This topic contains the following sections:

- [System Troubleshooting Methodology](#), on page 40
- [Preparing Your Network for Troubleshooting and Recovery](#), on page 50

System Troubleshooting Methodology

The Implementation phase of your network deployment is an excellent time to develop a methodology for troubleshooting the network as a whole. Troubleshooting networking equipment at a system level requires solid detective skills. When a problem occurs, the list of potential suspects is long. You must collect detailed information and systematically narrow the list of potential causes to determine the root problem. This topic does not provide step-by-instructions for resolving problems that occur during network installation. Instead, this topic describes sound methods for troubleshooting your network using the following general steps:

- 1 [Gather Information on the Problem](#), on page 40
- 2 [Isolate Points of Failure](#), on page 43
- 3 [Apply Tools to Determine the Problems Root Cause](#), on page 44

Gather Information on the Problem

Problems are typically discovered and reported by one of the following types of users:

- External customers dialing into a call center to order products, obtain customer service, and so forth.

- Internal agents receiving incoming calls from a call queue or initiating outbound collection calls to customers.
- Internal users using administrative phones to call employees in other company locations or PSTN destinations, and perform basic actions such as call transfers and dialing into conferences.

As the network administrator, you must collect sufficient information from these users to allow you to isolate the problem. Detailed, accurate information will make this task easier. The following table lists recommended questions to ask users when they report a problem. As you turn up your network, you may consider putting these questions in an on-line form. A form will encourage users to provide more details about the problem and also put them into the habit of looking for particular error messages and indicators. Capturing the information electronically will also permit you to retrieve and re-examine this information in the future, should the problem repeat itself.

Table 4: Questions to Ask Users When They Report Problems

Ask this Question...	To Determine...
Did something fail or did it simply perform poorly?	Whether the issue relates to system degradation or a connectivity failure. An example of a failure is when a user dials a phone number and hears fast busy tone. An example of a performance problem is when a user dials into a conference call and hears “choppy” audio when other parties speak. Quality of service or performance issues require a different approach than connectivity or operational problems. You must still isolate the potential sources of the problem, but you will typically use performance management tools instead of log files.
What device were you trying to use?	The device type, model and version of software installed. It is also critical to capture the IP address assigned to the device, as well as its MAC address. If the case of IP phones, determining the phone’s active Cisco Unified Communications Manager server is also important. On Cisco Unified IP phones, these important network values can be displayed by pressing the Settings button and choosing the Network Configuration option from the menu.
Did it ever work?	If a device was recently installed and the problem occurred while making it work for the first time, or if the device was operating normally before the problem occurred. If the device was newly installed, the problem is most likely due to improper configuration or wiring of that particular device. Problems with devices that are already up and running can typically be traced back to one of two causes: (a) the user modifying their device, such as changing their configuration or upgrading software, or (b) a change or failure elsewhere in the network

Ask this Question...	To Determine...
Exactly what action(s) did you perform?	The steps that led up to the problem, including which buttons were pressed and in which order. Capturing this information in detail is important so that you can consistently reproduce the problem.
What error message(s) appeared or announcements did you hear?	The visual and audio indicators of the problem. Ask users to provide the exact text that appears and any error codes in either an email or on-line form. If the error indication was audible, ask the user to write down the announcement they heard, the last menu option they were able to successfully choose or the tone they heard when the call failed.
What time did the problem occur?	The date and time to compare against entries in log files. If the problem occurred on a Cisco Unified IP phone, make certain the user provides the timestamp that appears on their phone's display. Several Cisco components in a network may capture the same problem event in separate log files, with different ID values. In order to correlate log entries written by different components, you must compare the timestamps to find messages for the same event. Cisco Unified IP phones synchronize their date and time with their active Cisco Unified Communications Manager server. If all Cisco components in the network use Network Time Protocol (NTP) to synchronize with the same source, then the timestamps for the same problem messages will match in every log file.
What is the number of the phone you used and what was the phone number you called?	If the problem relates to a WAN or PTSN link, or a Cisco Unified Communications Manager dial plan issue. Ask the user the phone number he or she dialed (called number) and determine if the destination was within his or her site, another site within the corporate network, or a PSTN destination. Because the calling number (the number of the phone used) also affects call routing in some cases, capture this number as well.
Did you try to perform any special actions, such as a transfer, forward, call park, call pickup, or meet-me conference? Is the phone set up to automatically perform any of these actions?	If the problem is not directly related to the calling number or called number but rather to the supplementary service setup on Unified Communications Manager or the problem is at the destination phone the user tried to reach by transferring or forwarding the call.

Ask this Question...	To Determine...
Did you attempt the same action on another device?	If the problem is isolated to that user's device or represents a more widespread network problem. If the user cannot make a call from his or her phone, ask the user to place a call to the same destination using a phone in a nearby office.

Isolate Points of Failure

After collecting information on the symptoms and behavior of the problem, to narrow the focus of your efforts you should:

- Identify the specific devices involved in the problem.
- Check the version of software running on each device.
- Determine if something has changed in the network.
- Verify the integrity of the IP network.

Identify Devices Involved in the Problem

In large- to medium-sized networks, it is crucial to identify the specific phones, routers, switches, servers and other devices that were involved in a reported problem. Isolating these devices allows you to rule out the vast majority of equipment within the network and focus your time and energy on suspect devices. To help you isolate which devices were involved in a problem, two types of information can prove invaluable:

- **Network topology diagrams:** It is strongly recommended that you have one or more diagrams that show the arrangement of all Cisco Unified Communications products in your network. These diagrams illustrate how these devices are connected and also capture each device's IP address and name (you may want to also have a spreadsheet or database of the latter information). This information can help you visualize the situation and focus on the devices that may be contributing to the reported problem. See [Network Topology Diagrams](#) for recommendations on how to prepare these diagrams.
- **Call flow diagrams:** Cisco equipment, including Unified Communications Manager servers, typically provide detailed debug and call trace log files. To interpret these log files, however, it is useful to understand the signaling that occurs between devices as calls are set up and disconnected. Using the network topology and call flow diagrams in conjunction with the log files, you can trace how far a call progressed before it failed and identify which device reported the problem. Examples of using call flow diagrams for problem isolation are shown in [Additional Sites and Services](#).

Check Software Release Versions for Compatibility

After you have identified which devices may be involved in the problem, verify that the version of software running on each device is compatible with the software running on every other device. As part of Cisco Unified Communications Release 10.6(1) verification, Cisco Systems has performed interoperability and load testing on simulated network environments running specific software versions. The [System Release Notes for Cisco Collaboration Systems, Release 10.6\(1\)](#) lists the combination of software releases that were tested.

However, if the combination of releases installed in your network does not match the values in the Release Matrix, it does not necessarily mean the combination is invalid. To check interoperability for a specific device

and software release, locate and review its Release Notes. Release Notes contain up-to-date information on compatibility between the product and various releases of other products. This document also describes open caveats, known issues that may cause unexpected behavior. Before beginning extensive troubleshooting work, examine the Release Notes to determine if you are experiencing a known problem that has an available workaround.

**Note**

The open caveat information in the Release Notes contains links to the Bug Search. The Bug Search requires that you are a Cisco partner or a registered Cisco.com user with a Cisco service contract. To access the Bug Search, go to the <http://tools.cisco.com/bugsearch/>

Determine If Network Changes Have Occurred

Before focusing on the particular device or site where the problem occurred, it may be useful to determine if a change was made to surrounding devices. If something has been added, reconfigured or removed from elsewhere in the network, that change may be the source of the problem. It is recommended that you track changes to the network such as:

- New phones added
- Modifications to Cisco Unified Communications Manager call routing settings, such as new directory numbers, route patterns and dial rules to support new sites or devices
- Changes to port configurations on switches, routers or gateways (new equipment, wiring changes or new port activation)
- Changes to IP addressing schemes (such as adding new subnets) that may have affected route tables

Verify the IP Network Integrity

Always remember that Cisco Unified Communications equipment relies on a backbone IP network. Many connectivity problems are not caused by configuration errors or operational failures on Cisco devices, but rather by the IP network that interconnects them. Problems such as poor voice quality are typically due to IP network congestion, while call failures between locations may be the result of network outages due to disconnected cables or improperly configured IP route tables.

Before assuming that call processing problems result from Cisco Unified Communications devices themselves, check the integrity of the backbone IP network. Keep the OSI model in mind as you perform these checks. Start from the bottom, at the physical layer, by checking that end-to-end cabling. Then verify the status of Layer 2 switches, looking for any port errors. Move from there to confirm that the Layer 3 routers are running and contain correct routing tables. Continue up the OSI stack to Layer 7, the application layer. To resolve problems occurring at the top levels of the stack, a protocol analyzer (or “sniffer”) may be useful. You can use sniffer to examine the IP traffic passing between devices and also decode the packets. Sniffers are particularly useful for troubleshooting errors between devices that communicate using Media Gateway Control Protocol (MGCP) or Session Initiation Protocol (SIP).

Apply Tools to Determine the Problems Root Cause

After you have eliminated the IP network as the source of the problem and you have isolated the specific Cisco Unified Communications components involved, you can start applying the many diagnostic tools provided by Cisco components.

The Table lists the diagnostic tools and supporting troubleshooting documentation available for most components in an IP telephony network. Note that this summary table is provided for reference only. The procedures in [Troubleshooting Daily Operations](#), on page 59 specify when to use each tool and provide links to the troubleshooting instructions in each component's documentation where appropriate.

Table 5: Component Troubleshooting Tools and Documentation

Component	Diagnostic Tools Available	Information Available In...
Call Control		
Cisco Unified Communications Manager	Serviceability System tools: <ul style="list-style-type: none"> • Alarms • Real-Time Monitoring Tool window Trace log files <ul style="list-style-type: none"> • Communications Manager trace log • SDL trace log (under TAC direction) 	<ul style="list-style-type: none"> • Troubleshooting Guides for Cisco Unified Communications Manager
Cisco Unified Communications Manager IM and Presence Service	<ul style="list-style-type: none"> • Cisco Unified Communications Manager IM and Presence Service 	<ul style="list-style-type: none"> • Error and System Messages • Troubleshooting TechNotes
Cisco Unified Communications Manager Express	<ul style="list-style-type: none"> • Cisco Unified Communications Manager Express 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Conferencing		
Cisco TelePresence Management Suite	<ul style="list-style-type: none"> • Cisco TelePresence Management Suite 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Cisco TelePresence Management Suite Extension	<ul style="list-style-type: none"> • Cisco TelePresence Management Suite Extension • Cisco TelePresence Management Suite Extension for Microsoft Exchange 	<ul style="list-style-type: none"> • General Information

Component	Diagnostic Tools Available	Information Available In...
Cisco TelePresence Server	<ul style="list-style-type: none"> • Cisco TelePresence Server • Cisco TelePresence Server on Virtual Machine • Cisco Multiparty Media 400v • Cisco TelePresence Content Server 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Cisco TelePresence Conductor	<ul style="list-style-type: none"> • Cisco TelePresence Conductor 	<ul style="list-style-type: none"> • Troubleshooting Guides
Cisco TelePresence MCU	Cisco TelePresence MCU	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Cisco Collaboration Meeting Rooms (CMR)	<ul style="list-style-type: none"> • Cisco Collaboration Meeting Rooms (CMR) Cloud • Cisco Collaboration Meeting Rooms (CMR) Hybrid 	<ul style="list-style-type: none"> • General Information
Enterprise Edge		
Cisco TelePresence Video Communication Server	<ul style="list-style-type: none"> • Cisco TelePresence Video Communication Server Control • Cisco TelePresence Video Communication Server Expressway 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Cisco Expressway Series	<ul style="list-style-type: none"> • Cisco Expressway Series 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Server Applications		
Cisco Emergency Responder	<ul style="list-style-type: none"> • Cisco Emergency Responder 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes

Component	Diagnostic Tools Available	Information Available In...
Cisco Unified Attendant Consoles	<ul style="list-style-type: none"> • Cisco Unified Attendant Console Standard • Cisco Unified Attendant Console Advanced 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Cloud Applications		
Cisco WebEx Meetings Server	<ul style="list-style-type: none"> • Cisco WebEx Meetings Server 	<ul style="list-style-type: none"> • Troubleshooting Guides
Cisco WebEx Meeting Center	<ul style="list-style-type: none"> • Cisco WebEx Meeting Center 	<ul style="list-style-type: none"> • Field Notes
Cisco Show and Share	<ul style="list-style-type: none"> • Cisco Show and Share 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Voice Mail and Messaging		
Cisco Unity Connection	Cisco Unity Connection	<ul style="list-style-type: none"> • Error and System Messages • Password Recovery Procedure for Cisco Unity Connection • Troubleshooting Guides • Troubleshooting TechNotes
Cisco Unity Express	<ul style="list-style-type: none"> • Cisco Unity Express 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Devices (Endpoints)		

Component	Diagnostic Tools Available	Information Available In...
Cisco Unified IP phones	Network configuration, status and phone model information on Settings menu	<ul style="list-style-type: none"> • End-User Guides <ul style="list-style-type: none"> ◦ Cisco Unified IP Phone 6900 Series ◦ Cisco IP Phone 7800 Series ◦ Cisco Unified IP Phone 8900 Series ◦ Cisco Unified IP Phone 9900 Series • Cisco Unified IP Phone Administration Guides for Cisco Unified Communications Manager, “Troubleshooting and Maintenance” chapters <ul style="list-style-type: none"> ◦ Cisco Unified IP Phone 6900 Series ◦ Cisco Unified IP Phone 8900 Series ◦ Cisco Unified IP Phone 9900 Series ◦ Cisco IP Phone 7800 Series • Error Message Decoder • Output Interpreter
Cisco DX Series	<ul style="list-style-type: none"> • Cisco Desktop Collaboration Experience DX650 • DX70 • DX80 	<ul style="list-style-type: none"> • Cisco Desktop Collaboration Experience DX650 Data Sheets • Cisco Desktop Collaboration Experience DX70 Data Sheets • Cisco Desktop Collaboration Experience DX80 Data Sheets

Component	Diagnostic Tools Available	Information Available In...
Cisco TelePresence System EX Series	<ul style="list-style-type: none"> • Cisco TelePresence System EX90 • Cisco TelePresence System EX60 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Cisco TelePresence System 500	<ul style="list-style-type: none"> • TelePresence System 500-32 • TelePresence System 500-37 	<ul style="list-style-type: none"> • Field Notices • Troubleshooting TechNotes
Cisco TelePresence MX Series	<ul style="list-style-type: none"> • Cisco TelePresence MX Series 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Cisco TelePresence SX Series	<ul style="list-style-type: none"> • Cisco TelePresence SX Series 	<ul style="list-style-type: none"> • Troubleshooting Guides • Field Notices
Cisco TelePresence Integrator C Series	<ul style="list-style-type: none"> • Cisco TelePresence Integrator C Series 	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Cisco TelePresence Precision 60 Camera	<ul style="list-style-type: none"> • Cisco TelePresence Precision 60 Camera 	<ul style="list-style-type: none"> • Technical References
Service Management		
Cisco Prime Collaboration Provisioning, Assurance and Deployment	<ul style="list-style-type: none"> • Cisco Prime Collaboration Provisioning • Cisco Prime Collaboration Assurance • Cisco Prime Collaboration Deployment 	<ul style="list-style-type: none"> • Troubleshooting TechNotes
Cisco Prime License Manager	<ul style="list-style-type: none"> • Cisco Prime License Manager 	<ul style="list-style-type: none"> • Important Notes
Communications Gateways		
Cisco Unified Survivable Remote Site Telephony	<ul style="list-style-type: none"> • Cisco Unified Survivable Remote Site Telephony 	<ul style="list-style-type: none"> • Field Notices • Security Advisories

Component	Diagnostic Tools Available	Information Available In...
Cisco Unified SIP Proxy	<ul style="list-style-type: none"> • Cisco Unified SIP Proxy 	<ul style="list-style-type: none"> • Datasheets
Cisco Integrated Services Router (ISR)	Cisco Integrated Services (ISR) 2900 Series, 3900 Series	<ul style="list-style-type: none"> • Troubleshooting Guides • Troubleshooting TechNotes
Cisco Unified Border Element Enterprise Edition for Cisco ISR Series	Cisco Unified Border Element Enterprise Edition for Cisco ISR Series	<ul style="list-style-type: none"> • Troubleshooting TechNotes

Preparing Your Network for Troubleshooting and Recovery

Before your network becomes operational, you can take several proactive steps to make troubleshooting easier, including:

- Produce network topology diagrams to help you isolate potential sources of problems.
- Synchronize the date and time on all servers.
- Set trace/logging levels on key devices so that diagnostic information is available when problems occur.
- Create IVR flowcharts that illustrate how calls are routed between agents and sites.

Network Topology Diagrams

One of the first lines of defense is possessing current topology information. One of the most important pieces of topology information is a detailed network diagram (usually created using Microsoft Visio or a similar application). At a minimum, your network topology diagrams should include the following information:

- The name assigned to each major device (typically the DNS name)
- IP addresses for all devices in the network
 - Addresses for each router, core and access switch
 - Addresses for all telephony and application servers, including the IP address for each server in a Cisco Unified Communications Manager cluster
 - DHCP address range for addresses assigned to endpoints such as IP phones and agent workstations
- Phone extension number ranges assigned to sets of agents or users, as well as the main inbound dial-up numbers for each location. This information is useful in resolving dial plan configuration errors.
- WAN IP and PSTN links between sites.

This information is critical for isolating which components are involved in a particular problem. For medium-to large-sized networks, you may want to take a “layered” approach in your diagrams. Create a high-level diagram that illustrates the overall physical layout of your network, including all sites and the links between

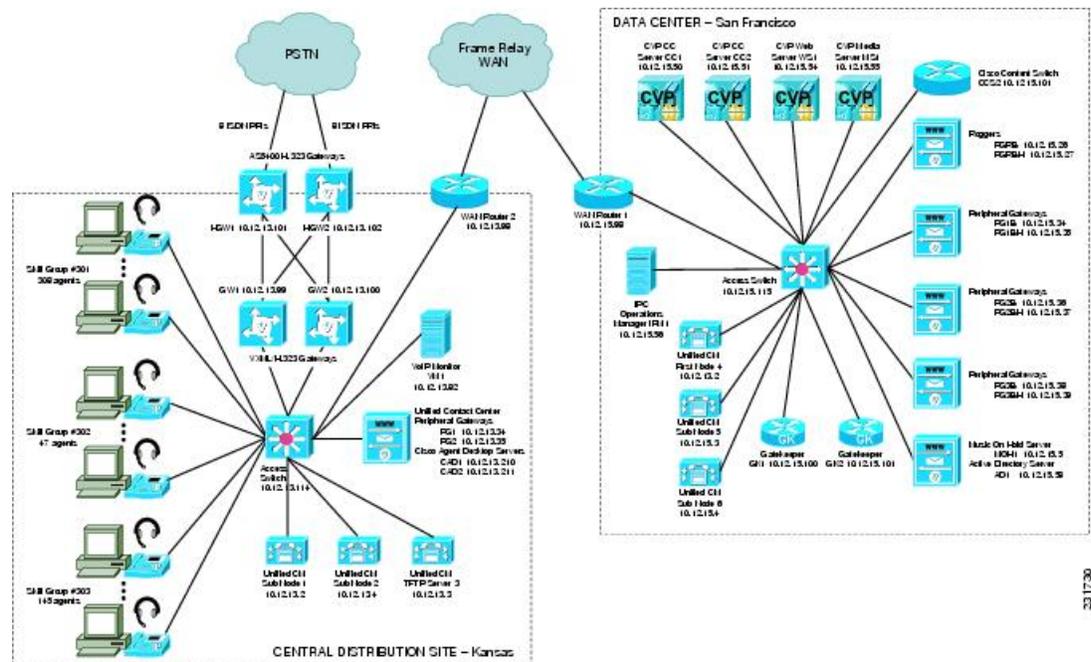
them. Then for each site create additional diagrams that show detailed addressing information, port numbers and dial plan configurations.



Note

Frequent adds, changes and upgrades to your network can quickly make these diagrams out-of-date. Inaccurate diagrams slow down the troubleshooting process and may lead to wrong diagnosis of the problem. Remember to keep these diagrams as current as possible.

The Figure shows a typical high-level topology diagram for a medium-sized enterprise IP telephony network. Note that only device names and IP addresses are listed in the diagram.



Synchronizing Server Date and Time

The best resources for diagnosing problems within your network are the debug and trace log files produced by individual Cisco devices. Tracing can be enabled on multiple devices and the log file output compared to isolate problems. In order to correlate messages for the same activity in different log files, you must compare the message timestamps and the source device MAC and IP addresses (there is no universal call ID value shared between Cisco devices). You should synchronize every device to the same date and time source so that the timestamps match. To accomplish this synchronization, set each device to obtain its date and time from the same Network Time Protocol (NTP) source.

For Cisco IOS-based devices (switches, routers or voice gateways), you can configure each device to act as a NTP client and periodically poll a master NTP source using the following command:

```
ntp server ip-address [version number] [key keyid] [source interface] [prefer]
```

Additional IOS commands are available to establish a device as a NTP peer (operating as the master source for other devices), as well as setting up NTP broadcasting instead of polling. See the [Using the Cisco IOS Command-Line Interface](#) for details about these IOS commands.

Recommended Trace/Logging Settings

In order to have diagnostic information available when you begin to research problems, you must configure devices in your network to capture signaling, processing and other activity in log files.

Cisco Unified Communications Manager Trace Settings

Trace settings for Cisco Unified Communications Manager servers are maintained using the Cisco Communications Manager Serviceability graphical interface. There are two ways to set trace logging levels for Unified Communications Manager services:

- **Customize trace levels for individual parameters:** This approach offers a high-degree of control and flexibility over the trace output. However, in order to use this approach you should understand not only the significance of each parameter, but also the impact of tracing on Unified Communications Manager server performance. For example, setting trace levels to “Error” has a minimal impact to CPU cycles while leaving the “Detail” level set for long periods of time may impact call processing. For instructions on setting individual trace levels, see the [Cisco Unified Serviceability Administration Guide, “Configuring Trace” chapter](#).
- **Apply predefined trace levels:** This approach allows you to quickly enable and disable tracing for each Unified Communications Manager service based on predefined levels. You can also use these default troubleshooting trace settings in combination with customized settings to temporarily override the your custom settings. For instructions on using the Troubleshooting Trace Settings option in the Cisco Unified Communications Manager Serviceability interface, see the [Cisco Unified Serviceability Administration Guide, “Configuring Troubleshooting Trace Setting Configuration” chapter](#).

Debug Trace Settings for Unified IP IVR System

If you encounter any problems with the Unified CCX platform and Unified IP IVR system, activate the following debug trace settings to generate debug logs:

- For Unified CCX platform issues: SS_TEL, SS_ICM, and LIB_ICM.
- For JTAPI Client issues: Enable all Trace Levels and select all debug levels except MISC_DEBUGGING.

However, deactivate the above trace settings if you experience any degradation in performance during heavy load situations.

Cisco Unified Communications Manager Trace Settings

Conduct User Acceptance Test

After the components are configured and integrated with other Collaboration System applications, the field engineer prepares the system for the user acceptance test. Test scripts are run and compared against expected results. Any variability in network performance is noted and addressed before the user acceptance test.

Testing the customer solution involves the following tasks:

- Determine the user acceptance test parameters and deliverables and record these in the user acceptance test plan.

- Conduct a prelaunch test—Using an incremental approach, test the solution against the system design in a low-risk environment with limited users. If the system is stable, the rollout pace is increased until the full implementation is operational.
- The customer signs the Ready-for-Use Acceptance Letter acknowledging that the acceptance test yielded satisfactory results.

Train End Users

The final stage of the Implement phase is to help ensure that the customer's system administration team and end users are trained to take over management of the new system.

Cisco Systems offers several training and certification programs for customers to maximize the usage of their newly adopted systems. See [Using the Training Library, on page 73](#) for more information on Cisco training websites and videos on demand (VODs).

Train End Users

The final stage of the Implement phase is helping to ensure that the customer system administration team and end users are trained to take over management of the new system.

Cisco Systems offers several training and certification programs for customers to maximize the usage of their newly adopted systems.

Additional Sites and References

Steps to Success is a Cisco methodology that outlines the tasks required to complete a successful customer engagement. Registered users can visit the [Steps to Success](#) resource site for Cisco Unified Communications process flows.

Cisco Unified Communications Services is a Cisco service offering that provides engineering expertise and best practices.

- Registered users can visit the [Cisco Unified Communications Services](#) partner site.
- Non registered users can visit the [Cisco Unified Communications Services](#) site.



Operate

- [Introduction to Operating the System, page 55](#)
- [Managing Your System, page 56](#)
- [Backing Up and Restoring Components, page 57](#)
- [Using Network Monitoring Tools, page 58](#)
- [Using Managed Services Documents, page 59](#)
- [Troubleshooting Daily Operations, page 59](#)
- [Additional Sites and Services, page 69](#)

Introduction to Operating the System

To ensure that your network operates efficiently and reliably, your daily operations should consist of system and performance management practices. This practices include scheduled routine maintenance; keeping maintenance records; and maintaining up-to-date upgrade, troubleshooting, and recovery strategies.

Before You Begin

User acceptance testing is completed and any problems that surfaced have been resolved. Users have been trained in using the new system.

Output of This Process

The Operate phase produces data that will inform the Optimize phase.

Major Tasks in This Process

- [Managing Your System, on page 56](#)
- [Backing Up and Restoring Components, on page 57](#)
- [Using Network Monitoring Tools, on page 58](#)
- [Using Managed Services Documents, on page 59](#)
- [Troubleshooting Daily Operations, on page 59](#)

Managing Your System

This topic provides a high-level summary of the ongoing tasks that are required for managing your system and the options for how these tasks can be performed. For detailed maintenance and operation guides for each component in your Cisco Collaboration system, see the product documentation listed in the Resource Library.

System Management Tasks

Managing a Cisco Collaboration system consists of performing the following activities:

- Integrating monitoring and management tools—Select, order, configure, integrate, and test a set of tools for monitoring and managing the Cisco Collaboration system.
- Monitoring—Set thresholds, monitor events, and generate notifications when service-impacting events occur.
- Ticketing—Generate and track system trouble tickets for each event.
- Diagnosing incidents—Analyze and troubleshoot incidents to determine the cause.
- Resolving incidents—Define and execute an action plan which can include performing break and fix activities, applying software updates and patches, managing hardware replacements, and executing change management processes.
- Managing changes in the network—Define a change management process for performing moves, adds, changes, and disconnects (MACDs) for your Cisco Collaboration system including network devices, phones/clients, software upgrades, voicemail boxes, dial plan updates, security patches, OS applications, and voice applications.
- Archiving configurations—Back up device configurations daily and restore device configurations when necessary.
- Managing voice as a network service—Track, measure, and resolve quality of service (QoS) issues such as jitter, delay, and dropped packets, and monitor service level agreements (SLAs) with service providers.
- Managing security posture—Detect, analyze, and address security events.
- Reporting—Define, develop, and generate performance, availability, event, and inventory reports.
- Backing up and restoring system components—Define backup methodologies and schedules, define a verification process for backups, secure storage of backups, and document backup processes.

System Management Options

There are two options for managing a Cisco Collaboration System:

- Do It Yourself—In this model, you are responsible for managing the entire Cisco Collaboration System. This approach requires developing business processes; integrating, provisioning and maintaining network management tools; and developing data and voice management skills and knowledge. Cisco offers tools as a means for monitoring your network; see [Using Network Monitoring Tools](#) for more information.
- Out tasking Hybrid Model—Using the [Services Portfolio](#) approach, Cisco and its partners provide a broad portfolio of end-to-end services and support that can help increase your Cisco Collaboration

system's business value and return on investment. This approach includes two services that provide different levels of management:

- [Cisco Unified Communications Essential Operate Service](#) —Cisco Essential Operate Services, part of Product Support in the Cisco Services Lifecycle framework, is available for Unified Communications software, collaboration software, and network management software. It provides the support you need to help reduce downtime, improve performance, and lead to higher productivity.
- [Cisco Unified Communications Remote Management Service](#) includes monitoring and reporting plus managing day-to-day system issues such logical moves, adds, changes, and disconnects; resolving incidents; performing configuration backups; and reporting.

For more information about the Cisco Unified Communications Essential Operate Service, Cisco Unified Communications Remote Management Service or other Cisco Unified Communications services, see <http://www.cisco.com/en/US/products/sw/voicesw/services.html> or contact your Cisco service account manager.

Backing Up and Restoring Components

This topic provides details on backup and restore for Cisco Collaboration components. First and foremost, the backup of Cisco Collaboration components needs to be incorporated into your corporate-wide backup operations. It is an important aspect of disaster recovery and is also essential before doing component upgrades. If you do not have a process in place, you must develop and document a backup and recovery management process. Some items to consider for this process are the following:

- Provide proper storage of operating system and Cisco Collaboration application CDs.
- Define incremental and full backup methodologies and schedules, assign an owner for each Collaboration component and database server.
- Define a verification process for backups:
 - Monitor backup logs on a daily basis for errors.
 - Periodically restore backup images to ensure validity.
- Secure onsite and offsite storage of backups.
- Develop well documented processes for system and configuration restoration.
- Ideally, provide central location(s) (for example, SFTP servers) for backup of data from all the Cisco Collaboration components.

The following topics provide backup and restore details on a component basis along with links to the appropriate component documentation:

- [Cisco Unified Communications Manager](#)
- [Cisco Unified Communications Manager Express](#)
- [Cisco Unified Contact Center Express](#)
- [Cisco Unified Communication Manager IM and Presence Service](#)

For additional information on backing up and restoring Unified Communications system components, as well as other system operations topics, see the documentation wiki (DocWiki) at http://docwiki.cisco.com/wiki/Unified_Communications_System_Operations.

Cisco Unified Communications Manager

Cisco Unified Communications Manager provides the Disaster Recovery System (DRS) for full backup and restore for all servers in a Unified Communications Manager cluster. The DRS performs a cluster-level backup, which means that it collects backups for all servers in a Unified Communications Manager cluster to a central location and archives the backup data to a physical storage device (tape or SFTP). For customers with multiple clusters, DRS must be configured per cluster.

DRS is invoked via the Unified Communications Manager Platform Administration. It allows you to perform scheduled (daily, weekly, monthly) automatic or user-invoked backups. DRS only supports a single backup schedule at a time. It provides a history (last 20 operations) of backup and restore operations.

**Note**

DRS does not support hostname or IP address change during restore. For more information about the Disaster Recovery System, see the [Disaster Recovery System Administration Guide for Unified Communications Manager](#).

Cisco Unified Communications Manager Express

Cisco Unified Communications Manager Express is an application that runs on Cisco IOS. Therefore, for backup and restore, the IOS facility for backup and restoring configuration data would be used. For more information, see specific documents in [Cisco Unified Communications Manager Express Documentation](#).

Cisco Unified Contact Center Express

For Unified CCX Release 10.6(1), the Backup and Restore application is described in Cisco Unified Contact Center Express Disaster Recovery System Administration Guide. For more information, refer [Cisco Unified Contact Center Express Configuration Guides](#).

Cisco Unified Communication Manager IM and Presence Service

Cisco Unified Communication Manager IM and Presence Service uses the Disaster Recovery System (DRS) for full data backup and restore capabilities of all Unified Presence Administration functions. For more information, see the IM and Presence Disaster Recovery System chapter in [Disaster Recovery System Administration Guide for Unified Communications Manager](#).

Using Network Monitoring Tools

Cisco Prime Collaboration allows businesses to actively monitor their Cisco Unified Communications solution to discover potential problems, maintain quality and user satisfaction, and help minimize service downtime. The following network monitoring tool is primarily used:

- [Cisco Prime Collaboration](#)

For more information about network monitoring, as well as other system operations topics, see the Cisco Unified Communications category on the documentation wiki (DocWiki) at http://docwiki.cisco.com/wiki/Cisco_Unified_Communications.

Cisco Prime Collaboration

Cisco Prime Collaboration removes management complexity and provides automated, accelerated provisioning, real-time monitoring, proactive troubleshooting, and long-term trending and analytics in one integrated product. The solution delivers a premier operations experience through an intuitive user interface and optimized operator methodology, including automated workflows that ease implementation and ongoing administration.

Provisioning features include automated processes for Cisco Collaboration Systems and Cisco TelePresence®. An intuitive user interface provides a single view of a subscriber and the subscriber's services, as well as a consolidated view of subscribers across the enterprise. With these capabilities, Cisco Prime Collaboration significantly accelerates site rollouts and dramatically reduces the time required for ongoing changes. In addition, by simplifying moves, adds, and changes, the solution facilitates delegation of these tasks, allowing organizations to optimize IT resources and further reduce total cost of ownership.

Cisco Prime Collaboration provides efficient, integrated service assurance management through a single, consolidated view of the Cisco voice and video collaboration environment. This includes continuous, real-time monitoring and advanced troubleshooting tools for Cisco Collaboration Systems and Cisco TelePresence systems including the underlying transport infrastructures.

For details, go to [Cisco Prime Collaboration](#).

Using Managed Services Documents

Managed Services documents provide essential information to ensure the continuous operation of a Cisco Collaboration System by monitoring faults, configuration, performance, and security. These documents define a component's Management Information Base (MIB) structure and also explain the syslogs, alerts, and alarms elements that service providers can incorporate in their managed services. They also describe the component's system architecture while outlining basic concepts such as Simple Network Management Protocol (SNMP) and presenting the capabilities of the management tools available for that component.

Refer to the individual product pages for more information on the managed services.

Troubleshooting Daily Operations

This topic describes how to diagnose and resolve system-level problems that occur during daily operations of a Cisco Collaboration network. It contains the following sections:

- [Common Problems Reported by Users](#)
- [PBX Interoperability Issues with Cisco Unified Communications Manager](#)
- [Using Call Flows to Resolve Call Processing Problems](#)
- [Failover and Recovery Procedures](#)

For an expanded list of general problem areas, as well as other system troubleshooting topics, see the documentation wiki (DocWiki) at http://docwiki.cisco.com/wiki/Unified_Communications_System_Troubleshooting.

Common Problems Reported by Users

This section describes basic approaches to diagnose and resolve common problems reported by end users. Note that this section demonstrates various tools and diagnostic approaches available in the context of specific problems, but does not provide a comprehensive list of all possible problems that may occur. Problems described in this section include:

- [One-Way Audio](#)
- [Poor Voice Quality](#)

One-Way Audio

One-way audio and no audio at all (no-way audio) are problems that are fairly common during a new network installation. The majority of these problems are caused by misconfigurations. For one-way audio problems, always pay attention the direction in which the one-way audio is occurring. For no audio in either direction, the troubleshooting methodology is the same. You might need to repeat the procedure for each direction of audio, but more likely you will find the source of the problem when trying to troubleshoot one direction. There are several steps you can take to troubleshoot a one-way/no-way audio problem:

- 1 [Verify Bidirectional IP Connectivity](#).
- 2 [Check Cisco IOS Software Gateway Configurations](#).
- 3 [Check for NAT or Firewall Restrictions](#).

For additional directions on troubleshooting one-way audio problems, refer to the [Troubleshooting One-Way Voice Issues Tech Note](#).

Verify Bidirectional IP Connectivity

You should verify IP connectivity as the first step in troubleshooting a one-way or no-way audio problem because IP connectivity must be present for voice packets to be exchanged between two devices. A large number of one-way or no-way audio problems are caused by lack of IP connectivity. Check that:

- If the two terminating devices involved in the call are on different IP subnets, each device has the correct default gateway and subnet mask settings.
- If one of the devices is a Unified IP phone, the DHCP scope has an incorrectly configured default gateway parameter.
- If one of the devices is a Cisco IOS software gateway, the default route is correct. Also, ping the other end from the gateway. If the ping is successful, you know that you have IP connectivity. If the ping is unsuccessful, perform a `traceroute` to determine where the problem lies.

**Note**

Remember that signaling packet traffic is always between Unified Communications Manager and the terminating device, whereas the RTP voice packet traffic is directly between the devices. So just because the devices are registered to Unified Communications Manager and can set up a call through Unified Communications Manager does not mean that the devices have proper IP connectivity between them.

Another useful tool for troubleshooting such a problem is the help (**i** or **?**) button on Cisco Unified IP phones. Press the help (**i** or **?**) button twice in quick succession during an active call. The display shows you receive and transmit statistics for the call. If you do not see the receive counter (RxCnt) incrementing, the packets are probably not arriving on that IP phone. If you go to the originating IP phone and the transmit count (TxCnt) is incrementing, the packets are probably being lost somewhere in the network. If a ping or traceroute does not provide enough information about where the packets are being lost, you may need to connect a sniffer to the network and perform the following steps:

- 1 Connect the sniffer to the back of the originating IP phone and make verify that the phone is actually transmitting packets.
- 2 On the originating phone, verify that the IP address and MAC address information is correct.
- 3 If the network settings on the originating phone are correct, go to the terminating IP phone to verify that the packets are not arriving.
- 4 If the voice packets are not arriving at the terminating phone, move the sniffer from network hop to network hop to isolate where the packets are being dropped. A common reason for a problem such as this is a missing or improperly configured IP route.

Check Cisco IOS Software Gateway Configurations

There are various reasons why you might encounter one-way audio on calls to a Cisco IOS software gateway. Most of these problems can be solved using simple configuration commands.

- 1 Check if IP routing is enabled on the gateway that you are using—You do not need to be running a routing protocol such as RIP, EIGRP, or OSPF, but IP routing must not be disabled. Make sure that the `no ip routing` command is not in your configuration. If it is, be sure to eliminate it by configuring the `ip routing` command. You can also issue the `show ip route` command to see if IP routing is enabled. If IP routing is disabled, there are no routes listed in the output, and the list of routing protocols is not present.
- 2 Determine if the VoIP subsystem is enabled—The VoIP subsystem in Cisco IOS software uses the IP routing code to aid in encapsulating and transmitting the VoIP packets, so the subsystem must be enabled to transmit and receive VoIP packets. It does not need the IP routing code to perform signaling such as H.323 or MGCP, so the signaling still works with IP routing disabled.
- 3 Check IP address configurations on gateway interfaces—Another common occurrence of one-way audio appears on Cisco IOS software H.323 voice gateways that have more than one data interface, such as a gateway that has both an Ethernet connection to the LAN and a serial connection to the WAN. When an H.323 gateway is configured in Cisco Unified Communications Manager Administration, you configure a specific IP address. Cisco Unified Communications Manager always uses this IP address for all its signaling to the gateway; however, Cisco IOS software voice gateways by default use the IP address of the interface that is closest to the destination. This could be a problem if Unified Communications Manager is connected via one interface and the device to which the RTP audio stream is destined for is connected to a different interface. To force the voice gateway to always use the same IP address, configure the `h323-gateway voip bind srcaddr ip-address` command on the interface that you are using for signaling

on the Cisco IOS software voice gateway. Make sure this is the same IP address configured in Cisco Unified Communications Manager Administration. Failure to do so could result in one-way audio when the gateway tries to use a different source interface than the one configured in Unified Communications Manager.

- 4 Configure `voice rtp send-recv` on the gateway—Sometimes you have one-way audio problems only when calling specific numbers, such as 411 or 911 in the North American numbering plan (NANP) or after you transfer a call or put it on hold. If you are having these problems when going through a Cisco IOS software voice gateway, be sure that the `voice rtp send-recv` command is configured on the gateway. Numbers such as 411 and 911 sometimes do not send back answer supervision (that is, an ISDN connect message) when the remote end answers. As a result, the Cisco IOS software voice gateway does not cut through audio in both directions to prevent toll fraud. Configuring the `voice rtp send-recv` command forces the voice gateway to cut through audio in both directions immediately.
- 5 If you are using a Cisco AS5350 or AS5400 as a gateway, configure the `no voice-fastpath enable` command in global configuration mode—When enabled, this command causes the voice gateway to cache the IP address and UDP port number information for the logical channel opened for a specific call and forwards the packets using the cached information. This helps marginally reduce CPU utilization in high-call-volume scenarios. Because of how Cisco Unified Communications Manager opens and closes logical channels to redirect RTP audio streams, such as in the case of a transfer or music on hold (MOH) server, the Cisco AS5350 and AS5400 cache the IP address information of the old IP address. Therefore, you end up with one-way audio when the call gets redirected to a new IP address because the voice gateway still uses the cached information instead of the newly negotiated information.

Check for NAT or Firewall Restrictions

One common cause of one-way or no-way audio is when Network Address Translation (NAT), Port Address Translation (PAT), or firewalls exist between two terminating devices. The SCCP protocol embeds IP addresses in the IP packet's payload to signal which IP address to send RTP packets to. If the device performing NAT or PAT is unaware of this fact, the embedded IP addresses are not translated. Therefore, one-way or no-way audio results.

Firewalls can also be a problem if they are unaware of the voice traffic passing through them. Firewalls often are configured to block all UDP traffic going through them. Because voice traffic is carried over UDP, it might be blocked while the signaling carried over TCP is passed. A sniffer is the best tool for debugging such a scenario. If both devices appear to be transmitting audio but the audio is not reaching the opposite side, take a sniffer trace at each hop along the way until you find the hop where the audio is not passing through. If the firewall is blocking UDP packets, you might need to open a hole in it to allow the voice traffic to pass through.

Problems Occurring After the Call Connects Successfully

The scenarios discussed so far are cases in which you have one-way audio or no-way audio from the beginning of the call or after a hold/transfer. Occasionally, however, you might encounter scenarios in which a call is up and suddenly becomes one-way or audio disappears entirely. Network problems are largely to blame for failures of this sort. Ensure that network connectivity between the two terminating devices still exists and that nothing on the network might be causing intermittent network connectivity. An example would be a *flapping* network connection—a network connection that is transitioning between up and down states over and over again—or a routing protocol that cannot converge correctly. Again, a sniffer is the best tool for diagnosing this kind of problem. The best place to start is on the device that originates the RTP stream to ensure that the stream is still being generated when the loss of audio occurs. If you discover that the originating device stops

sending packets for no reason, you might be dealing with a software or hardware problem on the originating device.

A common cause of such a failure is a Digital Signal Processor (DSP) crash. If the device is a Cisco IOS software voice gateway, you see an error displayed on the console that looks similar to the following:

```
%VTSP-3-DSP_TIMEOUT: DSP timeout on event 6: DSP ID=0x2312: DSP error stats
```

This message is also sent to a Syslog server if the Cisco IOS software voice gateway is configured to send Syslog information to a Syslog server. On a Cisco VG200, 2600, or 3600, you can issue the following command to check the status of the DSPs:

```
test dsprm slot #
```

The `show voice dsp` command displays which port and time slot are allocated to each DSP. If the `test dsprm slot #` command detects a DSP that has crashed, you can compare this with the information obtained from a `show call active voice` command (or a `show call history voice` command if the call has been disconnected) to see if the time slot of the failed call is the same as the slot of the DSP that is no longer available. Unfortunately, the only way to recover from this condition is to reload the gateway.

Poor Voice Quality

Nearly all voice quality problems can be attributed to some kind of degradation on the IP network that the voice traffic traverses. Network problems that might not be noticeable for normal data traffic are very apparent in a voice conversation because of the need to minimize packet loss and variable delay in an IP telephony network.

A variety of issues can result in poor voice quality:

- [Packet Drops](#)
- [Queuing Problems](#)

In addition to the information in this section, refer to the [Troubleshooting QoS Choppy Voice Issues](#) document on Cisco.com for additional techniques on resolving voice quality issues.

Packet Drops

IP telephony demands that voice packets reach their destination within a predictable amount of time and without being dropped somewhere along the path from the source to the destination. In a properly designed network with appropriate QoS provisioning in place, packet loss should be near zero. All voice codecs can tolerate some degree of packet loss without dramatically affecting voice quality. Upon detecting a missing packet, the codec decoder on the receiving device makes a best guess as to what the waveform during the missing period of time should have been. Most codecs can tolerate up to five percent random packet loss without noticeable voice quality degradation. This assumes that the five percent of packets being lost are not being lost at the same time, but rather are randomly dropped in groups of one or two packets. Losing multiple simultaneous packets, even as a low percentage of total packets, can cause noticeable voice quality problems.



Note

You should design your network for zero packet loss for packets that are tagged as voice packets. A converged voice/data network should be engineered to ensure that only a specific number of calls are allowed over a limited-bandwidth link. You should guarantee the bandwidth for those calls by giving priority treatment to voice traffic over all other traffic. For more information on prioritizing voice over data, refer to the [Voice Quality](#) information available on Cisco.com.

There are various tools that you can use to determine whether you are experiencing packet loss in your network and where in the network the packets are getting dropped. The starting point to look for lost packets is the call statistics screen on Cisco Unified IP Phones.

- 1 Do one of the following:
 - If you are troubleshooting at the phone experiencing the problem, access these statistics by pressing the help (i or ?) button on the IP phone twice in quick succession during an active call.
 - If you are working with a remote user, open a web browser on your computer and enter the IP address of the user's phone. During an active call, choose the **Streaming Statistics > Stream 1** options from the display.
- 2 Examine the counters RxDisc and RxLost shown on the IP phone (or Rcvr Lost Packets if you are viewing the statistics remotely using a web browser).
 - RxLost measures the number of packets that were never received because they were dropped in the network somewhere. By detecting a missing RTP sequence number, the IP phone can determine that a packet has been lost.
 - RxDisc corresponds to packets that were received but were discarded because they could not be used at the time they arrived. RxDisc can come from an out-of-order packet or a packet that arrived too late.
- 3 If either of these two counters increments, you should investigate to learn why packets are being lost or discarded.

Regardless of how low your packet loss is, if it is not zero, you should investigate the root cause because it might be a sign of a bigger problem that will get worse with higher call volume. Also, although small packet loss might not be perceptible in a conversation between two people, it can be detrimental to fax and modem transmissions. The packet loss can be occurring at any layer of the OSI model, so be sure to check for all possibilities for each hop. For example, if there is a Frame Relay connection over a T1 between two sites, you should:

- Make certain that there are no errors at the physical layer on the T1.
- Determine if you are exceeding your committed information rate (CIR) on the Frame Relay connection.
- Verify that you are not dropping the packets at the IP layer because you are exceeding your buffer sizes.
- Check that you have your QoS improperly configured.
- Ensure that your service provider not only guarantees packet delivery but also guarantees a low-jitter link. Some service providers may tell you that they do not provide a CIR but guarantee that they will not drop any packets. In a voice environment, delay is as important as packet loss. Many service providers' switches can buffer a large amount of data, thereby causing a large amount of jitter.

One common cause of drops in an Ethernet environment is a duplex mismatch, when one side of a connection is set to full duplex and the other side is set to half duplex. To determine if this is the case, perform the following steps:

- 1 Check all the switch ports through which a given call must travel and ensure that there are no alignment or frame check sequence (FCS) errors. Poor cabling or connectors can also contribute to such errors; however, duplex mismatches are a far more common cause of this kind of problem.

- 2 Examine each link between the two terminating devices that are experiencing packet loss and verify that the speed and duplex settings match on either side.

Although duplex mismatches are responsible for a large number of packet loss problems, there are many other opportunities for packet loss in other places in the network as well. When voice traffic must traverse a WAN, there are several places to look. First, check each interface between the two terminating devices, and look for packet loss. On all Cisco IOS software platforms, you can find this information using the `show interface` command. If you are seeing dropped packets on any interface, there is a good chance that you are oversubscribing the link. This could also be indicative of some other traffic that you are not expecting on your network. The best solution in this case is to take a sniffer trace to examine which traffic is congesting the link.

Sniffers are invaluable in troubleshooting voice quality problems. With a sniffer, you can examine each packet in an RTP stream to see if packets are really being lost and where in the network they are being lost. To troubleshoot using a sniffer, perform the following steps:

- 1 Start at the device that is experiencing the poor-quality audio where you suspect packet loss.
- 2 Take a sniffer trace of a poor-quality call and filter it so that it shows you only packets from the far end to the device that is hearing the problem. The packets should be equally spaced, and the sequence numbers should be consecutive with no gaps.
- 3 If you are seeing all the packets in the sniffer trace, continue taking traces after each hop until you get a trace where packets are missing.
- 4 When you have isolated the point in the network where the packet loss is occurring, look for any counters on that device that might indicate where the packets are being lost.

Queuing Problems

Queuing delay can be a significant contributor to variable delay (*jitter*). When you have too much jitter end-to-end, you encounter voice quality problems. A voice sample that is delayed over the size of the receiving device's jitter buffer is no better than a packet that is dropped in the network because the delay still causes a noticeable break in the audio stream. In fact, high jitter is actually worse than a small amount of packet loss because most codecs can compensate for small amounts of packet loss. The only way to compensate for high jitter is to make the jitter buffer larger, but as the jitter buffer gets larger, the voice stream is delayed longer in the jitter buffer. If the jitter buffer gets large enough such that the end-to-end delay is more than 200 ms, the two parties on the conference feel like the conversation is not interactive and start talking over each other.

Remember that every network device between the two terminating devices involved in a call (switches, routers, firewalls, and so on) is a potential source of queuing or buffering delays. The ideal way to troubleshoot a problem in which the symptoms point to delayed or jittered packets is to use a sniffer trace at each network hop to see where the delay or jitter is being introduced.

For more information on jitter, refer to the [Understanding Jitter in Packet Voice Networks](#) document on Cisco.com.

PBX Interoperability Issues with Cisco Unified Communications Manager

If calls to destinations outside the IP network are failing, it may be because the calls must be routed through non-Cisco PBX switches that are connected to the PSTN. In order for the Cisco Unified Communications Manager to properly direct calls out trunks on the PBX, proper interoperability configuration is required. Information on configuring PBXs to interoperate with Cisco devices is available on an [Interoperability Portal](#)

site. This site has information on third-party PBX interoperability with the following Cisco Collaboration products:

- Cisco Unified Communications Manager
- Cisco Unified Contact Center Enterprise
- Cisco Unified MeetingPlace

The information is provided in a series of application notes. If you cannot find your exact configuration in the list of available application notes, you may be able to use other application notes to meet your needs. Here are some suggestions:

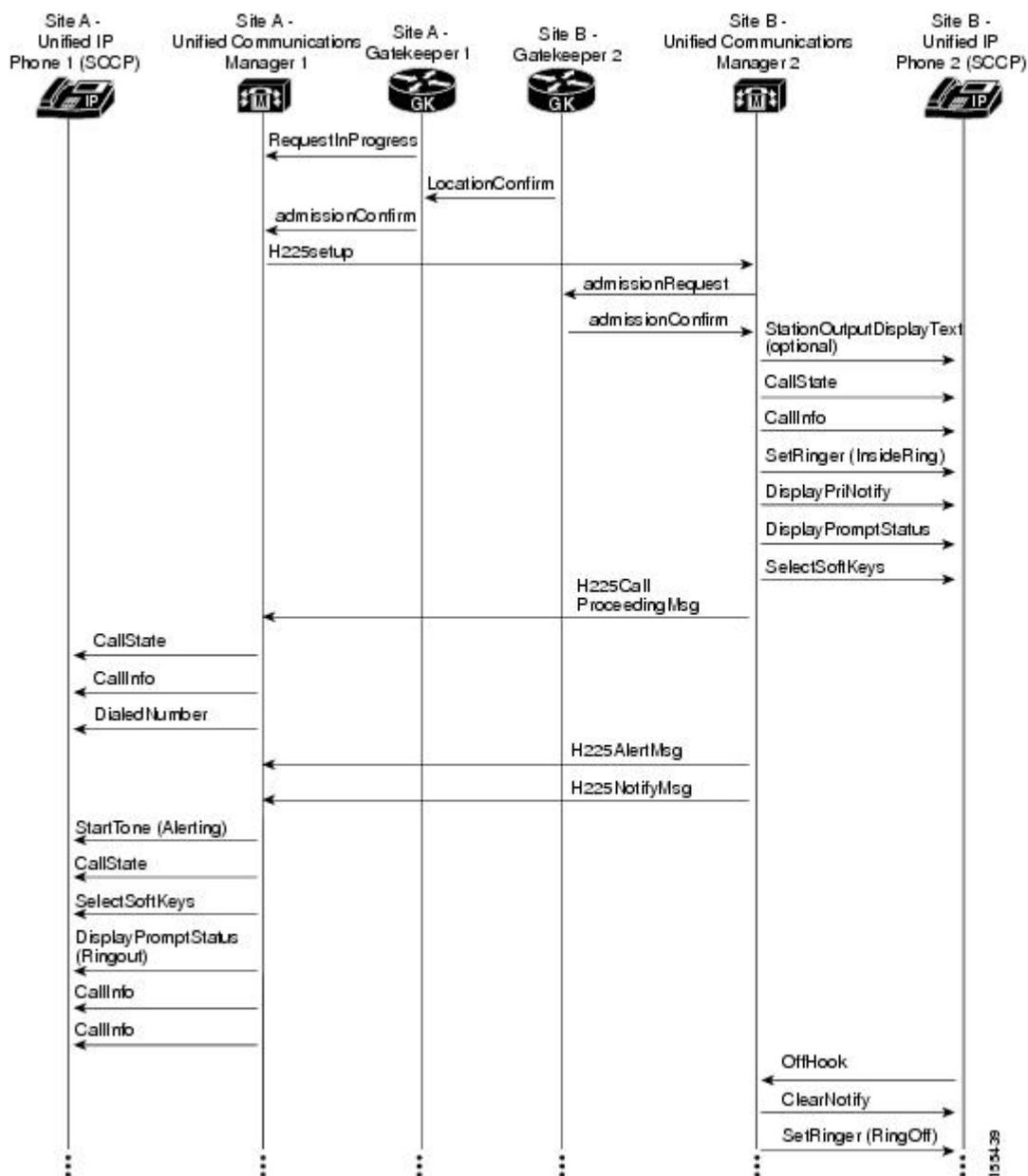
- PBX product families should have similar results. For example:
 - PBXs in the Nortel Meridian 1 family should have similar results. The Nortel Meridian 1 Option 11C will have similar configurations as the Nortel Meridian 1 Option 61C and the Nortel Meridian 1 Option 81C.
 - PBXs in the Avaya Definity G3 family should be similar. The versions VSI, R, CSI, and SI should have similar configurations.
 - PBXs in the Siemens 300 family also should have similar configuration results. This family includes the 330, 340, and 370.

Gateways configurations should be similar if the gateways are Cisco IOS based and have the same protocol (for example, MGCP, H.323, or SIP). For example, a Cisco 2801 gateway should have similar configurations to the 3845 when used with the Cisco Unified Communications Manager.

Using Call Flows to Resolve Call Processing Problems

This topic provides information about a typical call flow in an IP telephony environment. The figure shows a call flow that illustrates the actions in a typical call between the following devices at two different sites:

- Cisco Unified IP Phone (SCCP)
- Cisco Unified Communications Manager



For both successful and unsuccessful calls, an industry-standard cause code value appears in the disconnect or release signaling messages. The cause code reveals if the call was disconnected normally (typically cause code 16) or abnormally. Table 6-1 lists the standard cause values that may appear in the trace files as part of disconnect processing.

Failover and Recovery Procedures

The Disaster Recovery System (DRS), which can be invoked from Cisco Unified Communications Manager Administration, provides full data backup and restore capabilities for all servers in a Cisco Unified

Communications Manager cluster. The Disaster Recovery System allows you to perform regularly scheduled automatic or user-invoked data backups. DRS supports only one backup schedule at a time.

The Cisco Disaster Recovery System performs a cluster-level backup, which means that it collects backups for all servers in a Cisco Unified Communications Manager cluster to a central location and archives the backup data to physical storage device.

When performing a system data restoration, you can choose which nodes in the cluster you want to restore.

The Disaster Recovery System includes the following capabilities:

- A user interface for performing backup and restore tasks.
- A distributed system architecture for performing backup and restore functions.
- A scheduling engine to initiate tasks at user-specified times.
- Archive backups to a physical tape drive or remote sftp server.

The Disaster Recovery System contains two key functions, Master Agent (MA) and Local Agent (LA). The Master Agent coordinates backup and restore activity with all the Local Agents. The system automatically activates both the Master Agent and the Local Agent on all nodes in the cluster. However, you can only access the Master Agent functions on the first node of the cluster.

For more information on the Cisco Unified Communications Manager Disaster Recovery System, see the [Disaster Recovery System Administration Guide for Unified Communications Manager](#).

Additional Sites and Services

Steps to Success is a Cisco methodology that outlines the tasks required to complete a successful customer engagement. Registered users can visit the [Steps to Success](#) resource site for Cisco Collaboration process flows.

Cisco Unified Communications Services is a Cisco service offering that provides engineering expertise and best practices.

- Registered users can visit the [Sell and Market Services](#) partner site.
- Non-registered users can visit the [Services for Unified Communications](#) site.



Optimize

- [Optimizing Your System](#), page 71
- [Performing Your System Upgrade](#), page 71
- [Additional Sites and Services](#), page 72

Optimizing Your System

Optimization covers any changes to an existing system, including hardware and software upgrades, that enhance the functionality and performance of your network.

Collecting and analyzing data from your system's performance reports will provide crucial information for optimizing your system. By maintaining the routine system management procedures that you set up for your operations lifecycle, you will know when your traffic load increases, and when to increase your capacity.

Input to This Process

Your network has been operational for some period of time and is ready to optimize based on system performance criteria. Your daily operations and growing business needs provide continuous feedback for optimization.

Output of This Process

User feedback, audits, and test results provide data to continue optimizing the system.

Major Tasks in This Process

- [Performing Your System Upgrade](#)

Performing Your System Upgrade

See [Preparing for Your System Upgrade](#) in the Plan chapter to plan your overall strategy.

Upgrade IP Telephony Components

Once you have your upgrade plan and preparations in place, conduct your system upgrade following the guidelines and sequence in the individual product documentation (Refer to [Component Installation and Configuration Guides](#)):

- See the Collaboration Deployments Model chapter in [Cisco Collaboration Systems Solution Reference Network Designs \(SRND\)](#).
- See [Tested Deployments and Site Models](#) for a system level description of the tested deployment models.

Additional Sites and Services

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Training Library

- [Using the Training Library](#), page 73

Using the Training Library

The Training Library chapter includes training resources to help you learn more about Cisco Collaboration. The training resources are organized by audience:

- [General Training](#) contains links to courses and videos on demand (VoDs) for a general audience.
- [Training Available to Partners](#) contains resources for Cisco authorized partners and resellers.
- [Training Available to Cisco Employees](#) contains resources available for internal use only.

These categories list both online and instructor-led courses, downloadable VoDs, and links to online events and webcasts.

General Training

These Cisco training websites provide training on all Cisco products and technologies and are available to a general audience.

- [The Cisco Learning Network](#)
- [Global Learning Locator](#)
- [Featured Virtual Events and Webcasts](#)
- [Cisco Press self-study resources](#)

Training Available to Partners

Cisco offers a variety of training resources to partners. This topic describes some courses that are specific to Cisco Collaboration Systems.

Some Cisco Collaboration Systems training VoDs are available from the [Cisco Unified Communications System Release Technical Readiness](#) page.

For training information on all Cisco products and technologies, see the following sites.

**Note**

To access this site you must be registered as an employee of a Cisco Channel Partner company.

- [Partner Education Connection](#)

Partner Education Connection Courses

Partner Education Connection (PEC) courses are the primary learning source for Cisco Channel Partners. PEC provides training on products, tools, and solutions.

Use the following e-learning modules for information on Cisco Collaboration Systems:

- QuickStart modules

These web-based modules prepare partners to sell Cisco Collaboration Systems solutions. This course covers selling strategies, pricing, and customer testimonials.

- Partner Beta Training

The PEC site typically contains a VoD which provides information on what is new in the latest Cisco Collaboration system.

- Cisco Collaboration Systems Architecture and Design

These web-based modules address identifying the features of the Cisco Collaboration system and teaching the Cisco methodology for implementing voice over data networks.

Cisco Learning Partner Courses

[Training from Cisco Learning Partners](#) provides a comprehensive set of training resources, from instructor-led courses to remote access labs and e-learning solutions. These companies are the only organizations to employ Certified Cisco Systems Instructors and deliver Cisco authorized and approved content, including product-specific training, technology training, and certification-preparation courses.

Training Available to Cisco Employees

Cisco offers a variety of training resources to employees. These Cisco Collaboration Systems launch page and training websites provide training on all Cisco products and technologies:

- [Partner Education Connection](#)
- [Global Learning Partner Locator](#)



Resource Library

- [Using the Resource Library, page 75](#)
- [System Release Documentation, page 76](#)
- [Tested Deployment and Site Models, page 77](#)
- [Network Topology Diagrams, page 78](#)
- [Component Resources, page 80](#)
- [System Compatibility Matrix, page 82](#)
- [Ordering Guides, page 82](#)
- [End-of-Sale and End-of-Life Products, page 82](#)
- [Cisco Unified Workspace Licensing, page 83](#)
- [Service Offerings, page 83](#)
- [Cisco Technical Assistance Center, page 83](#)
- [Cisco SMARTnet Service, page 84](#)
- [Cisco Unified Communications Software Subscription, page 84](#)
- [Career Certifications, page 85](#)

Using the Resource Library

In the Resource Library chapter, you find an assortment of resources to help you learn more about Cisco Collaboration Systems.

- [System Release Documentation](#)
- [Solution Reference Network Design](#)
- [Tested Deployment and Site Models](#)
- [Network Topology Diagrams](#)
- [Component Resources](#)

- [System Compatibility Matrix](#)
- [Ordering Guides](#)
- [End-of-Sale and End-of-Life Products](#)
- [Cisco Unified Workspace Licensing](#)

System Release Documentation

The Cisco Collaboration Systems Documentation provides a suite of interactive documentation that covers details of the system architecture, components, release notes, troubleshooting, and related information. You can access this documentation at the following URL:

<http://www.cisco.com/go/unified-techinfo>

The following system-level documents are produced for Cisco Collaboration Systems releases:

- [System Release Notes](#)
- [Documentation Wiki](#)

System Release Notes

These documents describe the tested functionality, new and changed features, and limitations and restrictions for each of the following Cisco Collaboration Systems Release 10.6(1) solutions:

- Contact Center
 - [System Release Notes for Contact Center: Cisco Collaboration Systems Release 10.6\(1\)](#)
- Collaboration
 - [Collaboration System Release Notes for Cisco Collaboration Systems Release 10.6\(1\)](#)

Documentation Wiki

The Cisco documentation wiki ([DocWiki](#)) contains information on a number of Cisco product-related topics. Among these is a category for Cisco Collaboration systems, which currently includes topics for:

- [Unified Communications System Design](#): These topics include information and tutorials on design tools such as the Cisco Unified Communications Sizing Tool, which can be used to design and model solutions for existing and prospective customers.
- [Unified Communications System Implementation](#): This topic includes information on configuring system components, and provides detailed configuration examples based on tested deployment models.
- [Unified Communications System Operations](#): This topic includes information on the tasks you need to perform to maintain your system and keep it operating as trouble-free as possible. These tasks are broken down into two areas: one-time and infrequent tasks, and regular and scheduled tasks.

- **Unified Communications System Optimization:** This topic includes information on the tasks you need to perform to optimize your system and keep it operating as trouble-free as possible.
- **Unified Communications System Troubleshooting:** This topic includes information that will assist you with isolating and resolving problems you may have with Cisco Collaboration Systems components. This topic offers sections for system troubleshooting methodology and commonly encountered problems.
- **Unified Communications Virtualization:** This topic includes information on running Cisco Collaboration Systems applications on a virtual machine in a Unified Computing System (UCS) environment.

For additional Cisco Collaboration Systems topics posted on the Cisco documentation wiki, see http://docwiki.cisco.com/wiki/Cisco_Unified_Communications.

Solution Reference Network Design

The Solution Reference Network Design (SRND) user guides provide considerations and guidelines for deploying components of the Cisco Collaboration Systems solution. SRND resources are available at <http://www.cisco.com/go/srnd>.

Tested Deployment and Site Models

Cisco Collaboration Systems Release 10.6(1) testing is designed to test the hardware and software components that work together in a multisite distributed deployment. For these tests, several site models are created. Each site model is designed to test a specific set of features and interactions. For information about the components, configurations, and environment tested, see the following table.

Table 6: Tested Deployment and Site Models

Deployment Model	Description
Single-site model	This model is designed for autonomous offices in which most, or all, employees are IPC users. This model can support a maximum 30,000 users.
Multisite centralized call processing model	This model is designed for distributed operations with a large central office or headquarters site, with multiple remote or branch sites. This model can support a maximum of 30,000 phones distributed among a maximum of 1000 sites. Based on the bandwidth available, each site can support any number of users and a maximum of 30,000 phones.

Deployment Model	Description
Multisite distributed call processing model	<p>This model is designed for organizations with large user populations or large numbers of geographically distributed sites with a need for more than a single call processing entity. This model is suited for deployments that require multiple Cisco Unified Communications Manager clusters or Cisco Unified Communications Manager Express platforms. Each call processing entity in this model is configured as a single-site model or multisite centralized call processing model, and each has a common dial plan and feature set.</p> <p>The multisite distributed call processing model supports up to 30,000 SCCP or SIP IP phones or video devices per cluster.</p>
Clustering over IP WAN call processing model	<p>This model is designed for organizations with large user populations across multiple sites that are connected by an IP WAN with the QoS features enabled.</p> <p>This model supports the local failover deployment model and the remote failover deployment model.</p>

Network Topology Diagrams

This topic provides topology resources that you can use to document network plans.

- For Contact Center solutions: [Network Topology Diagrams for Contact Center](#), on page 79
- For IP Telephony solutions: [Network Topology Diagrams for Collaboration](#), on page 80

You can download zip files containing Microsoft Visio drawings of the logical and physical topologies.

Network Topology Diagrams for Contact Center

Table 7: Network Topology Diagrams for Contact Center

Description	Filename
Zip file includes logical and physical drawings in Test Bed as listed below.	http://www.cisco.com/c/dam/en/us/td/docs/voice_ip_comm/uc_system/V10-6-1/TIS/CC-UCCE1061-Topology.zip (right-click to download zip) <p>Note If you click the link rather than right-click, the zip file may open in the secondary window but also replace the contents of this window. Use the Back button to return to this window.</p>
Unified CCE components in Test Bed1	CC-UCCE1061-Topology.vsd
Zip file includes logical and physical drawings in Test Bed as listed below.	http://www.cisco.com/c/dam/en/us/td/docs/voice_ip_comm/uc_system/V10-6-1/TIS/CC-UCCX1061-Topology.zip (right-click to download zip) <p>Note If you click the link rather than right-click, the zip file may open in the secondary window but also replace the contents of this window. Use the Back button to return to this window.</p>
Unified CCX components in Test Bed2	CC-UCCX1061-Topology.vsd

Network Topology Diagrams for Collaboration

Table 8: Network Topology Diagrams for Collaboration

Description	Filename
Zip file includes the site model topology drawings listed below.	http://www.cisco.com/c/dam/en/us/td/docs/voice_ip_comm/uc_system/V10-6-1/TIS/COL-CSR1061-Topology.zip Note If you click the link rather than right-click, the zip file may open in the secondary window but also replace the contents of this window. Use the Back button to return to this window.
Collaboration Site in Test Bed	COL_CSR1061_Topology.vsd

Component Resources

For Cisco Collaboration Systems Release 10.6(1), there are two types of resources that provide descriptive information on each component in the solution:

- [Component Resources Documentation](#), on page 80
- [Configuration Command Files](#), on page 81

Component Resources Documentation

Depending on your Cisco Collaboration Systems solution type, choose one of the following sets of component resources documentation.

Component Resources Documentation for Contact Center

For links to the main **Support** and **Product Information** pages for Cisco Collaboration Systems Contact Center components, go to [Product documentation](#).

Component Resources Documentation for Collaboration

For links to the main **Support** and **Product Information** pages on Cisco Collaboration Systems components, go to [Product documentation](#).

Configuration Command Files

To understand how various components were configured during Cisco Collaboration systems testing, review the contents of the ZIP archives described in one of the following sections:

- [Configuration Command Files for Contact Center](#), on page 81
- [Configuration Command Files for Collaboration Systems](#), on page 81

Additional system-level configuration examples are available on the Cisco DocWiki at: http://docwiki.cisco.com/wiki/Category:Unified_Communications_System_Implementation

Configuration Command Files for Contact Center

The following table describes the contents of three ZIP files that you can download. Each ZIP file contains text files that contain the output from issuing a `show running-config` IOS command on various infrastructure components in the contact center test beds.

Table 9: Configuration Command Files for Contact Center

Description	Filename
Test Bed Local & Remote Agent Call Flows: Cisco Unified Customer Voice Portal (CVP) Post-Routed Call Flow Components	CC_UCCE1061_Configs.zip (right-click to download zip) includes the files below. Note If you click the link rather than right-click, the zip file may open in the secondary window but also replace the contents of this window. Use your Back button to return to this window.
Test Bed 2 Local & Remote Agent Call Flows: Cisco Unified Contact Center Express (Unified CCX) Call Flow Components	CC_UCCX1061_Configs.zip (right-click to download zip) includes the files below. Note If you click the link rather than right-click, the zip file may open in the secondary window but also replace the contents of this window. Use your Back button to return to this window.

Configuration Command Files for Collaboration Systems

The following table describes the contents of a ZIP file with sample IP telephony configurations that you can download. Each ZIP file contains text files that contain the output from issuing a `show running-config` IOS command on various components in the IP telephony tested deployments.

Table 10: Configuration Command Files for Collaboration

Description	Filename
<p>Zip file includes Cisco device configurations listed below:</p> <p>Note Some parameters, such as passwords, have been removed from the configuration files for security reasons.</p>	<p>COL_CSR1061_Configs.zip (right-click to download zip) includes the files below.</p> <p>Note If you click the link rather than right-click, the zip file may open in the secondary window but also replace the contents of this window. Use your Back button to return to this window.</p>
London/Heathrow (LHR) Cisco Unified Survivable Remote Site Telephony (Unified SRST) SIP	lhr-srst-sip-01-config.txt
Seattle (SEA) Unified SRST SIP	sea-srst-sip-01-config.txt
San Francisco (SFO) Cisco Unified Border Element (CUBE) Cisco Aggregation Services Router (Cisco ASR)	sfo-cube-asr-01-config.txt
PWashington DC (WDC) MGCP	wdc-pstn-mgcp-01-config.txt

System Compatibility Matrix

The [Cisco Collaboration Systems Compatibility Matrix](#) provides tables that identify the compatible software release versions for each product element in each release. For compatibility information prior to Collaboration Systems Release 10.6, refer to the [Compatibility Tool](#).

Ordering Guides

[Ordering guides](#) for most Cisco Collaboration Systems products are available for Cisco partners, Cisco sales staff, and Cisco service providers.

End-of-Sale and End-of-Life Products

The end-of-sale (EOS) date is the last date to order the product through Cisco point-of-sale mechanisms. The product is no longer for sale. There is also an end-of-life (EOL) process that guides the final business operations associated with the product life cycle.

The EOL process consists of a series of technical and business milestones and activities that, once completed, make a product obsolete. After a product is EOL, the product is not sold, manufactured, improved, repaired, maintained, or supported.

For information about recommended replacements, see the comprehensive list of announcements at the following URL:

http://www.cisco.com/en/US/products/prod_end_of_life.html

For information on specific products, choose a product from the following URL:

<http://www.cisco.com/en/US/products/sw/voicesw/index.html>

Then click the End-of-Life and End-of-Sale Notices link in the Product Literature section.

For an overview of the Products and Services EOL policy, see the information at the following URL:

http://www.cisco.com/en/US/products/products_end-of-life_policy.html

Cisco Unified Workspace Licensing

Cisco Unified Workspace Licensing is an easy, affordable program for procurement of a broad range of Cisco Collaboration Systems applications and services. Unified Workspace Licensing facilitates consistent deployment of multiple applications to all users in their workspaces and helps organizations maximize the potential of unified communications.

This program streamlines pricing, licensing, and deployment of Cisco Collaboration Systems solutions and enables organizations to implement a media-rich unified communications experience at a cost-effective user basis.

Service Offerings

Using the Cisco Lifecycle Services approach, Cisco Systems and its partners offer a broad portfolio of end-to-end services. These services are based on proven methodologies for deploying, operating, and optimizing Unified Communications solutions. Planning and design services, for example, can help you meet aggressive deployment schedules and minimize network disruption during implementation. Operate services reduce the risk of communications downtime with expert technical support. Optimize services enhance solution performance for operational excellence. Cisco and its partners offer a system-level service and support approach that can help you create and maintain a resilient, converged network that meets your business needs.

Cisco Unified Communications service offerings include:

- Cisco Unified Communications Essential Operate Service, which provides 24-hour, 365-day-a-year access to Cisco Systems engineers and certified partners who are highly trained and have a deep understanding of Cisco Unified Communications products and technologies.
- Cisco Unified Communications Select Operate Service, which provides a proactive support solution that combines 24-hour, 365-day-a-year access to technical support representatives plus a simple-to-install monitoring solution designed for Cisco Unified Communications.
- Cisco Unified Communications SMB Network Operate & Optimize Service, is a partner-led service offering (designed specifically for the medium-sized businesses) that enables the delivery of affordable, ongoing, high-availability network support.

For more information, go to <http://www.cisco.com/en/US/products/sw/voicesw/services.html>

Cisco Technical Assistance Center

For all customers, partners, resellers, and distributors who hold valid Cisco service contracts, Cisco provides around-the-clock, award-winning technical support services, online and over the phone.

For Enterprises and Service Providers, the TAC Service Request Tool lets you describe the issue in your own words and attach files to the service request, and will route your service request to an appropriate engineer as fast as possible. You can also use this tool to update your service request. The tool will send an automatic alert to your Cisco TAC engineer when you submit an update.

For more information about creating a service request, or for information about phone support for Enterprises and Service Providers, including the contact numbers appropriate for your country, go to:

http://www.cisco.com/web/tsweb/pdf/cisco_tools_tsrt.pdf

For urgent situations regarding enterprise level products, use the Phone Support for Enterprises and Service Providers.

To make a service request, go to:

<https://tools.cisco.com/ServiceRequestTool/scm/mgmt/case>

Cisco SMARTnet Service

Cisco SMARTnet Service is an award-winning technical support service that gives your IT staff direct, anytime access to Cisco engineers and extensive Cisco.com resources.

In addition to Cisco TAC phone support, Cisco SMARTnet Service includes unrestricted access to a range of online support resources, including the following:

- Solve technical support issues online without opening a case
- Quickly and easily access the latest security updates, patches, and fixes
- Expand your expertise and skills with technical support, tips and advice from Cisco experts and other industry professionals

For more information about Cisco SMARTnet Service, go to:

<http://www.cisco.com/web/services/portfolio/product-technical-support/smartnet/index.html>

Cisco Unified Communications Software Subscription

Cisco Unified Communications Software Subscription increases business value by providing an economical and timely approach to upgrading to new Cisco technology, thereby optimizing return on investment (ROI) and reducing total cost of ownership (TCO) for Cisco Unified Communications Solutions. During the Cisco Unified Communications Software Subscription term, which can be 1, 2, 3, or 5 years, you can order major release software upgrades at no additional charge. Minor and maintenance release updates are a part of Cisco Unified Communications Essential Operate Service.

In addition to Cisco TAC phone support, Cisco SMARTnet Service includes unrestricted access to a range of online support resources, including the following:

- Solve technical support issues online without opening a case
- Quickly and easily access the latest security updates, patches, and fixes
- Expand your expertise and skills with technical support, tips and advice from Cisco experts and other industry professionals

For more information about Cisco Unified Communications Software Subscription, go to:

<http://www.cisco.com/en/US/products/ps9158/index.html>

Career Certifications

Cisco offers the following levels of general IT certification:

- The Associate level is the first step in general Cisco Certifications and begins either with CCENT as an interim step to Associate level, or directly with CCNA for network operations or CCDA for network design. This level is the foundation level of networking certification.
- The Professional level is the second level in general Cisco Certifications and includes certifications such as CCNP, CCSP, CCDP, and CCIP each falling within a different certification path (or track) for meeting varying career needs. This level is an advanced level of certification that shows expertise with networking foundations.
- The Cisco Certified Design Expert (CCDE®) certification is one of the highest technical networking certifications offered by Cisco.
- The Cisco Certified Internetwork Expert (CCIE) certification is the highest level of technical networking certification offered by Cisco.
- The Cisco Certified Architect certification is the highest level of accreditation achievable within the Cisco Certification program. It is the pinnacle for individuals wishing to show their formal validation of Cisco technologies and infrastructure architecture.
- The Specialist designation certifies the expertise of experienced technical professionals, and those who have earned associate or professional-level Cisco Career Certifications. By earning specialist certifications, network professionals can enhance their core networking knowledge in technologies such as security, IP Communications, and wireless.

For additional information about these Cisco Certifications, go to:

<http://www.cisco.com/web/learning/certifications/index.html>

