



Cisco IPCC Express Solution Reference Network Design

Cisco IPCC Express Release 3.1
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Preface

Purpose

This document provides system-level best practices and design guidance for the Cisco IP Contact Center (IPCC) Express Edition Release 3.1. With proper planning, design, and implementation, Cisco IPCC Express provides a reliable and flexible voice processing and contact center solution for the enterprise.

Audience

This design guide is intended for the system architects, engineers, and Cisco channel partners who want to apply best design practices for Cisco IPCC Express.

This design guide assumes that the reader is already familiar with the following concepts:

- Cisco CallManager Administration
- Cisco IPCC Express and Cisco IP IVR administration
- General system requirements and network design guidelines available from your local Cisco Systems Engineer (SE)

Scope

This document describes the various components used to build a Cisco IPCC Express system, and it gives recommendations on how to combine those components into an effective solution for your enterprise.

The following topics are *not* covered in this design guide:

- Installation and configuration of Cisco IPCC Express, IP IVR, and Agent Desktop. For more information about these Cisco products, refer to the online product documentation available at Cisco.com.
- Cisco IP IVR programming guidelines.
- Best practices for Contact Service Queues (CSQs) and priority queuing of IPCC Express.
- Design guidelines for Cisco IP Telephony common infrastructure and call processing. For information on Cisco IP Telephony design, refer to the *Cisco IP Telephony Solution Reference Network Design* documentation available online at

<http://www.cisco.com/go/srnd>.

- IPCC Express Voice Browser (using VoiceXML), automatic speech recognition (ASR), and text-to-speech (TTS) best practices. For specific information on these topics, refer to the Nuance Communications Inc. website at <http://www.nuance.com>
- The call sizing guidelines in this document are intended only to illustrate concepts in providing high-level sizing of call center resources. This document is not intended to be an all-inclusive guide to designing and sizing contact centers. Each deployment will be different and specific to your system requirements.

Software Releases

Unless stated otherwise, the information in this document applies specifically to Cisco IPCC Express Edition Release 3.1. Software releases are subject to change without notice, and those changes may or may not be indicated in this document. Refer to the IPCC Express release notes for the latest software releases and product compatibility information.

Revision History

The following table lists the revision history for this document.

Revision Date	Comments
September, 2003	Initial draft.

Obtaining Documentation

Cisco provides several ways to obtain documentation, technical assistance, and other technical resources. These sections explain how to obtain technical information from Cisco Systems.

Cisco.com

You can access the most current Cisco documentation on the World Wide Web at this URL:

<http://www.cisco.com/univercd/home/home.htm>

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Cisco documentation and additional literature are available in a Cisco Documentation CD-ROM package, which may have shipped with your product. The Documentation CD-ROM is updated regularly and may be more current than printed documentation. The CD-ROM package is available as a single unit or through an annual or quarterly subscription.

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http://www.cisco.com/en/US/partner/ordering/ordering_place_order_ordering_tool_launch.html

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Cisco TAC Website

The Cisco TAC website (<http://www.cisco.com/tac>) provides online documents and tools for troubleshooting and resolving technical issues with Cisco products and technologies. The Cisco TAC website is available 24 hours a day, 365 days a year.

Accessing all the tools on the Cisco TAC website requires a Cisco.com user ID and password. If you have a valid service contract but do not have a login ID or password, register at this URL:

<http://tools.cisco.com/RPF/register/register.do>

Opening a TAC Case

The online TAC Case Open Tool (<http://www.cisco.com/tac/caseopen>) is the fastest way to open P3 and P4 cases. (Your network is minimally impaired or you require product information). After you describe your situation, the TAC Case Open Tool automatically recommends resources for an immediate solution. If your issue is not resolved using these recommendations, your case will be assigned to a Cisco TAC engineer.

For P1 or P2 cases (your production network is down or severely degraded) or if you do not have Internet access, contact Cisco TAC by telephone. Cisco TAC engineers are assigned immediately to P1 and P2 cases to help keep your business operations running smoothly.

To open a case by telephone, use one of the following numbers:

Asia-Pacific: +61 2 8446 7411 (Australia: 1 800 805 227)

EMEA: +32 2 704 55 55

USA: 1 800 553-2447

For a complete listing of Cisco TAC contacts, go to this URL:

<http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml>

TAC Case Priority Definitions

To ensure that all cases are reported in a standard format, Cisco has established case priority definitions.

Priority 1 (P1)—Your network is “down” or there is a critical impact to your business operations. You and Cisco will commit all necessary resources around the clock to resolve the situation.

Priority 2 (P2)—Operation of an existing network is severely degraded, or significant aspects of your business operation are negatively affected by inadequate performance of Cisco products. You and Cisco will commit full-time resources during normal business hours to resolve the situation.

Priority 3 (P3)—Operational performance of your network is impaired, but most business operations remain functional. You and Cisco will commit resources during normal business hours to restore service to satisfactory levels.

Priority 4 (P4)—You require information or assistance with Cisco product capabilities, installation, or configuration. There is little or no effect on your business operations.

Obtaining Additional Publications and Information

Information about Cisco products, technologies, and network solutions is available from various online and printed sources.

- The Cisco Product Catalog describes the networking products offered by Cisco Systems, as well as ordering and customer support services. Access the Cisco Product Catalog at this URL:

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

- Cisco Press publishes a wide range of networking publications. Cisco suggests these titles for new and experienced users: Internetworking Terms and Acronyms Dictionary, Internetworking Technology Handbook, Internetworking Troubleshooting Guide, and the Internetworking Design Guide. For current Cisco Press titles and other information, go to Cisco Press online at this URL:

<http://www.ciscopress.com>

- Packet magazine is the Cisco quarterly publication that provides the latest networking trends, technology breakthroughs, and Cisco products and solutions to help industry professionals get the most from their networking investment. Included are networking deployment and troubleshooting tips, configuration examples, customer case studies, tutorials and training, certification information, and links to numerous in-depth online resources. You can access Packet magazine at this URL:

<http://www.cisco.com/go/packet>

- iQ Magazine is the Cisco bimonthly publication that delivers the latest information about Internet business strategies for executives. You can access iQ Magazine at this URL:

<http://www.cisco.com/go/iqmagazine>

- Internet Protocol Journal is a quarterly journal published by Cisco Systems for engineering professionals involved in designing, developing, and operating public and private internets and intranets. You can access the Internet Protocol Journal at this URL:

http://www.cisco.com/en/US/about/ac123/ac147/about_cisco_the_internet_protocol_journal.html

- Training—Cisco offers world-class networking training. Current offerings in network training are listed at this URL:

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



IPCC Express Architecture and Capabilities

This chapter describes the basic architecture and capabilities of IPCC Express and explains how to match those capabilities to your system requirements. This chapter contains the following sections:

- [Introduction to IPCC Express, page 1-1](#)
- [Overview of IPCC Express Architecture, page 1-2](#)

Introduction to IPCC Express

Cisco IPCC Express performs two main functions:

- Contact center, or automatic call distribution (ACD)

IPCC Express automates the way incoming calls are queued and routed to agents to ensure optimal utilization of resources.

- Integrated IP interactive voice response (IVR)

IPCC Express enables callers to participate in intelligent call options, such as selecting an option from a spoken menu that will route them to an agent best able to handle their call.

IPCC Express can combine both IVR and ACD features in one server, and it can further extend standard IVR and ACD functions with web and email access. These voice and data features, all within one box, can help you to build a compact and robust converged application for your enterprise.

This document combines the discussions of both IPCC Express and IP IVR design considerations under the same main topics, for the following reasons:

- Both IPCC Express and IP IVR share the same platform, Java Telephony Application Programming Interface (JTAPI) subsystem, and computer telephony integration (CTI) interface to Cisco CallManager. These shared components facilitate integration of the call center into your existing IP Telephony infrastructure.
- IPCC Express options can be combined into one common flexible application. For example, you can install an IPCC Express Enhanced option to build a contact center application that prompts callers for account information prior to queuing a call. This very common ACD functionality combines features that are used in IP IVR as well as IPCC Express, offering (among other things) the ability to better support call center agents by providing real-time access to customer information and enterprise databases. See the section on [IPCC Express Product Packages, page 1-2](#), for more information on IPCC Express option packages.

Overview of IPCC Express Architecture

IPCC Express and IP IVR contain a number of subsystems that handle different functions in your contact center and/or IVR application. The system designer should identify what functions the IPCC Express and/or IVR application needs to perform, size the call center, and then match these applications and call center sizing requirements to the IPCC Express system design principles described in this guide.

To best match your application requirements with the IPCC Express capabilities, it is helpful to understand some basics of the IPCC Express architecture as well as the available product option packages.

IPCC Express Architecture

IPCC Express is a Java-based rapid application development (RAD) environment and runtime engine. The IPCC Express architecture consists of various subsystems that use industry standard interfaces, such as Hypertext Transfer Protocol (HTTP), Simple Mail Transfer Protocol (SMTP), Open DataBase Connectivity (ODBC), VoiceXML, and Lightweight Directory Access Protocol (LDAP). This type of standards-based architecture enables you to develop robust voice and data applications. For more details on the IPCC Express architecture, refer to the *Cisco Customer Response Applications Administrator Guide*, available online at

http://www.cisco.com/univercd/cc/td/doc/product/voice/sw_ap_to/apps_3_1/english/admn_app/cra_adm/index.htm

IPCC Express Product Packages

Table 1-1 lists the available product packages for IPCC Express. The packages cannot be intermixed, and only one package can be used on one server at a time. Components cannot be added to a package unless they are explicitly listed in the Available Licensed Components column.

Table 1-1 Available Product Packages for IPCC Express

Package	Available Licensed Components	Purpose
IP Queue Manager (QM)	<ul style="list-style-type: none"> • IP Queue Manager Server Software (Required) • IP Queue Manager Ports (Required number of ports must be purchased) 	<p>Limited version of the IP IVR:</p> <ul style="list-style-type: none"> • It is used only for IPCC Enterprise deployments. • Only JTAPI triggers are supported. • Provides only basic call treatment options such as prompt-and-collect (P&C) and GED125 (Cisco ICM integration). • It does not provide capability for database dips, email, automatic speech recognition (ASR), text-to-speech (TTS), or web capabilities that allow IP QM to act as a web server. <p>Editor: Available to create Voice Response Unit (VRU) scripts with limited steps.</p> <p>Software Developers Kit (SDK): Disabled.</p> <p>Applications: Only Intelligent Contact Management (ICM) (translation routes and post-routes), busy, and ring-no-answer (RNA) applications can be configured. Other types of applications are not available.</p> <p>Historical Reporting (HR): The Historical Reporting Client is enabled, but the IPCC Express Standard and Enhanced reports are disabled and cannot be viewed.</p>
IP IVR	<ul style="list-style-type: none"> • IP IVR Server Software (Required) • IP IVR Ports (Required number of ports must be purchased, including all types of IVR interactions such as ASR, TTS, database dips, and so forth.) • Automatic Speech Recognition (ASR) (Optional) • Text-To-Speech (TTS) (Optional) <p>You do not have to specify separate ASR and TTS ports in the configuration tool. They are configured as regular IVR ports, but usage can vary.</p>	<p>Allows applications to handle "typical" questions by letting callers interact directly with back-end databases without agent intervention. This option is ideal for contact centers that receive more calls than their agents can comfortably handle. This includes Intelligent Contact Management (ICM) integration if needed. This option also includes HTTP triggers, XML, VoiceXML, HTTP, outgoing email support, and database support. It includes basic historical reporting (see note on historical reporting below) and supports IP QM completely.</p> <p>Editor: Available with all steps except for specific IPCC Express steps.</p> <p>Software Developers Kit (SDK): Enabled.</p> <p>Applications: All type of applications, including Cisco Intelligent Contact Management (ICM), busy, and ring-no-answer (RNA), are available.</p> <p>Historical Reporting (HR): The Historical Reporting Client is enabled, but the IPCC Express Standard and Enhanced reports are disabled and cannot be viewed. Only the IVR-related reports can be viewed.</p> <p>Extension Mobility: Enabled.</p>

Table 1-1 Available Product Packages for IPCC Express (continued)

Package	Available Licensed Components	Purpose
IPCC Express Standard	<ul style="list-style-type: none"> IPCC Express Standard Server Software (Required) Agent (At least one is required) Supervisor (Optional) Media Termination (Optional) Historical Reporting (Optional) 	<p>Provides informal call center features in any Cisco CallManager deployment. Some of the features include:</p> <ul style="list-style-type: none"> Resource selection (linear, circular, longest available) Call routing (conditional routing on ANI/DNIS, time of day, day of week, any real-time statistic or on-queue condition, overflow routing) IP queue points and fully customizable queued call treatments, including music in queue and custom messaging No Cisco Intelligent Contact Management (ICM) integration is supported <p>Editor: Available with limited steps. Software Developers Kit (SDK): Disabled. Applications: ICM applications are not available. Historical Reporting (HR): The Historical Reporting Client is enabled by default. The IPCC Express Enhanced HR Client is available for upgrade at an additional cost.</p>
IPCC Express Enhanced	<ul style="list-style-type: none"> IPCC Express Enhanced Server Software (Required) Agent (At least one is required) Supervisor (Optional) Media Termination (Optional) On-demand Recording (Optional) IPCC Express IVR Port Option (Could be basic prompt-and-collect ports¹) (Optional) Historical Reporting (Optional) Automatic Speech Recognition (ASR) (Optional) Text-To-Speech (TTS) (Optional) 	<p>IPCC Express Enhanced provides everything IPCC Express Standard provides plus a significantly greater level of sophistication and power, including:</p> <ul style="list-style-type: none"> Resource Selection (Highest average calls handled and shortest average call handling time) Call Routing (Priority routing and skills-based routing. You can define up to 50 skills, each with up to 10 competency levels. Every active agent can have all 50 skills defined and active at the same time.) Priority Queuing (Ten levels of priority are provided so that any call at any time can be reprioritized under workflow control.) No Cisco Intelligent Contact Management (ICM) integration is supported <p>Editor: Available with limited steps. Software Developers Kit (SDK): Disabled. Applications: ICM applications are not available. Historical Reporting (HR): The Historical Reporting Client is enabled by default. The IPCC Express Enhanced HR Client is available for upgrade at an additional cost.</p>

1. Prompt-and-collect (P&C) ports are included with IPCC Express at no additional charge.

The following notes apply to [Table 1-1](#):

- All IPCC Express product components are sold and licensed on a concurrent-use basis. For example, if your contact center runs two shifts of 50 agents each, you need to purchase only 50 agent licenses, not 100 licenses.

- When deployed on a standalone server (not co-resident with Cisco CallManager), both of the IPCC Express packages (Standard and Enhanced) include basic IVR capability and come with 150 prompt-and-collect (P&C) ports, or with 300 P&C ports on the Cisco MCS-7845 H-2.4-CC1 server. (See [Server Capacities and Limits, page A-1.](#)) The number of ports is irrespective of the number of agent licenses purchased and cannot be changed. When IPCC Express is deployed on the same server with Cisco CallManager, only 10 IVR ports are available.
- In contrast, the IP QM and IP IVR packages do not come with any ports as a part of the package. You must purchase the ports separately.
- Basic historical reporting, such as the IVR Traffic Analysis Report and the IVR Application Performance Analysis Report, is available with all packages and does not require a separate license.
- All supported IVR languages are included in all the packages listed in [Table 1-1](#). It is up to the system administrator to install as many of the languages as are needed.

[Table 1-2](#) lists the optional components available for IPCC Express.

Table 1-2 *Optional Components for IPCC Express*

Component Type	Purpose
Automatic Speech Recognition (ASR): <ul style="list-style-type: none"> • ASR Server Software (Required) • ASR ports (Part of the IVR ports purchased; you do not have to purchase them separately) 	ASR technology interprets voice input. Cisco has integrated IVR with Nuance Communications Inc. technology to provide "speaker-independent" speech recognition. This feature enables a caller to convey information by speech to the system for processing instead of by pressing keys on a touch-tone phone.
Text-To-Speech (TTS): <ul style="list-style-type: none"> • TTS Server Software (Required) • TTS ports (Part of the IVR ports purchased; you do not have to purchase them separately) 	TTS is the ability to convey text words phonetically so that a caller can hear them. Cisco has integrated IVR with Nuance Vocalizer technology to provide this capability in both designated languages and voice gender. TTS is used primarily to convey information obtained from a database or other source that is non-repetitive. Examples of such information include name and address verification. Repetitive information, such as numbers in an account balance, normally is not conveyed using TTS. Although text-to-speech technology has improved greatly since its inception, the tone still sounds mechanical, so it is best used only when the source information makes .wav file generation impossible.

Table 1-2 Optional Components for IPCC Express (continued)

Component Type	Purpose
Agent	<ul style="list-style-type: none"> • Agent login/logout and agent state change through the Cisco IP Phones 7940 and 7960. • This package is licensed per agent. Receiving a license for the IP Phone Agent package has no effect on the need to license other packages. • These agents can be monitored silently but not recorded. Supervisor barge-in and intercept features are not supported on IP Phone Agents.
IPCC Express Standard Agent	<p>PC-based basic agent interface, used for IPCC Express Standard only. The IPCC Express Standard Agent package provides:</p> <ul style="list-style-type: none"> • Agent window with agent login, agent state buttons, and agent statistics • Call/chat window • Enterprise data window • System administration without the ability to define workflows or reconfigure user interfaces • This package is licensed per desktop. Receiving a license for the agent package has no effect on the need to license other packages. License files are not shared across packages. • Media termination option
IPCC Express Enhanced Agent	<p>PC-based agent interface, used for IPCC Express Enhanced only. It provides many more features than its Standard equivalent, including:</p> <ul style="list-style-type: none"> • Agent window with agent login, agent state buttons, and agent statistics • Call/chat window • Enterprise data window • Full system administration capability • This package is licensed per desktop. Receiving a license for the agent package has no effect on the need to license other packages. License files are not shared across packages. • Media termination option • On-demand call recording option <p>The IPCC Express Server Software enables agents to go into work state and produces relevant reports. The Enhanced version of the Agent Desktop software allows desktop workflows and customizable toolbars. Together with the available IPCC Express IVR Port Option, this package provides for sophisticated screen pops via integration with any Microsoft Windows application.</p>

Table 1-2 Optional Components for IPCC Express (continued)

Component Type	Purpose
Supervisor IPCC Express Standard Supervisor	<p>PC-based basic supervisor interface, used for IPCC Express Standard only. This option provides:</p> <ul style="list-style-type: none"> • Supervisor with tree view of agents, skills, supervisors, and IP phone agents; associated statistics and data for tree nodes; and toolbar features without VoIP features (silent monitor, barge-in, intercept, and record) • Agent window with agent login, agent state buttons, and agent statistics • Call/chat window • Enterprise data window • This package is licensed per desktop. Receiving a license for the Supervisor package has no effect on the need to license other packages. License files are not shared across packages. • Media termination option <p> Note When the supervisor is using silent monitoring and media termination, both applications are using the sound card. On certain sound cards, this situation might cause hardware conflicts.</p>
IPCC Express Enhanced Supervisor	<p>PC-based supervisor interface, used for IPCC Express Enhanced only. This option provides:</p> <ul style="list-style-type: none"> • Supervisor with tree view of agents, skills, supervisors, and IP phone agents; associated statistics and data for tree nodes; and toolbar features plus VoIP features (silent monitor, barge-in, intercept, and record) • Supervisor Viewer to review recording of agent conversations • Agent window with agent login, agent state buttons, and agent statistics • Call/chat window • Enterprise data window • This package is licensed per desktop. In addition, it requires an agent license. Receiving a license for the Supervisor package has no effect on the need to license other packages. License files are not shared across packages. • Media termination option • On-demand call recording option (licensed through agent) <p> Note When the supervisor is using silent monitoring and media termination, both applications are using the sound card. On certain sound cards, this situation might cause hardware conflicts. Similarly, listening to recordings on a media terminated desktop can result in calls being dropped.</p>

Table 1-2 Optional Components for IPCC Express (continued)

Component Type		Purpose
Media Termination		Enables a PC-based client (agent or supervisor) or the Cisco Agent Desktop softphone to act as a VoIP device, eliminating the need for a hardware IP Phone. An agent can also use a Cisco IP Softphone as the VoIP device. Without this component, a PC-based agent must have a hardware IP Phone to use media termination.
Historical Reporting	IPCC Express Standard Historical Reporting	Used for IPCC Express Standard only, and it provides the following additional reports: Agent Summary, Agent Detail, Abandoned Call Detail Activity, Called Number Activity, and Call-by-Call Detailed Reports.
	IPCC Express Enhanced Historical Reporting	Used for IPCC Express Enhanced only. In addition to the reports for IPCC Express Standard, this component provides the following reports: Skill Routing Activity, Called Number Activity, and Priority Summary Activity Reports.
On-Demand Recording		Enables an agent or supervisor to record any call on demand. One, some, or all of the agents and supervisors can have this option. The number of calls that can be recorded depends on the number of recording licenses that have been purchased.
IPCC Express IVR Port Option		<p>This option enhances the IVR functionality on an IPCC Express package by including database integration, VoiceXML, XML, HTTP triggers, and eNotification services. This option is not an independent package. Normally, you would buy IPCC Express and then buy the IVR add-on option for it, giving you a full system that includes everything except IP QM.</p> <p>Editor: Available with all steps (except ICM).</p> <p>Applications: ICM applications are not available.</p> <p>Historical Reporting (HR): The IVR HR Client is available by default. If the IPCC Express Standard HR Client is purchased, it is automatically disabled. The IPCC Express Enhanced HR Client is available for upgrade at an additional cost.</p>

The following notes apply to [Table 1-2](#):

- The number of ASR ports should be less than or equal to the number of optional IVR ports.
- If you want multi-language ASR/TTS support, purchase licenses for the additional ASR/TTS languages.

License Update Utility

You can use this utility to update license capacities of a IPCC Express or IP IVR system without having to reinstall the system. For example, if you installed IPCC Express or IP IVR with the IVR package and 10 IVR ports and now want to increase the IVR ports to 20, you will have to purchase 10 more IVR port licenses and use the License Update Utility to refresh the licenses on the IPCC Express or IP IVR server. This utility can be used to increase license counts for agents, ports, supervisors, media termination, on-demand recording sessions, and IPCC Express IVR port options. *However, this utility cannot be used to add new components.* The number of IVR ports in an IPCC Express package cannot be increased via this utility.

If you did not buy IVR ports initially but later you want to add ASR, TTS, database dips, or VoiceXML functionality, you will have to add all the P&C ports to the total number of IVR ports that you purchase.

IP IVR Step Library Support

Table 1-3 lists the IVR editor workflow steps enabled by each product package. For more details about the functions offered in each workflow tray, refer to the *IVR Step Reference*, available online at

http://www.cisco.com/univercd/cc/td/doc/product/voice/sw_ap_to/rel_2_1/editor/ed_appb.htm

Table 1-3 Editor Step Supported for IVR Workflow

Workflow Step	IP QM	IP IVR	IPCC Express Standard	IPCC Express Enhanced	IPCC Express Enhanced plus IVR Option
General	Yes	Yes	Yes	Yes	Yes
Session	Yes	Yes	Yes	Yes	Yes
Contact	Yes	Yes	Yes	Yes	Yes
Call Contact	Yes	Yes	Yes	Yes	Yes
Email Contact	No	Yes	No	No	Yes
HTTP Contact	No	Yes	No	No	Yes
Media	Yes	Yes	Yes	Yes	Yes
User	No	Yes	Yes	Yes	Yes
Prompt	Yes	Yes	Yes	Yes	Yes
Grammar	Yes	Yes	Yes	Yes	Yes
Document	Yes	Yes	Yes	Yes	Yes
Database	No	Yes	No	Yes	Yes
Integrated Contact Distribution (ICD)	No	No	Yes	Yes	Yes
Intelligent Contact Management (ICM)	Yes	Yes	No	No	No
Java	Yes	Yes	No	No	Yes



IPCC Express in Cisco CallManager Deployment Models

This Chapter discusses the design implications of where IPCC Express is located in your network with respect to call processing resources. On a systems level, how IPCC Express is deployed can affect its performance, possibly even compromising functionality. This section addresses the importance of the IPCC Express location within a Cisco CallManager deployment.

Cisco CallManager Deployment Models

The IPCC Express design considerations in this section focus on the following main IP Telephony deployment models:

- [Single-Site Deployment, page 2-2](#)
- [Multi-Site WAN Deployment with Centralized Call Processing, page 2-2](#)
 - [IPCC Express Located at the Central Site, page 2-3](#)
 - [IPCC Express Located at the Remote Site, page 2-3](#)
- [Multi-Site WAN Deployment Distributed Call Processing, page 2-4](#)

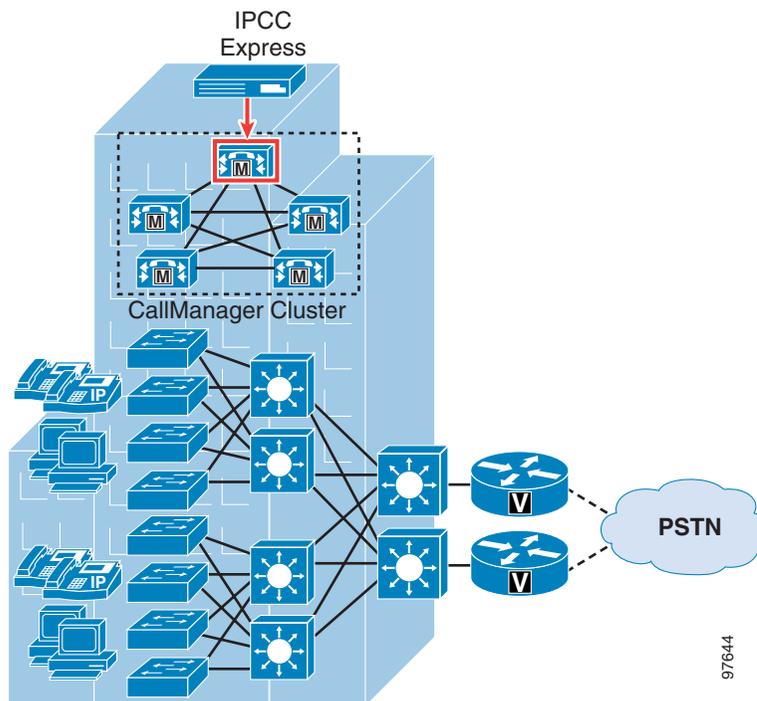
This section assumes that you are already familiar with the Cisco Architecture for Voice, Video, and Integrated Data (AVVID) network infrastructure and the Cisco CallManager cluster design considerations for each deployment model. For more information on the infrastructure and design models, refer to the *Cisco IP Telephony Solution Reference Network Design* documentation, available online at

<http://www.cisco.com/go/srnd>

Single-Site Deployment

In a single-site deployment, the Cisco CallManager cluster, its supporting IP Telephony application servers, IPCC Express agents, and their IP phones, are all located on a single central campus. [Figure 2-1](#) shows an example IPCC Express configuration of a single-site campus.

Figure 2-1 IPCC Express in a Single-Site Deployment



In [Figure 2-1](#), the IPCC Express telephony subsystem connects to one of the Cisco CallManager servers in the cluster (outlined in red in the figure). This server also runs the CTI Manager service that handles the CTI call processing requests from IPCC Express.

Multi-Site WAN Deployment with Centralized Call Processing

This deployment model supports two configuration options:

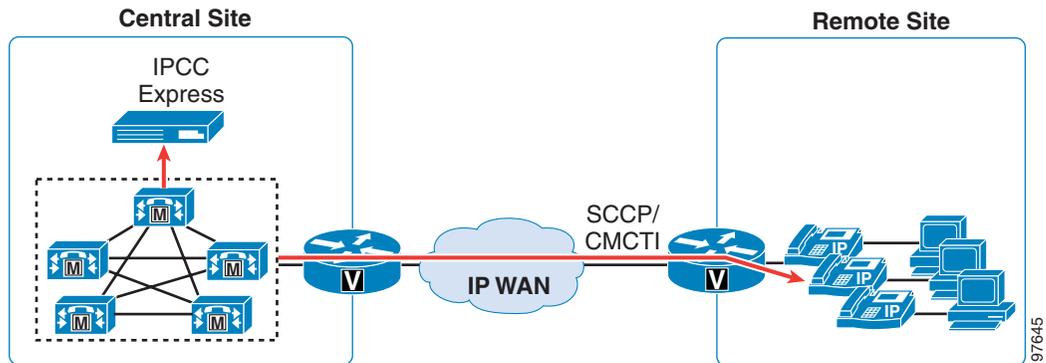
- [IPCC Express Located at the Central Site, page 2-3](#)
- [IPCC Express Located at the Remote Site, page 2-3](#)

Bandwidth considerations for both of these deployment models can vary based on the location of the IPCC Express. See the section on [Estimating Bandwidth Consumption, page 8-1](#), for more details.

IPCC Express Located at the Central Site

In this deployment model, all of the call processing and IPCC Express application servers are located at the central site. Phones and IPCC Express agents are distributed at remote branches. Phones and other call processing endpoints interface to Cisco CallManager over an IP WAN link (for example, Frame-Relay). CTI, Skinny Client Control Protocol (SCCP), and RTP traffic pass over the IP WAN link between the central and remote sites. [Figure 2-2](#) shows an example of this deployment model.

Figure 2-2 Centralized Call Processing with IPCC Express at the Central Site

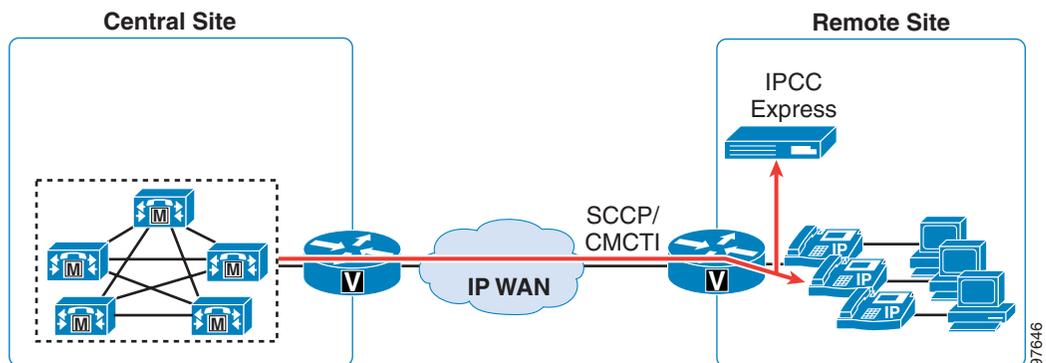


The chief advantages of this deployment model include easier maintenance through a single physical location for administration and the cost savings of not having to purchase additional servers for each remote branch. The disadvantage is that any IP WAN link failure prevents remote agents from accepting incoming calls; however, IPCC Express agents at the central site can continue to accept incoming calls.

IPCC Express Located at the Remote Site

As an alternative configuration, you can install IPCC Express at the remote site while leaving the Cisco CallManager cluster at the central site, as shown in [Figure 2-3](#).

Figure 2-3 Centralized Call Processing with IPCC Express at the Remote Site



A primary benefit of this configuration is that it saves backhauling of the call from the central site, provided that the gateway handling the call is at the remote site. Another benefit is contact center manageability at the remote site due to the fact that real-time and historical reporting are processed on the IPCC Express server, independent of Cisco CallManager.

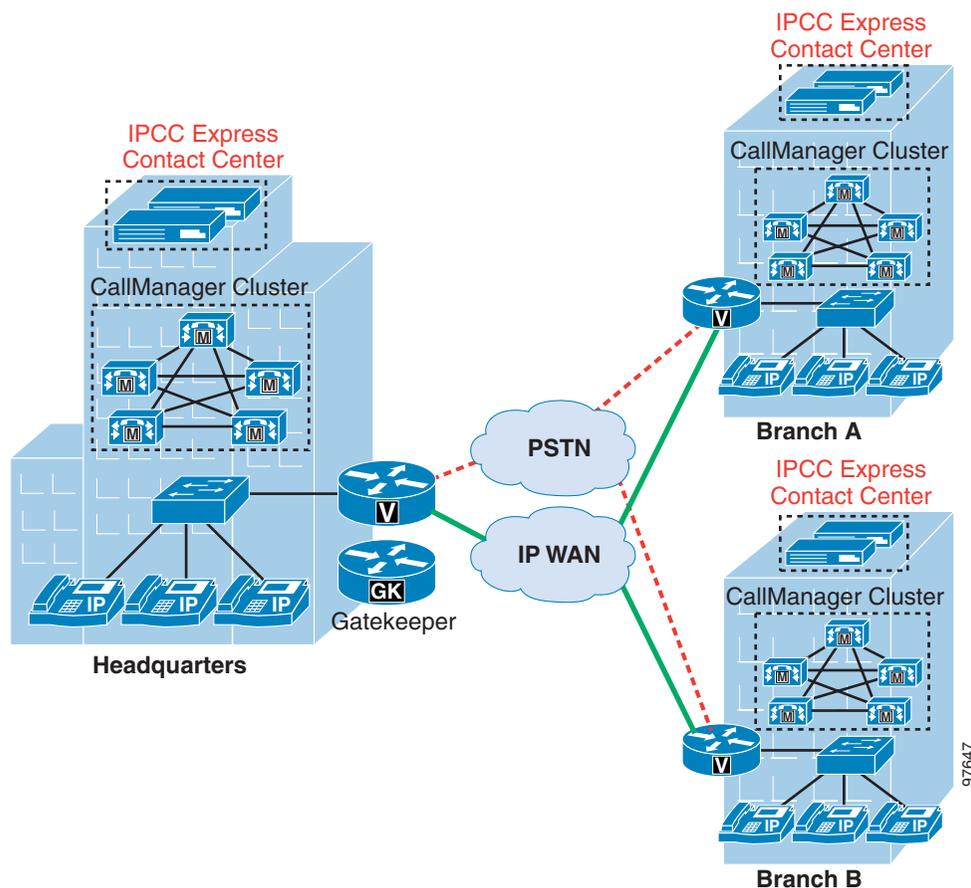
The drawback of this deployment model is the potential loss of WAN connectivity, which exposes IPCC Express to the following problems:

- Unavailability of a directory server for Lightweight Directory Access Protocol (LDAP) authentication. (For example, agents, supervisors, and administrators are logged off, and the administrator is unable to log in to IPCC Express to make configuration changes. The JTAPI subsystem therefore becomes unavailable.)
- No IPCC Express agents can log in or accept incoming calls.

Multi-Site WAN Deployment Distributed Call Processing

In a distributed call processing deployment, each site has its own Cisco CallManager server clusters. [Figure 2-4](#) shows an example of this type of configuration.

Figure 2-4 IPCC Express in a Distributed Call Processing Deployment



In this model, the contact center at each remote site is treated as a separate single-site deployment. Therefore, you can apply single-site design considerations to each site in this model. The major consideration with call treatment is bandwidth provisioning for call admission control at the gatekeeper. For more details call admission control in a distributed call processing deployment, refer to the *Cisco IP Telephony Solution Reference Network Design* documentation, available online at

<http://www.cisco.com/go/srnd>

IPCC Express Multiple-Server Deployment Scenarios

This section describes and provides examples of deployment scenarios that distribute various IPCC Express components across multiple servers.

IPCC Express lets you install some components on a server other than the IPCC Express server itself. Such a separate server is called a *dedicated server*. A dedicated server can conserve CPU resources on the IPCC Express server because the IPCC Express server will not have to handle the functions assigned to the dedicated server.

IPCC Express supports the following types of dedicated servers:

- Call Statistics, Recording, and Monitoring Server
Maintains IPCC Express call statistics and provides for recording and call monitoring for Cisco IPCC Express Enhanced.
- Call Recording and Monitoring Server
Provides for call monitoring and recording. Also enables you to deploy agents on multiple LAN segments. As long as the Call Recording and Monitoring server is on the same VLAN as the agents, the supervisor can be local or remote and still have the ability to silently monitor and record.
- Historical Reports Database Server
Stores IPCC Express databases for historical reporting.

If you are using Cisco IPCC Express Standard or Cisco IP IVR, you can set up an Historical Reports Database Server. If you are using Cisco IPCC Express Enhanced, you can implement any of the following options:

- Set up an Historical Reports Database Server.
- Use the Historical Reports Database Server as the Call Statistics, Recording, and Monitoring Server, or set up a separate Call Statistics, Recording, and Monitoring Server.
- Set up as many as four Call Monitoring Servers. If you do so, you must also set up one Call Statistics, Recording, and Monitoring Server. A maximum of 200 devices are supported in a span port for either server.

The following sections provide examples of various configuration scenarios using dedicated servers.

Scenario 1: Silent Monitoring and Recording with Remote Agents on Multiple LAN Segments

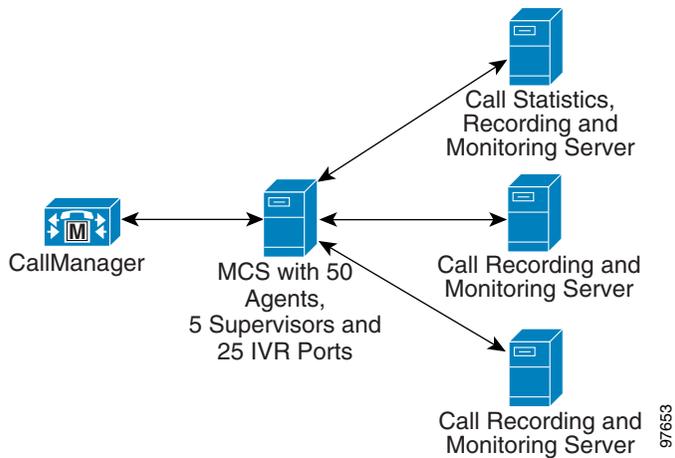
Requirement

Agents on multiple LAN segments, or availability of more ports and agents for scalability.

Solution

Set up a Call Statistics, Recording, and Monitoring Server, and set up multiple Call Recording and Monitoring Servers. (See [Figure 2-5](#).) You can have up to four Call Monitoring and Recording Servers, but this example shows only two.

Figure 2-5 Deployment Scenario for Example 1



Advantage

Allows the implementation of the required scenario.

Disadvantages

None.

Scenario 2: Single-Site Call Processing with Remote Historical Reports Database Server

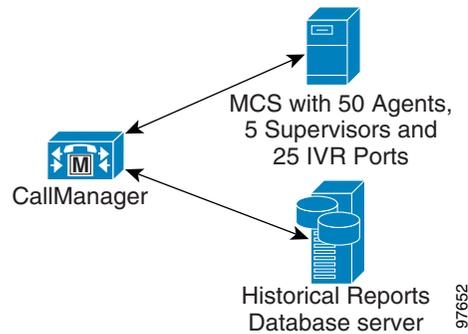
Requirement

The ability to run Historical Reporting sessions without affecting the performance of the Cisco IPCC Express or IP IVR server.

Solution

Set up an Historical Reports Database Server and run Historical Reporting Sessions on this dedicated server. (See [Figure 2-6](#).)

Figure 2-6 Deployment Scenario for Example 2



Advantage

Allows the implementation of the required scenario.

Disadvantages

None.

Scenario 3: IPCC Express at Multiple Sites Connected to a Centralized Cisco CallManager Cluster

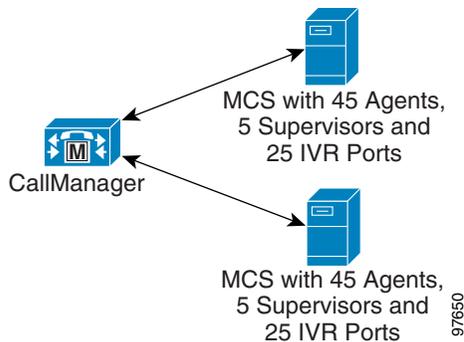
Requirement

100 agents, 10 supervisors, and 50 IVR ports. Upon investigation, it is determined that agents can be partitioned in a roughly even manner between two servers based on skill sets.

Solution

Distribute the deployment between 2 servers. Configure one server with 45 agents in the first group, 5 supervisors, and 25 IVR ports. Configure the other server with 55 agents in the second group, 5 supervisors, and 25 IVR ports. (See [Figure 2-7](#).)

Figure 2-7 Deployment Scenario for Example 3



Advantages

- Allows the implementation of the required scenario.
- Self-service information collected from users can be transferred to an agent and can pop up on an agent's screen.

Disadvantages

- Historical reports must be run separately on each server. One report cannot contain information from both servers.
- If an agent transfers a call from one server to the another, the server to which the call was transferred will not identify the call as an agent-to-agent transfer. Instead, the server to which the call was transferred will identify the call as a new call.
- Installation and configuration must be performed separately on each server.

Scenario 4: Multiple IP IVR Servers with Distributed ASR/TTS Servers

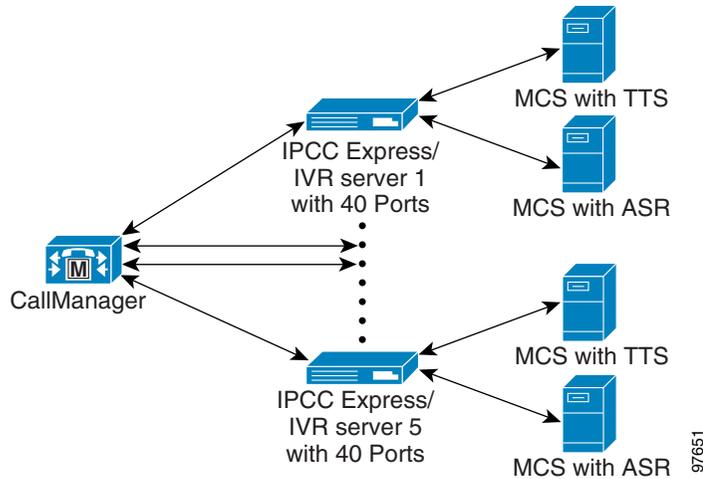
Requirement

200 IVR ports with automatic speech recognition (ASR) and text-to-speech (TTS), which is more than one server can support. There is no need to transfer information between IVR sessions.

Solution

Distribute the deployment among 5 groups of 3 servers. Each group of servers supports 40 IVR ports and includes a Cisco IPCC Express or IP IVR application server, a TTS server, and an ASR server. (See [Figure 2-8](#).)

Figure 2-8 Deployment Scenario for Example 4



Advantage

Allows the implementation of the required scenario.

Disadvantages

- Historical reports must be run separately on each server and cannot contain information for the entire system.
- Installation and configuration must be performed separately on each server.
- Cisco CallManager must be configured properly to achieve distribution of calls among the IVR ports.

Scenario 5: Separating Contact Center Capability from Voice Processing

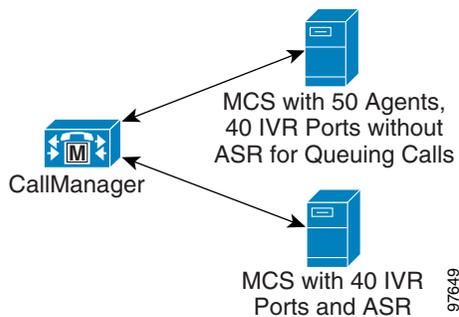
Requirement

50 ACD agents and 40 IVR ports with automatic speech recognition (ASR).

Solution

Distribute the deployment between 2 servers. Configure 50 agents on one server, and configure the 40 IVR ports with ASR on the other server. (See [Figure 2-9](#).)

Figure 2-9 Deployment Scenario for Example 5



Advantage

Allows the implementation of the required scenario.

Disadvantages

- Self-service information collected from users cannot be transferred to an agent and cannot pop up on an agent's screen.
- Historical reports must be run separately on each server. One report cannot contain information from both servers.
- Installation and configuration must be performed separately on each server.

Scenario 6: Distributing IVR Ports Among MCS Servers

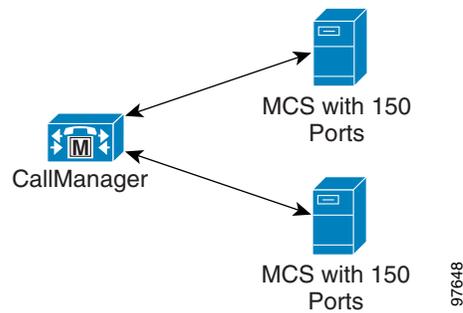
Requirement

300 IVR ports, which is more than one server (other than the MCS-7845-H) can support. There is no need to pass information between the IVR sessions.

Solution

Distribute the deployment between 2 servers, each supporting 150 IVR ports. Use the Cisco CallManager Forward on Busy, Forward on Failure, and Forward on No Answer features to forward CTI route points to the second server's CTI route points so that callers need dial only one phone number to reach the system. (See [Figure 2-10](#).)

Figure 2-10 Deployment Scenario for Example 6



Advantages

- Allows the implementation of the required 300 IVR ports.
- If one server fails, 150 ports will still be able to operate.

Disadvantages

- Historical reports must be run separately on each server. One report cannot contain information from both servers.
- Installation and configuration must be performed separately on each server.



IPCC Express System Design Considerations

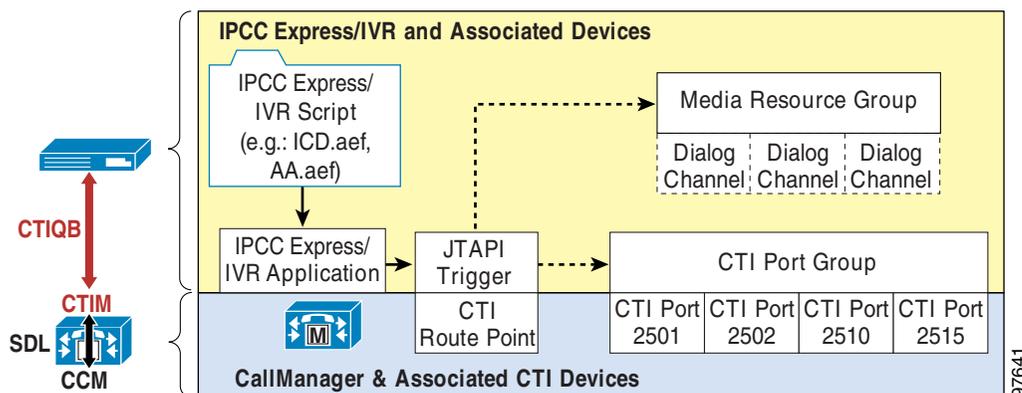
This chapter addresses system design consideration for integrating IPCC Express with a Cisco IP Telephony network, and it contains the following major sections:

- [Mapping IPCC Express to Cisco CallManager Devices, page 3-1](#)
Describes how physical and logical devices on IPCC Express map to Cisco CallManager devices (together with a description of a typical IPCC Express call flow), and it explains how to provision these Computer Telephony Integration (CTI) devices.
- [Provisioning Cisco CallManager Resources, page 3-4](#)
Shows how to determine the number of Cisco CallManager servers needed to support agent phones, gateways, and IVR applications.

Mapping IPCC Express to Cisco CallManager Devices

To scale end-to-end IP Telephony call processing resources accurately, it helps to understand how the IPCC Express telephony (JTAPI) and Integrated Contact Distribution (ICD) subsystems interface with Cisco CallManager. [Figure 3-1](#) illustrates how Computer Telephony Integration (CTI) serves as an interface for the IPCC Express, CTI Manager, and Cisco CallManager services, and how the physical and logical devices of IPCC Express map to Cisco CallManager and associated CTI devices.

Figure 3-1 IPCC Express Resources in Relation to Cisco CallManager Devices



As shown in [Figure 3-1](#), IPCC Express interfaces with the Cisco CallManager server primarily through its JTAPI subsystem. CTI Manager (CTIM) is a service running on a Cisco CallManager server. CTIM acts as an application broker for IPCC Express, and it abstracts the physical binding of the application to a particular Cisco Call Manager server to handle call control for its CTI resources. The CTI Manager handles CTI requests from IPCC Express via the CTI Quick Buffer Encoding (CTIQBE) protocol. CTIM then passes those requests to the Cisco CallManager service for call processing. In turn, the CTI Manager is aware of secondary and tertiary Cisco CallManager (CCM.EXE) services that may be prioritized to handle these call processing requests.

From the perspective of IPCC Express, an IVR application script is associated with a JTAPI trigger in order to handle an incoming call routed from the Cisco CallManager server. To Cisco CallManager, this JTAPI trigger (configured in IPCC Express) maps to an associated Route Point configured in Cisco CallManager. IPCC Express then determines if there are available CTI ports within one of its CTI port groups that can handle the call session. If prompting is required, IPCC Express uses a configured resource from its media port group.

Typical IPCC Express Call Flow

With a basic understanding of the CTI Architecture, the first step is to determine what types of CTI resources are required by IPCC Express for configuration on the Cisco CallManager server. As an example, we will use a typical IPCC Express call flow, as illustrated in [Figure 3-2](#).

Figure 3-2 Typical IPCC Express Call Flow

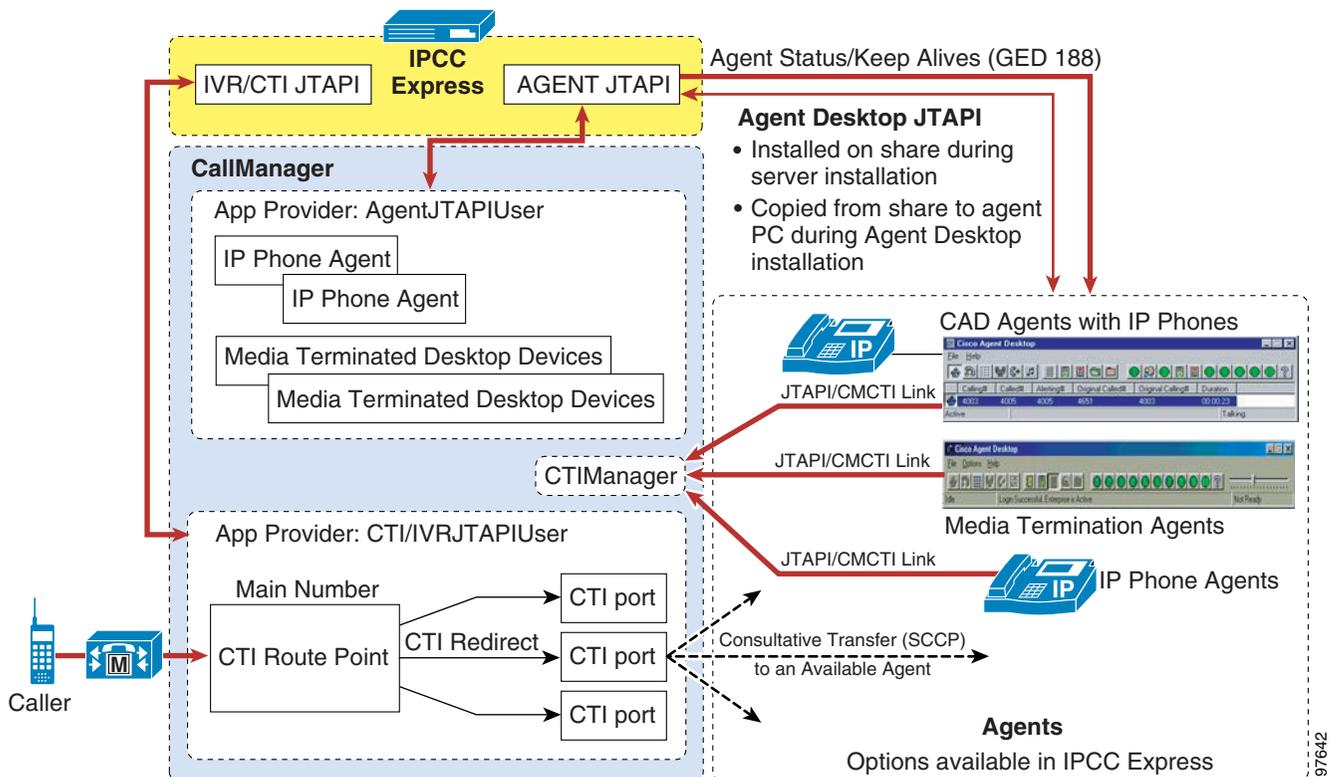


Figure 3-2 shows an incoming call routed through the Cisco CallManager server to a CTI route point assigned to the IPCC Express JTAPI trigger. Route points and CTI ports are configured in IPCC Express such that all calls received at the main directory number are routed through the JTAPI subsystem to the IPCC Express script.

In Figure 3-2, the dotted line around the Cisco CallManager and IPCC Express servers represents logical instances of the CTI route point and CTI ports. This depiction shows that the IPCC Express and Cisco CallManager servers both have handles to these route points and CTI ports, but each uses these handles differently. In particular, IPCC Express does not process the internal CTI route point and CTI port messages. Instead, IPCC Express makes CTI requests for Cisco CallManager to perform the call routing. Cisco CallManager then processes the CTI Redirect message from the route point to an available CTI port. Finally, the CTI port performs a consultative transfer to an available agent. This process is relevant to the following approach for assessing Cisco CallManager scalability:

1. Determine how many CTI resources are required by IPCC Express.
2. Calculate the required device weights for the server.
3. Determine how many Cisco CallManager server units are consumed by the IPCC Express CTI resources.

Table 3-1 maps IPCC Express logical devices (application providers) to their equivalent Cisco CallManager devices

Table 3-1 Mapping IPCC Express Application Providers to Cisco CallManager CTI Resources

IPCC Express Application Provider	Cisco CallManager CTI Resources	Description
IPCC Express IVR/CTI JTAPI Provider (CTI components)	CTI route points	Main directory number fronting incoming calls to open call handling sessions
	CTI ports	Call handling sessions for incoming calls
IPCC Express Agent JTAPI Provider (Agent Desktop components)	CTI ports	IPCC Express agent softphones
	Third-party control phones	Monitoring of: <ul style="list-style-type: none"> • Cisco IP Phone (not media termination) • Media-terminated desktop devices
Cisco Agent Desktop Client Machine JTAPI Provider	IP Phone extensions	The JTAPI Client on the Cisco Agent Desktop authenticates with the agent's UserID. In Cisco CallManager, the agent's UserID has devices associated with it. The JTAPI Client takes control of the agent's device line for call control capabilities.

Note that there are no equivalent media termination ports mapped to Cisco CallManager because the IPCC Express media termination ports, from the perspective of Cisco CallManager, are the CTI ports themselves. IPCC Express imposes a media port license that blocks dialog channels from being able to establish Real-Time Transport Protocol (RTP) streaming connections. Therefore, when provisioning, make sure the number of media ports does not exceed the total number of provisioned CTI ports per group, as indicated in the following equation:

$$\text{Total number of media ports} \leq \text{Total number of CTI ports}$$

Provisioning Cisco CallManager Resources

After determining how many IPCC Express resources are required for your contact center or IVR solution, the next step is to determine which Cisco CallManager resources (if any) are needed for your IPCC Express solution.

As indicated in [Table 3-1](#), IPCC Express uses the following logical devices, or application providers:

- CTI and IVR JTAPI provider — Consists of route points and CTI ports per caller session.
- Agent JTAPI provider — Consists of all phones that can be used by logged-in agents.
- Cisco Agent Desktop Client Machine JTAPI providers — Each agent that uses Cisco Agent Desktop also requires one application provider per Cisco CallManager CTI connection.

Each application provider function maps to a related Cisco CallManager CTI resource.



Note

Currently, Cisco strongly recommends that you configure both the CTI/IVR JTAPI and Agent JTAPI application providers on the same Cisco CallManager and CTI Manager server. The backup Cisco CallManager and CTI Manager server should be used as a hot standby. Ideally, at least one backup CTI Manager should be configured in the CTI/IVR JTAPI and Agent JTAPI (ICD) subsystems. Cisco recommends that you do *not* use the database publisher as the primary CTI Manager because the publisher would then become a single point of failure. Therefore, if you have two active Cisco CallManager servers for your IPCC Express, place the primary CTI Manager on the subscriber and the backup CTI Manager on the publisher.

Provisioning IPCC Express Agents

You must provision IPCC Express agents in two places:

- IPCC Express Agent (ICD) subsystem
- Cisco CallManager device pools (as part of the Cisco CallManager CTI design)

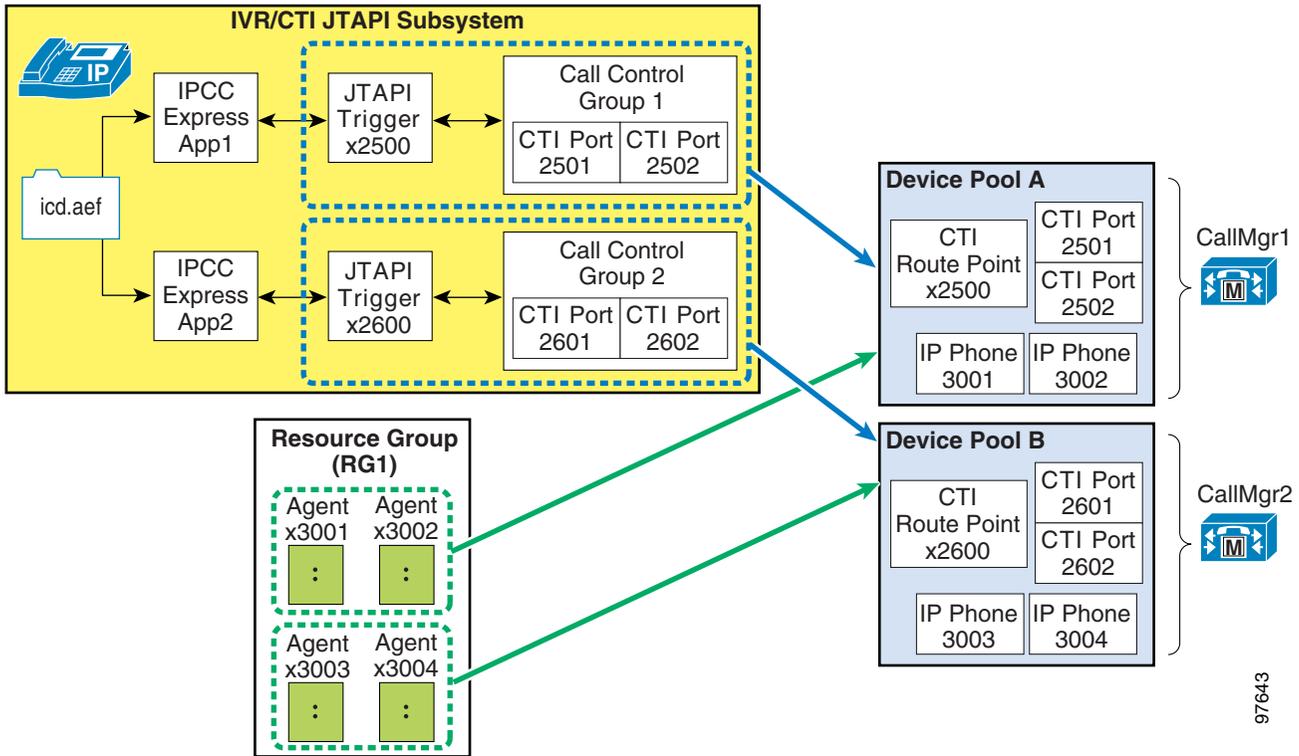
The following agent provisioning configurations are possible:

- One pool of agents shared among multiple IPCC Express scripts.
- One pool of CTI ports shared among multiple IPCC Express or IP IVR scripts. (For example, all CTI ports in Cisco CallManager device pool X can be assigned to multiple CTI port groups in the IPCC Express JTAPI subsystem.)
- NxN mesh of agents and ports shared among N scripts. (For example, if the agents and CTI ports are in device pools X and Y, the agents can be assigned to one or more IPCC Express resource groups, and the CTI ports can be assigned to one or more CTI port groups.)

Provisioning CTI Port Groups

In IPCC Express, CTI devices can be pooled into CTI port groups (also known as call control groups) and assigned to triggers. As previously mentioned, CTI ports can be related to individual IVR or IPCC Express sessions. [Table 3-1](#) illustrates an example of how you can distribute IPCC Express resources across different Cisco CallManager device pools and CTI port groups.

Figure 3-3 Grouping IPCC Express Agents and CTI Ports



Within the IPCC Express, call control groups (CTI port groups) and dialog groups are assigned to triggers. Triggers are assigned to an application, and the application also has an associated script, such as `icd.aef`. A single application can have multiple triggers and, depending on the trigger configuration, could be associated dynamically with ports from different call control groups and dialog groups. Agents within a single resource group can also be distributed among multiple Cisco CallManager device pools and groups. This flexibility in distributing JTAPI triggers, call control groups, and agent resource groups can be beneficial for redundancy purposes if there is a Cisco CallManager or CTI Manager failure within a Cisco CallManager cluster. For more information on redundancy considerations, see the chapter on [Design Considerations for High Availability](#), page 4-1.



Design Considerations for High Availability

This chapter presents design considerations to help ensure that your IPCC Express applications remain available for use even under certain fault conditions. Various system failure scenarios are presented, along with the expected effects on IPCC Express agents and calls in those scenarios.

Designing for Fault Tolerance

IPCC Express applications predominantly focus on providing some type of customer service (for example, bank transactions, customer order status, call center forwarding, and so forth), where unavailability of the system could have a direct impact on business revenue. Therefore, the IPCC Express applications must maintain a high level of availability to ensure reliable service for business customers. This includes ensuring a seamless transition to backup systems during a failure scenario.

IPCC Express applications can be configured for CTI redundancy across Cisco CallManager servers in a single cluster. The IPCC Express JTAPI client connects to the primary CTI Manager (CTIM) and is aware of secondary and tertiary CTIMs on other Cisco CallManager servers. CTIM uses the same intra-cluster communication Signal Distribution Layer (SDL) mechanism that Cisco CallManagers in the cluster use to communicate with each other.

At a minimum, perform the following steps to enable CTIM fault tolerance in an IPCC Express solution:

- Set up a Cisco CallManager cluster that includes at least one publisher and one subscriber, then configure a Cisco CallManager group that includes the publisher and primary subscriber servers (plus any other secondary subscribers). All Cisco CallManager servers configured for IPCC Express should be running CTIM. (The CTI Manager Service is installed automatically during Cisco CallManager installation, and it is configured to start automatically with Windows 2000 Server, unless otherwise specified by the user.)
- For the IPCC Express JTAPI and Integrated Contact Distribution (ICD) subsystems, configure more than one CTIM.
- Ensure that the JTAPI preferences for each Cisco Agent Desktop point to a primary and a redundant CTIM.

The following sections describe failure scenarios for CTI redundancy:

- [Cisco CallManager and/or CTI Manager Fails, page 4-2](#)
- [IPCC Express Server Fails, page 4-4](#)

Furthermore, the following single points of failure exist in an IPCC Express solution under the specified conditions:

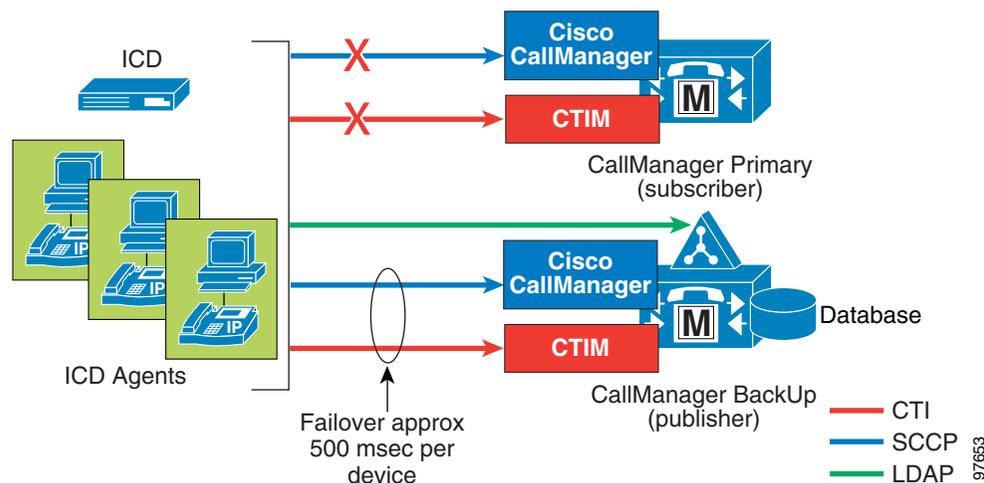
- Cisco CallManager publisher fails
This failure is an issue only where the publisher is serving as the Domain Controller Directory (DCD) server. Primary CTIM failure is not of itself a single point of failure unless there is only one Cisco CallManager server or IPCC Express is a co-resident configuration.
- IP WAN fails in a centralized call processing model (with IPCC Express at the central site)
Agents at the remote sites lose connectivity to either the IPCC Express application or to the Cisco CallManager cluster.
- IPCC Express Server fails
If there is an IPCC Express application failure, all IPCC Express subsystems and application functions are unavailable, even though CTIM and Cisco CallManager services are running normally.

In all three scenarios, the IPCC Express application's CTI connection to its configured primary CTIM fails, thereby affecting call routing and IPCC Express agent connections. The following sections focus on anticipated behavior of call routing as well as call and agent availability after the failure. You should review these failure cases in order to address and appropriately set user expectations in providing redundancy for your IPCC Express system.

Cisco CallManager and/or CTI Manager Fails

In this failure scenario, IPCC Express loses its CTI connection to the primary Cisco CallManager or CTI Manager configured for IPCC Express. (See [Figure 4-1](#).)

Figure 4-1 IPCC Express Recovery from Cisco CallManager or CTIM Failure (with Two Servers)



For the example in [Figure 4-1](#), the IPCC Express JTAPI provider is pointing to the Cisco CallManager primary (subscriber) server for both its primary Cisco CallManager and CTIM services.

The following IPCC Express behavior can be expected of IPCC Express if the connection to Cisco CallManager primary is lost:

- The JTAPI and Integrated Contact Distribution (ICD) subsystems reconnect to the backup CTIM, as it was configured in the IPCC Express JTAPI and ICD subsystem parameters.
- All of the application provider resource management gets transferred to the backup server, which in this example is the publisher.

CTI devices (CTI ports and route points) re-home to the backup Cisco CallManager server. (Cisco recommends that you do not configure any devices on the publisher in a Cisco CallManager cluster with multiple servers.) Re-registration takes approximately 500 msec per single line device or CTI port. During this re-registration period, there could be 15 to 20 seconds of call center downtime, and this delay can vary with the number of CTI devices in use. Once all devices have been re-registered to the backup Cisco CallManager and CTIM, routing of new incoming calls will resume, and IPCC Express agents can log in again and accept incoming calls.

If the failed Cisco CallManager is the DCD server authenticating the IPCC Express (the Directory Host Name defined in IPCC Express Configuration and Repository, Directory Setup parameters), there is no IP application redundancy because the failure of a Cisco CallManager hosting DCD is a single point of failure for IP IPCC Express. The following behavior can occur:

- LDAP authentication errors will occur in IPCC Express Application Administration.
- All incoming calls to the IPCC Express route point will return reorder tone (fast busy).
- Agents will not be able to log in again.

For this reason, the subscriber server should be configured as the primary CTIM and Cisco CallManager. An option for reducing the downtime is to install a DCD on a standalone Cisco CallManager server in the cluster or on an external corporate directory server.

Call Survivability

During Cisco CallManager or CTIM failure, expect the following call survivability behavior:

- Calls in progress with IPCC Express agents prior to failure are not interrupted.
- Calls in queue during failure are dropped.
- The average time for failover for a single server with CTI devices ranges from 15 to 20 seconds. During this time, incoming calls receive a busy (reorder) tone until all CTI devices have re-registered to the backup Cisco CallManager and CTIM.

You can use the following option to provide call continuity during this failure scenario:

- Distribute the agents and CTI ports into multiple device pools on Cisco CallManager.
- Have route points, CTI ports, and agent devices in a non-failed device pool to continue queuing calls and routing them to agents.
- If the failed Cisco CallManager and CTIM does not host the IPCC Express application route point, agents in a non-failed device pool can continue to accept calls from the queue with no downtime.



Note

Adding a second IPCC Express application with a forward-on-failure to a secondary route point does not appear to improve failover time. Testing has shown that the time for Cisco CallManager to detect that the application is no longer available (and forward to a second route point) is equal to the time it takes for Cisco CallManager to re-register CTI devices to the backup server.

IPCC Express Agent Impact

As mentioned previously, calls in progress to agents prior to failure will survive. All agents are automatically logged out of their Cisco Agent Desktop. Agents receive a message indicating that either their phone or Cisco CallManager is offline. Agents might also observe the following behavior:

- Agent's desktop might go into a Reserved state, and all of the hot buttons are grayed. In such a case, that agent cannot become available to accept calls.
- Agent's IP phone might display a TEMP FAIL message. This event is related to a Cisco CallManager survivability feature, Quiet Clear, which sends a DeviceUnregistered message from Cisco CallManager to the phone where a call state is active during a failover.

The Cisco Agent Desktop will re-register to the CTIM configured in the JTAPI preferences on the local PC. The agent will have to log back in twice, once after failover and once after failback. All agents without active calls who log in again will have their agent states reset to the default Not Ready state, and they will have to make themselves available again to accept incoming calls. Agents with calls in progress prior to the failure must hang up (that is, release control of the old call) before they can become ready to accept new calls.

Cisco Agent Desktop VoIP Monitor server uses information in the SQL server database on the Cisco CallManager publisher to monitor calls silently. It needs this information to begin a monitoring session, but it does not require access to Cisco CallManager after a monitoring session has begun. If the SQL server or the connection to it fails, the currently active voice monitoring sessions are not interrupted because the VoIP Monitor server does not realize that failover has occurred. However, the first attempt to start a voice monitoring session will fail. The failure may take up to one minute if the failure is because the Cisco CallManager's IP address is not accessible. Subsequent attempts to monitor will try to connect to other Cisco CallManagers (subscribers) in the cluster until a connection is made. This process can take up to five minutes, depending on how many Cisco CallManagers there are in the cluster and how many of them are running. For example, if there are five Cisco CallManagers and they are all down and inaccessible on the network, the VoIP Monitor server will try each in succession. Each attempt can take up to a minute, for a total of five minutes.

IPCC Express Server Fails

This scenario focuses on the impact if the IPCC Express application server fails.

IPCC Express Availability

Currently, there is no failover or hot standby mechanism for the IPCC Express server. If the IPCC Express server hosting the IPCC Express application fails, the following conditions apply:

- No automatic failover mechanism for IPCC Express agents
- No intra-cluster communication among IPCC Express servers that will maintain transitional states in the event of a IPCC Express application service failure

There is, however, an IPCC Express recovery mechanism that can be performed manually through hard disk mirroring and drive swapping over to an identical Cisco Media Convergence Server (MCS). This recovery method is generically referred to as *cold standby*. For configuration details on this manual system recovery process for IPCC Express, refer to the section on [IPCC Express Server Recovery – Cold Standby Server Configuration](#), page 4-5. Future releases of IPCC Express will have a warm standby option.

Call Survivability

During failure of the IPCC Express application server, expect the following call survivability behavior:

- Calls in progress with IPCC Express agents prior to the IPCC Express failure are not interrupted.
- Incoming calls from either the PSTN or the local network will receive a reorder (fast busy) tone until the IPCC Express server has recovered.

IPCC Express Agent Impact

During failure of the IPCC Express application server, agents might observe the following behavior:

- All agents are automatically logged out of their Cisco Agent Desktop. Agents receive a message indicating that either their phone or Cisco CallManager is offline.
- Agents are not able to log back in until the IPCC Express server is restored. Any attempt to do so will return a licensing error message (which means that the share to the IPCC Express server is not available).
- Cisco Agent Desktop will not re-home if you simply move the network cable to an identically configured IPCC Express server (unless you use the recover method described in [IPCC Express Server Recovery – Cold Standby Server Configuration, page 4-5](#)). Agents will not be able to log in and will receive an error message. Similarly, if the IP address or subnet mask of the IPCC Express server is changed, IPCC Express will have to be reinstalled to remove these errors and allow agents to log in again.

IPCC Express Server Recovery – Cold Standby Server Configuration

An *identically configured cold standby* implies one of the following recovery methods:

- An image of the IPCC Express server's disk drive is placed on a backup server (the cold standby). You can create the image by using either Ghost or similar imaging tools, or by using the replication mechanism in RAID. To be identically configured, the cold standby must contain a periodic snapshot of a known working image of the primary IPCC Express server.
- The redundant disk drive in the failed IPCC Express server is moved into a backup server (the cold standby). To be identically configured, the cold standby must contain a mirrored drive that provides a backup copy of the failed IPCC Express server.

Perform the following steps to recover IPCC Express with a redundant disk and a cold standby server.

-
- Step 1** Install and configure the primary IPCC Express server, with all agents up and running (Cisco Agent Desktops and/or Supervisor Desktops logged in and agents accepting calls from queue).
 - Step 2** Install a cold standby server in a location near the primary IPCC Express server. Leave the cold standby unplugged from the network in a powered-down state.
 - Step 3** If a failure of the primary IPCC Express server occurs, all callers in the queue will be disconnected. Agents with calls already in progress will be able to complete those calls; however, their desktops will be logged off. All agents should exit their desktops in preparation for the cold standby server to go online.
 - Step 4** Remove the redundant drive (for example, disk 1, or ID 1) with the good configuration from the primary IPCC Express server. The Cisco MCS-7835 supports hot-swappable drives, so you can remove the disk drive without turning off the system power.

- Step 5** Unplug the failed primary server's network cable, and move that same cable to the Network Interface Card (NIC) on the cold standby server. Keep the network cable in the same VLAN and subnet on the switch port.
- Step 6** Insert the redundant drive (for example, disk 1, or ID 1) into the cold standby's disk array. Insert the drive while the standby server's power is still off.
- Step 7** Boot up the cold standby server with this disk. At the boot-up prompt, press F2 to declare the empty bay as failed. (The F1 option ignores the missing drive and continues.) Automatic data recovery is enabled, and the server will boot into an identical copy of the primary IPCC Express server.

According to *Configuring and Using Redundant Disks with Cisco MCS* (available online at http://www.cisco.com/warp/public/788/AVVID/disk_redundancy_mcs_9229.html), the time required for an MCS rebuild is approximately 15 minutes per GB (time for the drives to sync up). The actual rebuild time is dependent upon the rebuild priority set, the amount of I/O activity occurring during the rebuild operation, the number of drives in the array, and the disk drive speed.



Note The IPCC Express application will still be available during this sync-up period.

- Step 8** Once the cold standby server is up and running, check that the JTAPI subsystem is in IN_SERVICE state on the Application Administrator Engine Status page. Agents should then be able to start their desktops, log back in, and accept calls.



Note It is important to verify that both the server and the Cisco Agent Desktops and Supervisor Desktops have started up after the failure because they do not have the ability to switch over automatically. Each client application has to re-discover and re-establish a share to the cold standby IPCC Express server.

Normal contact center operations are interrupted for only as long as it takes to move the drive to the cold standby's array, write the redundant drive's information to the cold standby disk, and log agents back in.

- Step 9** Once the primary IPCC Express server is restored, power down the primary and move the network cable back to this server. If add or modify changes have occurred on the cold standby in the interim, it may be necessary to take the drive from the cold standby's array and place it back into the primary. Boot the primary with the redundant drive, as described in [Step 7](#). (A general field practice is to remove all of the drives and boot the restored primary with the redundant drive, then reinstall the original drive back into the server and mirror it.) Verify that agents can log back in, transition to a ready state, and accept calls.

Failure Scenario Summary

Table 4-1 summarizes the impacts from failures of particular components in the IPCC Express solution. The estimated downtime varies based on the number of CTI devices in use.

Table 4-1 Impacts of IPCC Express System Failures

Failed Component	Estimated Downtime ¹	Impact on IPCC Express	Impact on Agent (Cisco Agent Desktop)
Cisco CallManager server (CM1), with CTI Manager and/or DCD	91 seconds for 183 CTI devices	Application provider resource management transferred to CM2. Re-registration takes 500 msec per single line device or CTI port.	Calls in progress with agents are not interrupted. All logged-in agents are automatically logged out, unless CM1 is the DCD. If the DCD fails, agents cannot log in again until the DCD is restored.
Cisco CallManager server (CM2), with IPCC Express route point and one device pool (PoolA)	15-20 seconds	Calls will be routed to agents with devices in PoolB. Callers dialing the route point during the 15-20 second failover hear reorder (fast busy). CM3 takes on the additional device weight load of CM2.	Calls in progress with agents are not interrupted. PoolA agents are logged out and must wait for their phones to re-register to CM3 before logging in again.
Cisco CallManager server (CM3), with one device pool (PoolB)	None	Calls will be routed to agents with devices in PoolA. CM2 takes on the additional device weight load of CM3.	Calls in progress with agents are not interrupted. PoolB agents are logged out and must wait for their phones to re-register to CM2 before logging in again.

1. Estimated downtime depends on the number of CTI resources in use.



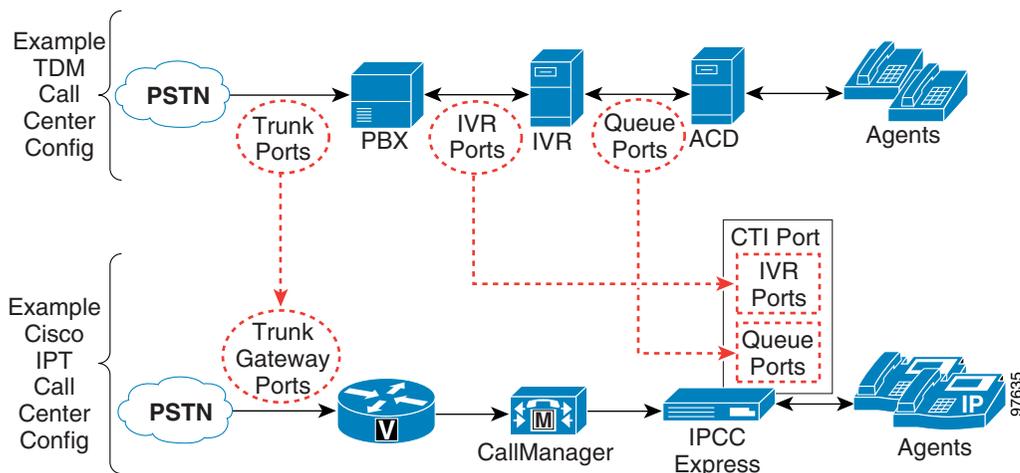
Basics of Call Center Sizing

This chapter introduces the basic concepts involved in call center sizing.

Terminology

Figure 5-1 illustrates the common port types and how they map to IPCC Express.

Figure 5-1 Call Center Port Types



Call center sizing differentiates the port types as follows:

- **Gateway or PSTN trunk ports** — handle calls originating from the PSTN. They are purchased separately from IPCC Express.
- **Prompt-and-collect (P&C) ports** — perform basic P&C and/or queuing only. P&C ports are IVR ports that have limited functionality, and they are available for both IPCC Express Standard and IPCC Express Enhanced. These ports perform basic call treatment of P&C only, and they do *not* provide the capability to do database dips, email, ASR/TTS, VoiceXML, or HTTP. Both IPCC Express Standard and IPCC Express Enhanced have basic IVR capability in the form of P&C ports, and you can have as many P&C ports as the hardware server supports. (See [Server Capacities and Limits, page A-1](#).) These ports are included at no additional cost with IPCC Express Standard or

Enhanced, but they must be sized for proper capacity planning for the IPCC Express server. For sizing and capacity details, refer to the IPCC Express Configuration and Ordering Tool, available online at

http://www.cisco.com/en/US/partner/products/sw/custcosw/ps1846/prod_how_to_order.html

- **Queue ports** — are IVR ports that queue calls prior to transferring the caller to an available agent. These ports are included at no additional cost with IPCC Express Standard or Enhanced, but they must be sized for proper capacity planning for the IPCC Express server. Refer to the IPCC Express Configuration and Ordering Tool for more details.
- **IVR ports** — are full-featured IVR ports with all the capabilities found in the standalone Cisco IP IVR product, except that the IPCC Express IVR ports do not support Intelligent Contact Management (ICM) integration.
- **CTI ports** — are computer software devices used to handle telephony hardware devices such as IVR ports and queuing ports. CTI ports include all three types of IVR port functions for P&C, queuing, and IVR port options for database dips, ASR, and TTS. CTI ports are an important component in the IPCC Express architecture, but you do not have to purchase them separately.

If you want additional supporting features such as automatic speech recognition (ASR), text-to-speech (TTS), email notification, web server or client functionality, and database operations, then IPCC Express would need additional functionality in the IP IVR to perform these operations. Because the basic P&C ports cannot handle additional features such as these, you would have to purchase additional IVR port licenses. These IVR ports, in addition to functioning as P&C ports, will also perform database dips, VoiceXML, ASR, TTS, web operations, and so forth.

The goal of the system architect is to determine the appropriate number and types of IVR ports to provision for the IPCC Express system. However, as shown in [Figure 5-1](#), the IPCC Express architecture differs slightly from the example TDM call center configuration in that IVR ports and queue ports (and P&C ports as well) are combined into one logical CTI port. Therefore, the call sizing approach in this document calculates trunk, IVR, and queue ports. The remaining sections of this chapter use the term *IVR port* to denote the combined queue port and IVR port (both full-service and P&C ports).

Preliminary Information Requirements

Cisco recommends that your system designers create a sizing document to do the following:

- Scope out the preliminary configuration information for the IPCC Express server.
- Size the gateways for the system.

To determine the size of the call center, obtain answers to the following questions:

- How many IVR ports do you need?
- How many gateway trunk ports do you need?
- How many agents will answer incoming calls?

To answer these questions properly, you will need the sizing metrics and information listed in [Table 5-1](#).

Table 5-1 Call Center Sizing Metrics

Metric	Description
Service level goal for gateway trunk ports	Percentage of total calls to gateway trunk ports that need to be answered within a specific number of seconds.
Average handle time (AHT)	Average duration (talk time) of a call plus after-call work time, which is the wrap-up time after the caller hangs up.
Average IVR port usage time	The total time for prompt playout and/or menu navigation (if any) in the IPCC Express script.
Service level goal for agents	Percentage of calls answered by agents within a specific number of seconds.
Busy Hour Call Attempts (BHCA)	Average number of calls received in a busy hour.
Grade of service (% blockage) for gateway ports to the PSTN	Percentage of calls that get a busy tone (no gateway trunks available) out of the total BHCA.
Grade of service (% blockage) for IVR ports	Percentage of calls blocked when no ports are available. This percentage should be as low as possible.

All of the metrics in [Table 5-1](#) are basic call sizing metrics. Once this information is obtained, the number of gateway trunk ports, IVR ports, and agents can be calculated. Use Erlang C for sizing agents, and use Erlang B for sizing gateway trunk ports and IVR ports. The output of this sizing process will provide you with the total number of IVR ports and total number of agents to size the IPCC Express system properly.

See [Figure 5-2](#) for an overview of the IP call center sizing process, and see the section on [Planning Resource Requirements for Call Center Sizing, page 5-5](#), for detailed sizing information for both IVR ports and IPCC Express agents.

**Note**

If the system being designed is a replacement for an existing IPCC Express or IP IVR system, you might not need all of the information listed above. You might be able to use the current agents, call flow, and historical reporting information from the existing system to size the new system (assuming there are no changes in the application, load, call flow routing, or service level desired).

In addition, call sizing design considerations may vary if the call center is more self-service oriented.

Principal Design Considerations for Call Center Sizing

Figure 5-2 illustrates the principal steps and design considerations for sizing a call center.

Figure 5-2 IPCC Express Design Process – Call Center Sizing

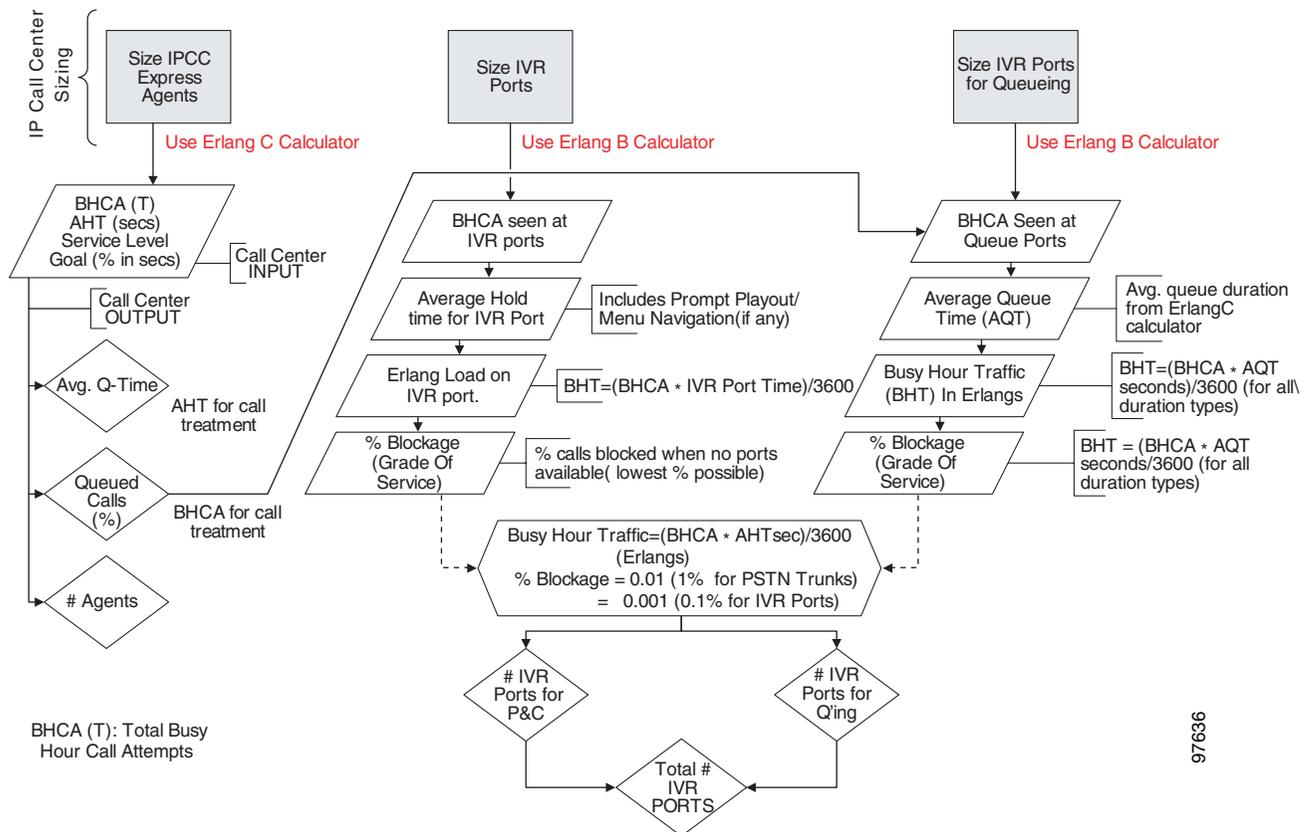


Figure 5-2 is a general overview of the design considerations for call sizing. For a detailed description of the call center sizing design process, refer to the section on sizing call center resources in the *Cisco IP Contact Center Solution Reference Network Design Guide*, available online at

<http://www.cisco.com/go/srnd>

There are similar basic call center sizing considerations and steps for IPCC Enterprise, and they also can be used in sizing a smaller contact center for IPCC Express. This call sizing approach will provide you with the minimum number of IVR ports to support the total BHCA.

In addition, you should include the following design considerations, specific to IPCC Express, in your call center sizing calculations:

- At a minimum, plan on enough capacity to replace your existing system. The replacement system should perform at least as well as the one it is replacing.
- All call center designs must be sized to the system correctly. Do not size a call center without using the IPCC Express Configuration and Ordering Tool to determine the required quantity of servers and gateway trunks.

- After all of the Erlang (C and B) calculations are complete for the call center sizing, any changes in queue times or agents will affect the total number of trunks and IVR ports required for an IPCC Express solution.
- As you increase the size of the agent pool, very small changes in the average queue time and percentage of queued calls will affect the required number of gateway trunks and IVR ports.
- Running the Historical Reporting client on a co-resident Historical Reporting Database is a CPU-intensive process.
- Even if you perform all of the calculations for a call center, there are still some variables that you cannot plan for but that will affect the ports needed on an IPCC Express system. For example, one or more agents could call in sick, and that would affect the port count and queue time for each call. Just two agents calling in sick could increase the port count by over 12%. This would affect the price of the system and, if not planned for, would affect the ability of the call center to meet caller requirements. Properly sizing call center resources is integral to designing an effective IPCC Express system.

**Note**

Not all of the IPCC Express system limits are available at the same time. In particular, the number of calls in queue can impact a system limit such as the maximum number of agents in a resource group.

If all of the call sizing information is available, the next step is to apply IPCC Express sizing limits to the call center requirements. For this step, use the IPCC Express Configuration and Ordering Tool, available online at

http://www.cisco.com/en/US/partner/products/sw/custcosw/ps1846/prod_how_to_order.html

Planning Resource Requirements for Call Center Sizing

To assist you with planning resource requirements, this section illustrates how to size an IPCC Express Standard application with 25 agents.

Example of Sizing IPCC Express Standard Application with 25 Agents

This example is not intended to be a comprehensive contact center design example, but it illustrates how changing metrics such as BHCA, AHT, and Service Levels can affect provisioning of agents.

The following information applies to this example of IPCC Express Standard with 25 agents:

Metric	Metric Value
Service level goal	90% of all calls handled within 15 seconds
Average handle time (AHT)	90 seconds: <ul style="list-style-type: none"> • Average talk time = 90 seconds • Wrap-up time = 0 seconds
Busy Hour Call Attempts (BHCA)	800
Grade of service (% blockage) for gateway ports to the PSTN	1% (0.01)
Grade of service (% blockage) for IVR ports	0.1% (1 in 1000, or 0.001)

Checking the IPCC Express Configuration and Ordering Tool indicates that all of these parameters fit within a single-server IPCC Express system. Using the call sizing steps in [Principal Design Considerations for Call Center Sizing, page 5-4](#), we can determine that 25 agents are needed for this system. [Figure 5-3](#) shows the Erlang C calculation for determining the number of agents.

Figure 5-3 Erlang C Calculation to Determine Number of Agents Needed

Agents	Srv Lvl	Queued	Abndon	Usage	Ave Ans	Q Time	Avg Q	Trunks
22	59%	57%	57%	91%	00:26	00:45	6	42
23	75%	42%	42%	87%	00:12	00:30	3	38
24	85%	30%	30%	83%	00:07	00:23	1	37
25	91%	21%	21%	80%	00:04	00:18	1	36
26	95%	14%	15%	77%	00:02	00:15	0	35
27	97%	10%	10%	74%	00:01	00:13	0	35
28	98%	6%	7%	71%	00:01	00:11	0	35
29	99%	4%	5%	69%	00:00	00:10	0	35
30	100%	2%	3%	67%	00:00	00:09	0	35
31	100%	2%	2%	65%	00:00	00:08	0	35

Sizing gateway trunk ports provides the total number of gateway ports you need to provision for your IP Telephony infrastructure. Using Erlang B, the number of gateway trunk ports needed for this example system is 31 (factoring in the queue time from Erlang C and putting it into Erlang B).

For more gateway sizing guidance, refer to the *Cisco IP Telephony Solution Reference Network Design* documentation available online at

<http://www.cisco.com/go/srmd>

Only the IVR port calculation is used for IPCC Express sizing to determine the total number of IVR ports needed for the IPCC Express application. The first part of the IVR port calculation assumes that there is no additional delay time used by a call center application in processing a call. For example, the IPCC Express application allows a script developer to insert a delay of any amount at any point in the application. This delay can affect the queue time estimate shown in [Figure 5-3](#). Therefore, the next steps focus on factoring in these possible application delay times.

Before sizing the total number of IVR ports required for an IPCC Express or IP IVR application, you must determine how many ports are needed for each segment of the call processing flow. Sizing ports for call treatment, queuing, and self-service applications (for example, applications that do not transfer to an available agent) should be calculated separately and then added together.

The total number of IVR ports can be calculated as follows:

Total IVR ports = IPCC Express IVR ports for call treatment (both full-service and P&C) + IPCC Express IVR ports for queuing

The total application processing time can be calculated as:

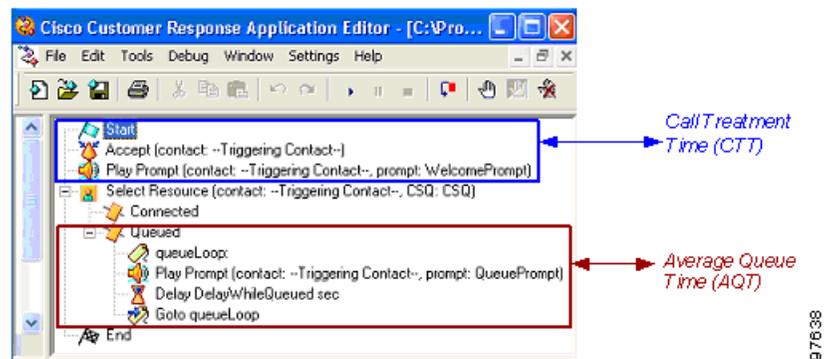
Total application processing time for IPCC Express = Call treatment time (CTT) + average queue time (AQT)

Where:

- Call treatment time (CTT) includes application steps such as prompting, collecting, database dip, and so forth. For IPCC Express, this time can span from the initial call arrival (not including anything during the call on queue) up to the resource selection step.
- Average queue time (AQT) includes the time a call is in the queue. For IPCC Express, this time begins after the resource selection step and lasts until the "connected" event.

As an example of this calculation, we will use the default icd.aef script logic that is available with all the Cisco IPCC Express packages. Figure 5-4 differentiates between the delay times in handling the incoming call.

Figure 5-4 Application Processing Time for IPCC Express



Calculating these various delays helps us to estimate the number of required IVR ports for a particular IPCC Express or IP IVR scripted application.

The following steps detail the procedure for calculating IVR ports for our example IPCC Express application:

Step 1 Calculate the number of IVR ports required to handle IVR call treatment functionality:

- Estimate the average time the call is being processed by the IPCC Express script, from the time the initial call enters the application until the time the call is queued. This value is the call treatment time (CTT). Using the default icd.aef script for our example, this value would be the time the welcome prompt is played. The welcome prompt used by this particular IPCC Express application was estimated at 1.5 seconds.
- Calculate the total number of required IVR ports:
 - Calculate the following interim value to put into the Erlang B calculations:

$$[\text{BHCA} * \text{CTT}] / 3600$$

For our example, this calculation yields $[800 * 1.5] / 3600 = 0.333$.

For BHCA, we are assuming that all the calls come in through the PSTN gateway. We are using the total 800 BHCA for this portion of our calculation because all calls processed by the icd.aef script receive a welcome prompt.

2. Enter this interim value (0.33 for this example) into the Erlang B calculator (available online at <http://www.erlang.com/calculator/erlb/>). For this example, the Erlang B calculator yields a value of 3.8, or 4 IVR ports.

Step 2 Calculate the number of IVR Ports required to handle queuing functionality.

In this step, we take into account the IPCC Express average queue time (AQT), which is the time a call is queued until that call is answered by an available agent. Based on our Erlang C calculations, and as illustrated in [Figure 5-3](#), approximately 21% of all calls entering our IPCC Express application are queued, or $[800 \text{ BHCA} * 0.21] = 168 \text{ BHCA}$ are queued.

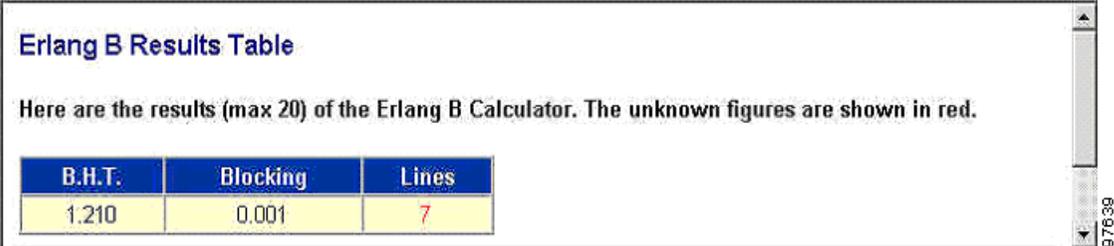
We next add two delays:

- Average queue time (AQT)
- Average time for the call to be answered by an agent
 - a. The average queue time from our previous Erlang C calculation is 18 seconds.
 - b. Estimate the time for the call to be transferred and answered by an available agent. This value varies, based on the time it takes for a given agent to answer the call. For our example, assume that it will take an agent no more than 2 rings to answer a call, which is approximately 8 seconds.
 - c. Add the delays to calculate the total AQT, which for our example is $18 + 8 \text{ seconds} = 26 \text{ seconds}$.
 1. Calculate the following interim value to put into Erlang B calculations:

$$[\text{BHCA} * \text{CTT}] / 3600$$

For our example, this calculation yields $[(0.21) * 800 * 26] / 3600 = 1.21$.
 2. Enter this interim value (1.21 for this example) into the Erlang B calculator, which yields a value of 7 ports for our example. [Figure 5-5](#) shows a snapshot of this result using the Erlang B calculator.

Figure 5-5 Calculation of IVR Ports Needed for Example System with 25 Agents



Erlang B Results Table

Here are the results (max 20) of the Erlang B Calculator. The unknown figures are shown in red.

B.H.T.	Blocking	Lines
1.210	0.001	7

Step 3 Add the values for both the IPCC Express IVR ports for call treatment ([Step 1](#)) and the IPCC Express IVR ports for queuing ([Step 2](#)). For our example, we obtain a total of $4 + 7 = 11$ IVR ports.

These results indicate that the IPCC Express application needs at least 11 IVR ports to handle the maximum amount of calls planned for this call center. (Add the number of ports only if one IVR is used for all IPCC Express applications and call types.)

Note that changes in BHCA, CCT, and service level will affect the overall number of ports and agents required in a call center. Each increase or decrease in call handling time will affect the number of ports much more dramatically than in a smaller call center.



Sizing the IPCC Express Server

With the call sizing guidelines from the preceding chapters, we are able to calculate the number of agents and CTI ports (queuing and P&C IVR ports) required to deploy a contact center solution. What does this mean in terms of sizing the IPCC Express resources? When do we know that we have reached maximum capacity on the IPCC Express system and need to add another server? These are some of the questions addressed in this chapter.

To help the designer estimate overall scalability on the IPCC Express server, Cisco has conducted extensive performance testing, and the section on [Impact of Performance Criteria on the IPCC Express Server](#), page 6-3, summarizes the critical factors and their impact on performance.

Configuration and Ordering Tool

The IPCC Express Configuration and Ordering Tool uses a points system to size the server automatically based on your specific configuration. You are not required to size the server manually using this points system, but [Table 6-3](#) lists the point values for reference only. The Configuration and Ordering Tool for IPCC Express and IP IVR, Release 3.0(3) or 3.1(1) v. 1.6, is available online at

http://www.cisco.com/en/US/partner/products/sw/custcosw/ps1846/prod_how_to_order.html



Note

BHCA rate has an impact on scalability and is not explicitly called out in the IPCC Express Configuration and Ordering Tool; however, the impact of the BHCA is implicitly accounted for in the device quantities in the input section of that Tool.

The Configuration and Ordering Tool enables you to configure and order your system using step-by-step instructions in the following basic order (the exact steps may vary as the tool is enhanced for future releases):

- Step 1** Select the deployment type (for example, standalone or co-resident, upgrade or new order). Also choose the type of hardware server on which you will deploy the software product you are configuring. Each type of hardware server has a specific “total available server points” value associated with it. As you go through the rest of the configuration, each feature and quantity you select will be deducted from the total available server points.

Then choose the specific product that you want to configure. You must select (or check for) correct values for this server configuration for each and every gray cell in the tool (Excel based). If you do not, the results might not be correct.

- Step 2** Select the server, the SmartNet option (if applicable), and the feature(s) for the respective Feature Servers available. Based on your selections and completion of the remaining feature Tabs, the configured feature points will be off-loaded and allocated to the respective Feature Server from the main server. Some examples of Feature Servers include:

Server	Uses
Main Server	ACD, CTI, IVR, VoiceXML, Recording and Monitoring Server (RMS), Historical Reports Database Server (HRDB), ASR, TTS
Recording and Monitoring Feature Server	IPCC Express Call Recording and Monitoring Server (RMS1)
ASR/TTS Feature Server	Automatic Speech Recognition Server (ASR), Text-to-Speech Server (TTS)
Historical Reporting Feature Serve	Historical Reports Database Server (HRDB)

The Configuration and Ordering Tool lists more server options.

- Step 3** Configure IPCC Express (agents, supervisors, and so forth) and CTI ports (prompt-and-collect, full IP IVR ports, and so forth). Enter or check for correct values for the above server configuration you choose for each and every gray cell in the tool. If you do not, the results might not be correct.
- In this step of the Tool, you are configuring for the type of deployment, hardware server, and product. The value shown for the server type currently being configured comes from the values you entered in [Step 1](#).
- Step 4** Configure the Call Monitor and Record features. Enter or check for correct values for the server configuration for each and every gray cell in the tool. If you do not, the results might not be correct.
- The value shown for the server type currently being configured comes from the values you entered in [Step 1](#) and/or [Step 3](#).
- Step 5** Configure the Historical Reporting feature. Enter or check for correct values for this server configuration for each and every gray cell in the tool. If you do not, the results might not be correct.
- The value shown for the server type currently being configured comes from the values you entered in [Step 1](#) and/or [Step 3](#).
- Step 6** Configure IVR ports, ASR, TTS, and VoiceXML. Enter or check for correct values for this server configuration for each and every gray cell in the tool. If you do not, the results might not be correct.
- The value shown for the server type currently being configured comes from the values you entered in [Step 1](#).
- This last step will give you the status of your configuration and order, and will indicate whether it is approved or if it will require Bid Assurance approval.

Use the output of the Configuration and Ordering Tool to determine whether or not your IPCC Express system design is a valid configuration. If not, the options are to reduce or remove the use of features such as simultaneous recording sessions or historical reporting sessions, to reduce the number of agents or IPCC Express related devices, or (if appropriate) to move one or more of the functions to a separate feature server that accommodates the desired configuration.

**Note**

The IPCC Express points system applies only to the IPCC Express server and does not consider Cisco CallManager scalability. Sizing Cisco CallManager servers requires the use of the latest Cisco CallManager capacity sizing tool. Check with your Cisco Systems Engineer (SE) or Partner for the latest Cisco CallManager capacity tool.

Impact of Performance Criteria on the IPCC Express Server

System performance criteria fall into two general categories:

- IPCC Express and IP IVR components — Applications, capabilities, and options that your system requires.
- System usage — The average number of calls placed and received per hour, the average call length, the scripts being executed, grammar used for ASR, and so forth.

Effect of Performance Criteria

Each performance criterion can have an effect on the performance of the Cisco IPCC Express or IP IVR system. In general, the more Cisco IPCC Express or IP IVR components that you install and the heavier the system usage, the higher the demand on the server. However, the performance criteria can also interact in various non-linear ways to affect performance.

List of Performance Criteria

[Table 6-1](#) lists the criteria that can affect the performance of system hardware, and in turn the performance of the Cisco IPCC Express system. Cisco conducted extensive testing to quantify the effect of many of the performance criteria, and a point value was assigned to each of these effects. [Table 6-3](#) lists these point values.

Table 6-1 System Performance Criteria

Criterion	Effect on System
Busy-hour call completion rate	As the call rate increases, more resources are consumed on the Cisco Customer Response Solutions (CRS) server and on the Cisco CallManager server.
Average call duration	Longer average call duration means a lower busy-hour call completion rate, which lowers CPU usage.
Trace enabled	CPU resource consumption: Varies depending on trace level enabled. Cisco CallManager tracing can consume significant additional CPU resources on a co-resident system.
Number of IVR ports	CPU resource consumption: Light.
IVR software redundancy option	No effect.
Number of IP Queue Manager ports	CPU resource consumption: Light.
HTTP traffic	CPU resource consumption: Light.
Number of TTS ports	CPU resource consumption: Moderate.

Table 6-1 System Performance Criteria (continued)

Criterion	Effect on System
ASR or TTS with VoiceXML	CPU resource consumption: <ul style="list-style-type: none"> • Heavy • Varies depending on the grammar used
Number of ASR ports	CPU resource consumption: <ul style="list-style-type: none"> • Heavy • Varies depending on the language and the complexity of the grammar
ASR grammars	CPU resource consumption: Varies depending on the complexity of the grammar.
Languages	CPU resource consumption: <ul style="list-style-type: none"> • CPU usage varies depending on the language. • Memory usage is heavy for each additional language.
On-demand recording session	CPU resource consumption: <ul style="list-style-type: none"> • Heavy for G.711 codec. • Very heavy for G.729 codec. <p>Each minute of recording takes approximately 1 MB of disk space.</p> <p> Note To prevent on-demand recording sessions from consuming CPU resources on the Cisco IPCC Express or IP IVR server, you can set up a dedicated Call Statistics, Recording, and Monitoring Server. With this configuration, on-demand recording sessions will consume resources on the dedicated server but will not consume resources on the Cisco IPCC Express or IP IVR server. (For information about setting up a Call Statistics, Recording, and Monitoring Server, refer to <i>Getting Started with Cisco Customer Response Applications</i>, available online at http://www.cisco.com/univercd/cc/td/doc/product/voice/sw_ap_to/apps_3_1/english/admin_app/index.htm.)</p>
Number of IPCC Express agents (equivalent to an IP Phone agent)	CPU resource consumption: Moderate.
Media termination (agent without a hardware IP Phone)	No effect.
Number of supervisors	CPU resource consumption: Moderate.
ACD	Because an ACD system is a collection of many features, you must analyze the effect of each feature separately.

Table 6-1 System Performance Criteria (continued)

Criterion	Effect on System
Silent monitoring	<p>CPU resource consumption:</p> <ul style="list-style-type: none"> • Heavy for G.711 codec. • Very heavy for G.729 codec. <p> Note To prevent silent monitoring sessions from consuming CPU resources on the Cisco IPCC Express or IP IVR server, you can set up a dedicated Call Statistics, Recording, and Monitoring Server. You can also set up one or more dedicated Call Monitoring Servers. With these servers, silent monitoring sessions will consume resources on the dedicated server but will not consume resources on the Cisco IPCC Express or IP IVR server. (For information about setting up these dedicated servers, refer to <i>Getting Started with Cisco Customer Response Applications</i>, available online at http://www.cisco.com/univercd/cc/td/doc/product/voice/sw_ap_to/apps_3_1/english/admin_app/index.htm.)</p>
Historical Reporting session	<p>CPU resource consumption: Very heavy (increases as the size of the Cisco IPCC Express and IP IVR databases increase).</p> <p> Note If you run historical reporting sessions on the Cisco IPCC Express or IP IVR server, Cisco recommends that you run these sessions during off-peak hours so that the generation of historical reports does not compete for server resources.</p> <p> Note To prevent historical reporting sessions from consuming CPU resources on the Cisco IPCC Express or IP IVR server, you can set up a dedicated Historical Reports Database Server. With this configuration, historical reporting sessions will consume resources on the dedicated server but will not consume resources on the Cisco IPCC Express or IP IVR server. (For information about setting up an Historical Reports Database Server, refer to <i>Getting Started with Cisco Customer Response Applications</i>, available online at http://www.cisco.com/univercd/cc/td/doc/product/voice/sw_ap_to/apps_3_1/english/admin_app/index.htm.)</p>
Size of IPCC Express and IP IVR databases	CPU resource consumption: Increases as database size increases.

Supported Servers

Table 6-2 shows the point value for the maximum acceptable CPU usage for each type of supported server. It also shows the minimum memory each server requires in a deployment scenario, and the number of IP phones that each server supports.

Table 6-2 Point Values and Memory Requirements for Supported Servers

Server Model	Equivalent Model	Maximum Points Supported	Minimum Memory Required
Cisco MCS-7815-1000	IBM xSeries 200	1,000	1 GB ¹
Cisco MCS-7815 I-2.0-CC1	IBM 205-2000	1,000	1 GB ¹
Cisco MCS-7825-800	Compaq DL320	800	1 GB ¹
Cisco MCS-7825-1133	Compaq DL320	900	1 GB ¹
Cisco MCS-7825 H-2.2-CC1	Compaq DL320-2266 G2	900	1 GB
Cisco MCS-7835-1000	Compaq DL380	1,000	1 GB
Cisco MCS-7835 H-2.4-CC1	Compaq DL380-2400 G3 (single CPU)	1,266	1 GB
Cisco MCS-7845 H-2.4-CC1 (dual CPU, using Windows 2000 Advanced Server OS)	Compaq DL380-2400 G3 (dual CPU)	2,600	4 GB
IBM 330-1266		1,000	1 GB ¹
IBM 342-1266		1,266	1 GB
IBM 345-2400		1,266	1 GB

1. You must add 512 MB of memory to this sever to bring its total memory to 1 GB.

Point Values for IPCC Express

The following table shows each performance criterion and its corresponding point value. You *do not* have to use these point values to configure your IPCC Express server manually; rather, they are intended as a guide for planning system capacity. To determine the actual configuration and capacity of your system, use the IPCC Express Configuration and Ordering Tool because it incorporates the latest revisions and values.

Table 6-3 Point Values for Performance Criteria

Performance Variable	Point Value	Notes
IVR Variables		
IP IVR server software	0	
IP IVR port	5	For the maximum number of IVR ports that are supported on a single server, see Server Capacities and Limits, page A-1 .
IVR Software Redundancy Option (per port)	0	<ul style="list-style-type: none"> The number of ports in the backup IVR server does not affect the performance of the primary IVR server. The configuration of the backup IVR server is assumed to be the same as that of the primary IVR server.

Table 6-3 Point Values for Performance Criteria (continued)

Performance Variable	Point Value	Notes
VoiceXML parser (per port)	4	<ul style="list-style-type: none"> Each VoiceXML parser requires an IVR port, so add 5 points for each port that you will use. Because VoiceXML invokes the ASR and TTS functions, add 16 points for each VoiceXML port that will be used. The notes that apply to TTS and ASR variables also apply to the VoiceXML parser variable.
IP Queue Manager software	0	
IP Queue Manager port	5	Equivalent to IVR port.
Text-to-Speech (TTS) Variables		
TTS client and server port, for any language except German	8	<ul style="list-style-type: none"> On an MCS-7825-800, an MCS-7835-1000, or an MCS-7825H-22-CC1, use this configuration only for a single language. If installed, TTS consumes some system resources even if it is not being used. Each TTS port requires an IVR port, so add 5 points for each TTS port that you will use. These point values were determined for short TTS prompts. For longer prompts (text files greater than 5 KB, which equate to audio files greater than 2.5 MB), fewer ports are supported. You should make application-specific measurements before deployment.
TTS client and server port, for multiple languages (per each additional language)	200	<ul style="list-style-type: none"> If installed, TTS consumes some system resources even if it is not being used. In some scenarios, to make more efficient use of server memory, Cisco recommends that you run the TTS server on a separate MCS. Each TTS port requires an IVR port, so add 5 points for each TTS port that you will use. These point values were determined for short TTS prompts. For longer prompts (text files greater than 5 KB, which equate to audio files greater than 2.5 MB), fewer ports are supported. You should make application-specific measurements before deployment. If you move the TTS server to a separate MCS, the 200 points per port for each additional language apply to the TTS server on the separate MCS.

Table 6-3 Point Values for Performance Criteria (continued)

Performance Variable	Point Value	Notes
TTS client-only port	8	<ul style="list-style-type: none"> • If installed, TTS consumes some system resources even if it is not being used. • If a system is using multiple languages, each language consumes an additional 10 MB plus 2 MB per channel or license, whichever is higher. • Each TTS port requires an IVR port, so add 5 points for each TTS port that you will use. • These point values were determined for short TTS prompts. For longer prompts (text files greater than 5 KB, which equate to audio files greater than 2.5 MB), fewer ports are supported. You should make application-specific measurements before deployment.
ASR client port	16	<ul style="list-style-type: none"> • For the maximum number of ASR ports that are supported on a single server, see Server Capacities and Limits, page A-1. • Each ASR port requires an IVR port, so add 5 points for each ASR port that you will use. • If installed, ASR consumes some system resources even if it is not being used. • Point values for an ASR client increase with a complex grammar, so Cisco recommends that you test a prototype of the desired speech recognition application to determine the point values for your specific scenario.
ASR client and server port, for each additional language	180	<ul style="list-style-type: none"> • An MCS-7815-1000 (IBM xSeries 200) or an MCS-7815I-2.0-CC1 (IBM xSeries 205-2000) supports a maximum of 24 ASR client and server ports. • For the maximum number of ASR ports that are supported on other servers, see Server Capacities and Limits, page A-1. • Each ASR port requires an IVR port, so add 5 points for each ASR port that you will use. • If installed, ASR consumes some system resources even if it is not being used. • Cisco recommends that you use a separate ASR server for a scenario with more than one language. • If you move the ASR server to a separate MCS, the 180 points per port for each additional language apply to the ASR server on the separate MCS.

Table 6-3 Point Values for Performance Criteria (continued)

Performance Variable	Point Value	Notes
Agent: <ul style="list-style-type: none"> • IP Phone Agent • Cisco Standard Agent Desktop • Cisco Standard Supervisor Desktop • Cisco Enhanced Agent Desktop • Cisco Enhanced Supervisor Desktop 	10	<ul style="list-style-type: none"> • For the maximum number of agents and supervisors that are supported on a single server, see Server Capacities and Limits, page A-1. • A maximum of 40 agents are supported on an MCS-7825-800 or on an MCS-7825 H-2.2-CC1. • If a supervisor will perform silent monitoring or on-demand recording, also add the points for the appropriate feature.
Cisco Standard or Enhanced Historical Reporting: <ul style="list-style-type: none"> • One session • Database size of 100,000 records 	200	<p>Add 20 points per session for each additional record, up to 500,000 records. Do not continue to add points for databases larger than 500,000 records.</p> <p>If you run Historical Reporting sessions on the Cisco IPCC Express or IP IVR Server:</p> <ul style="list-style-type: none"> • Only 1 Historical Reporting session can run at a time on an MCS-7825-800. • No more than 2 Historical Reporting sessions can run simultaneously on an MCS-7835-1000, an MCS-7825-1133, or an MCS-7825 H-2.2-CC1. • No more than 3 Historical Reporting sessions can run simultaneously on an MCS-7835-1266, an MCS-7835 H-2.4-CC1, or an MCS-7835 I-2.4-CC1. <p>If you run Historical Reporting sessions on an Historical Reports Database Server:</p> <ul style="list-style-type: none"> • No more than 6 Historical Reporting sessions can run simultaneously when using Microsoft SQL Desktop Edition (MSDE). • No more than 13 Historical Reporting sessions can run simultaneously when using Microsoft SQL Server 2000. (Microsoft SQL Server 2000 is supported in Cisco IPCC Express and IP IVR Release 3.1(2) and later.) <p>If you run Historical Reporting sessions on a Call Statistics, Recording, and Monitoring Server or on a Call Monitoring Server:</p> <ul style="list-style-type: none"> • No more than 3 Historical Reporting sessions can run simultaneously when using Microsoft SQL Desktop Edition (MSDE). • No more than 7 Historical Reporting sessions can run simultaneously when using Microsoft SQL Server 2000. (Microsoft SQL Server 2000 is supported in Cisco IPCC Express and IP IVR Release 3.1(2) and later.)

Table 6-3 Point Values for Performance Criteria (continued)

Performance Variable	Point Value	Notes
IPCC Express Enhanced server	0	
Cisco CTI option	0	
Cisco on-demand recording, using G.711 codec (per session)	20	<ul style="list-style-type: none"> For the maximum number of call recording sessions that are supported under any deployment scenario, see Server Capacities and Limits, page A-1. Each minute of recording takes approximately 1 MB of disk space, so allow enough disk space for the amount of recording that will be done. Agents and supervisors can initiate recording.
Cisco on-demand recording, using G.729 codec (per session)	25	<ul style="list-style-type: none"> For the maximum number of call recording sessions that are supported under any deployment scenario, see Server Capacities and Limits, page A-1. Each minute of recording takes approximately 1 MB of disk space, so allow enough disk space for the amount of recording that will be done. Agents and supervisors can initiate recording.
Barge-in	0	
Local silent monitoring, using G.711 codec (per session)	20	<ul style="list-style-type: none"> Silent monitoring is not a feature that is sold separately, so add points for this feature if it will be used. Only supervisors can initiate silent monitoring.
Local silent monitoring, using G.729 codec (per session)	25	<ul style="list-style-type: none"> Silent monitoring is not a feature that is sold separately, so add points for this feature if it will be used. Only supervisors can initiate silent monitoring.
Remote silent monitoring, using G.711 codec (per session)	35	<ul style="list-style-type: none"> Remote silent monitoring is available in Cisco IPCC Express and IP IVR Release 3.1 and higher. Remote silent monitoring is available only with G.711 codecs; G.729 codecs are not supported. Only properly configured supervisors can access remote silent monitoring.
Call intercept	0	

Supported Co-Resident Scenarios

In a co-resident system, Cisco IPCC Express and/or IP IVR run on the same server with Cisco CallManager. A co-resident system is typically used in light load situations. The server used for a co-resident system must be an MCS 7835-1266 or a server with a faster processor. Although the scenarios listed in this section are all supported, the following factors can affect the performance of your installation:

- Cisco CallManager features that you have implemented

If several Cisco CallManager features are running simultaneously, there might not be enough CPU resources available for Cisco IPCC Express or IP IVR features. For example, music on hold (MOH) consumes significant additional CPU resources.

- Related applications and configurations

For example, certain voice gateways may consume more or fewer resources than other voice gateways.

Other applications, including Cisco Personal Assistant (PA), Cisco Unity, Cisco WebAttendant, and Telephony Call Dispatcher (used by the Attendant Console application), are not supported on the same server as Cisco CallManager and the IPCC Express or IP IVR system.

The following co-resident deployment scenarios are supported only on an MCS-7835-1266 or equivalent server. These scenarios have not been tested on any server other than an MCS-7835-1266 or equivalent, and therefore are not supported on any other servers.

- Scenario A: IPCC Express with 10 agents, 2 supervisors, and 15 IPCC Express or IP IVR ports (5 IVR ports).
 - No more than one historical reporting session can run at a time, and it must be run during off-peak hours.
 - No more than one on-demand recording or silent monitoring session can run at a time.
- Scenario B: 15 IVR ports.
- Scenario C: 4 IVR ports with single-language ASR and/or TTS.
- Scenario D: 4 IVR ports with VoiceXML.

**Note**

A system with a complicated ASR grammar might require deployment on multiple servers.

The following co-resident deployment scenario is supported on an MCS-7825-800 or higher:

- IPCC Express with 10 agents, no more than 50 IP Phones, and no more than 15 external phone lines.

IPCC Express Silent Monitoring and Recording Considerations

The silent monitoring and recording features of the IPCC Express agent desktop are implemented with a Voice over IP (VoIP) Monitor Server in IPCC Express. The following scalability limits apply to the VoIP Monitor Server and are based on Cisco Agent Desktop Release 4.5 server capacity data:

- You can have a maximum of four instances of the VoIP Monitor Server per logical contact center. You can use multiple VoIP Monitor Servers in a single Cisco CallManager cluster.
- There are no hard limits in the VoIP Monitor Server on the number of calls that can be monitored by the server, nor on the number of supervisors; its capacity is limited only by the hardware.

- The VoIP Monitor Server must be on the same VLAN as the agent phones, and it requires an available Switched Port Analyzer (SPAN) port. The VoIP Monitor Server and agent phones cannot be separated by a WAN, but they can be on different Cisco Catalyst switches if those switches support SPAN. Otherwise, voice monitoring and recording will not work.
- The VoIP Monitor Server can support up to 256 simultaneous calls and up to 32 simultaneous monitoring and recording sessions. A single recording application for the desktop client can have up to 16 simultaneous recordings.
- The VoIP Monitor Server can monitor IP phones connected to a Cisco CallManager. It can also monitor: (a) the agent desktop softphone if Cisco Media Termination Service (MTS) is installed or (b) the Cisco IP SoftPhone when used for an agent's IPCC Express extension.
- The Ethernet port for the VoIP Monitor Server must be manually configured to monitor all ports connected to agent IP phones as source ports. If the voice packets going to and from an agent's IP phone are not sent to the VoIP Monitor Server's port for any reason, that conversation will not be available to the supervisor. Any attempts to run silent monitoring will return an error message, and attempts to record the call will not succeed (even if there is no error message).
- The SPAN or port monitoring requirement can create network design issues under the following conditions:
 - The VoIP Monitor Server resides on a different VLAN than the agent phones (for example, in a server farm). Silent monitoring and recording works only when the VoIP Monitor port is a member of the same VLAN as the port being monitored.
 - The voice VLAN is trunked back to a distribution switch. A monitor port cannot be a multi-VLAN port or a trunk port. If the phones reside on a remote switch (that is, not on the same switch as the VoIP Monitor) and the voice traffic runs over a trunk, it is necessary to use Remote Switched Port Analyzer (RSPAN). RSPAN allows phones to reside on a downstream switch, but a Cisco Catalyst 6000 or 4000 is required at the access layer to take advantage of this topology. RSPAN is not supported on a Cisco 2900 or 3500 switch. Furthermore, the VoIP Monitor and agent phones must still reside in the same VLAN.

**Note**

Silent Monitoring and Recording was designed to work in a deployment where supervisors and agents are located at a single site or at remote sites. A remote supervisor can silently monitor and record conversations between callers and agents as long as the agents and the VoIP Monitor Server are on the same VLAN segment.

IPCC Express Historical Reporting Considerations

Requests for historical reports are generated on a desktop client where historical reporting is installed. However, historical reports are generated by querying the IPCC Express or IP IVR database running on the IPCC Express server. This poses some additional overhead on CPU utilization, depending upon the size of the dataset requested.

Requests for large historical datasets can affect network performance, depending on bandwidth constraints, and such large requests can affect the ability of agents to monitor their phones during peak work hours. This effect is particularly noticeable where the IPCC Express traffic is marked with a default Type of Service (ToS) setting (for example, TOS0) and where QoS is not properly provisioned in the network. See the section on [Multi-Site WAN Deployment with Centralized Call Processing, page 2-2](#), for more details on the network impact of running historical reporting across a WAN connection.

If you run Historical Reporting sessions on the Cisco IPCC Express or IP IVR server, the following considerations apply:

- Only one Historical Reporting session can run at a time on an MCS-7825-800.
- No more than two Historical Reporting sessions can run simultaneously on an MCS-7835-1000, an MCS-7825-1133, or an MCS-7825H-2.2-CC1.
- No more than three Historical Reporting sessions can run simultaneously on an MCS-7835-1266, an MCS-7835H-2.4-CC1, or an MCS-7835I-2.4-CC1.

If you run Historical Reporting sessions on a Historical Reports Database server, the following considerations apply:

- No more than six Historical Reporting sessions can run simultaneously when using MSDE.
- No more than 13 Historical Reporting sessions can run simultaneously when using Microsoft SQL Server 2000. (Microsoft SQL Server 2000 is supported in Cisco IPCC Express and IP IVR Release 3.1(2) and later.)

If you run Historical Reporting sessions on a Call Statistics, Recording, and Monitoring server or on a Call Monitoring server, the following considerations apply:

- No more than three Historical Reporting sessions can run simultaneously when using MSDE.
- No more than seven Historical Reporting sessions can run simultaneously when using Microsoft SQL Server 2000. (Microsoft SQL Server 2000 is supported in Cisco IPCC Express and IP IVR Release 3.1(2) and later.)



Sizing the Cisco CallManager Servers

This chapter documents general best practices and scalability considerations for sizing the Cisco CallManager servers used with your IPCC Express deployment. Within the context of this document, scalability refers to server capacity of both the IPCC Express server and the Cisco CallManager server handling CTI messages and call processing for IPCC Express.

Before applying the guidelines presented in this chapter, you should perform the following steps:

- Determine customer call center application requirements.
- Calculate call sizing estimates.
- Determine the types of call center resources used in IPCC Express.
- Also determine the equivalent call resource in Cisco CallManager.
- Select a deployment model.
- Select a single or multi-server IPCC Express deployment scenario.

To proceed with sizing the Cisco CallManager servers, you will also need the following information:

- Number of required IPCC Express agents
- Number of required IVR or IPCC Express CTI ports
- Number of PSTN lines
- Estimated Busy Hour Call Attempts (BHCA) rate for all agents

Impact of IPCC Express on Cisco CallManager Scalability

The Configuration and Ordering Tool (available online at http://www.cisco.com/en/US/partner/products/sw/custcosw/ps1846/prod_how_to_order.html) uses a point-weighting system for sizing the IPCC Express server. At this time, the Configuration and Ordering Tool does not include server sizing information for co-located Cisco CallManager and IPCC Express configurations.

The IPCC Express point system can help determine system capacity for the IPCC Express server. However, the IPCC Express server adds a second, indirect impact on the Cisco CallManager and CTI Manager servers through the JTAPI subsystem of IPCC Express. This impact can be attributed to the following interactions:

- Call processing requests between the IPCC Express and Cisco CallManager servers, such as transferring calls to agents or to an extension, or placing a call on hold while in queue.
- Third-party monitoring of agents.

- Call processing requests between an individual desktop agent and Cisco CallManager. These requests (for example, an agent transferring a call to another extension) take the form of CTI messages directly to Cisco CallManager, originating from the desktop agent software.
- Transcoding resources if G.729 is used for RTP streaming to agents.

Each device that registers with Cisco CallManager has a weight measured in terms of device units. The weight depends on:

- Device type
- Device utilization, or Busy Hour Call Attempts (BHCA)

Therefore, in addition to using the point system for IPCC Express, we have to determine scaling capacity for this indirect impact on the Cisco CallManager that serves as the primary CTI Manager.

For proper sizing of the Cisco CallManager and CTI Manager servers, you must use the latest Cisco CallManager sizing tools, which are available through your Cisco Systems Engineer (SE) or Partner.

Impact of IPCC Express on the Cisco CallManager Performance

Cisco CallManager system performance is influenced by many factors such as the type and quantity of devices registered (CTI ports, gateway ports, agent phones, route points, CTI Manager, and so forth), the load processed by these devices (calls per second), various application call flows (IVR self-service, call treatment, and routing to agents), and special Cisco CallManager configurations and services (music on hold, tracing levels, and so forth). This section describes the impact of some of these factors on the performance capacity (CPU and memory consumption) of Cisco CallManager.

Effect of Performance Criteria

[Table 7-1](#) summarizes the results of testing conducted on a Cisco CallManager server (Cisco MCS-7835), with the IPCC Express application running on a separate server. Each performance factor can have an effect on the performance of Cisco CallManager, and some of the results will vary in a non-linear fashion based on load, call flow complexity, and interactions with other applications running on the same Cisco CallManager cluster.

The testing was conducted on a Cisco CallManager cluster with two subscriber servers (MCS-7835, 1.266 MHz, 1 GB) and a separate publisher. A series of tests were run with various BHCA loads. The first set of tests established a baseline, where all devices were registered on one Cisco CallManager subscriber server and no devices on the second subscriber. Another set of tests was conducted by moving key devices to the second subscriber node by themselves and in combinations to measure their individual performance impact on Cisco CallManager. The key devices were IPCC Express agents, gateway ports, CTI ports and CTI rout points. The last set of tests included other Cisco CallManager services such as music on hold and various levels of tracing (full, default, and no tracing). There were two applications profiled (with call flows): Self-service IVR applications (no IPCC Express agents involved and no transfer to other devices) and IPCC Express agent applications, including the use of IVR ports for simple prompt-and-collect (P&C) and queuing before transferring to an agent.

Based on the information in [Table 7-1](#), it is important to balance all resources equally as much as possible if you are using more than one primary Cisco CallManager server. This balancing of resources will prevent overloading one server at the expense of the other.

Table 7-1 Effect of IPCC Express and IP IVR Applications on Cisco CallManager System Performance

Performance Factor	Effect on System
Busy-hour call completion rate	<ul style="list-style-type: none"> As the call rate increases, more CPU resources are consumed on the Cisco CallManager server. Memory consumption (committed bytes in use) also increases, but at a much slower rate, and it remains well below the 1 GB available on each Cisco CallManager server. (Testing used the MCS-7835 server with 1.266 MHz and 1 GB.) CPU consumption also varies by type of call flow. For simple IVR self-service applications, the CPU consumption is moderate, but CPU consumption for IPCC Express call flows is much higher. (See listings below for details.)
Average call duration	<ul style="list-style-type: none"> Longer average call duration means a lower busy-hour call completion rate, which lowers CPU usage.
IVR ports for self-service applications (no transfer to agents or other devices)	<ul style="list-style-type: none"> CPU resource consumption: Moderate. The portion of the CPU consumed by the CTI ports (IVR self-service) is about 30% of the total CPU consumption (this includes the CRSJtapi application monitoring the CTI ports).
IVR ports used with IPCC Express for call treatment (prompt-and-collect or queuing) and initiating a transfer to agents or other devices	<ul style="list-style-type: none"> CPU resource consumption: Heavy. The portion of the CPU consumed by the CTI ports (call treatment, P&C, and queuing) is 30% of the total CPU consumption (this includes the CRSJtapi application monitoring the CTI ports).
Gateway ports	<ul style="list-style-type: none"> CPU resource consumption: Moderate for IVR self-service application and heavy for IPCC Express application (including IVR P&C) due to the additional transfer of calls to agents. The portion of the CPU consumed by the gateway ports is about 56% of the total CPU consumption. This result is the same for both call scenarios (IVR self-service and IPCC Express).
IPCC Express agent phones	<ul style="list-style-type: none"> CPU resource consumption: Light. The portion of the CPU consumed by the IPCC Express agent phones is about 11% of the total CPU consumption (this includes the RMJtapi application monitoring the phones).
CTI route points	<ul style="list-style-type: none"> CPU resource consumption: Light. The portion of the CPU consumed by the CTI route points is about 3% of the total CPU consumption. This result is mainly because the route point is only redirecting calls and not terminating media.
Music on hold (MoH), when used as the source for CTI ports instead of playing .wav files residing on CRS	<ul style="list-style-type: none"> CPU resource consumption: Light. MoH adds about 5.5% to the total CPU consumption on the Cisco CallManager server at a load of 2.2 calls per second (cps). This result can vary based on number of streams and call load.

Table 7-1 Effect of IPCC Express and IP IVR Applications on Cisco CallManager System Performance (continued)

Performance Factor	Effect on System
Trace enabled	<ul style="list-style-type: none"> • Cisco CallManager CPU resource consumption: Varies depending on trace level enabled. Changing the trace level from Default to Full on Cisco CallManager can increase CPU consumption by more than 20% at high call loads. Changing the tracing level from Default to No tracing can decrease CPU consumption by more than 30% at high loads. These percentages are not fixed and will vary in a non-linear fashion based on load and call flow complexity. • Cisco CallManager tracing can consume significant additional CPU resources on a co-resident system.
Moving gateway (MGCP) resources to a second Cisco CallManager server in the cluster and keeping all other resources (CTI ports, agent phones, route points) on the first Cisco CallManager server in the same cluster.	<ul style="list-style-type: none"> • When running the IVR self-service application only, total CPU consumption on both Cisco CallManager servers increases by an additional 20% compared to having all resources on one Cisco CallManager server. • Similarly, when running the IPCC Express application only (including P&C), total CPU consumption in both Cisco CallManager servers increases by 20%. • When both applications are running concurrently, total CPU consumption in both Cisco CallManager servers adds up to the same CPU consumption as having all resources on one Cisco CallManager server.
Moving IPCC Express agent phones, CTI ports, and route points individually to a second Cisco CallManager server while keeping other resources on the first server	<ul style="list-style-type: none"> • When both applications are running concurrently, there is no noticeable increase in total CPU consumption on both Cisco CallManager servers compared to having all resources in one server.

Additional Performance Considerations

The performance factors described in this chapter take into account the effects of IPCC Express resources on Cisco CallManager scalability limitations. Also, the caveats discussed above (specifically, how an increase in call activity impacts resource handling) should be closely reviewed in provisioning agent resources on Cisco CallManager. For example, testing has shown that incoming calls to a route point that does not have a CTI port available will result in the calls being queued at the route point. When this occurs, the caller will hear silence until the call is redirected from the route point to an available CTI port. While in most cases the silence does not persist for long, this example highlights the need to properly provision IPCC Express resources on Cisco CallManager.

IPCC Express Point Values Compared to Cisco CallManager Device Weights

Currently, the IPCC Express point values used to size hardware servers differ from the Cisco CallManager device weights reported in the *Cisco IP Telephony Solution Reference Network Design* documentation (available online at <http://www.cisco.com/go/srnd>). Table 7-2 compares the point values for IPCC Express resources to their device weight equivalents.

Table 7-2 IPCC Express Point Values and Corresponding Cisco CallManager Device Weights

IPCC Express Device (and corresponding Cisco CallManager device)	IPCC Express Point Weight	Cisco CallManager Equivalent Device Weight ¹	Comments
IPCC Express or IP IVR port (CTI port)	5	2 * (BHCA factor)	BHCA factor = 1 for 0 to 6 BHCA, and increases by 1 for every 6 additional BHCA.
JTAPI trigger (CTI route point)	None	2 * (BHCA factor)	IPCC Express does not account for the number of route points in its server. The estimate rolls in the cost of a route point for individual IPCC Express or IP IVR ports.
IPCC Express agent (Third-party IP phone)	5	3 * (BHCA factor)	
IPCC Express supervisor (Third-party IP phone)	5	3 * (BHCA factor)	The BHCA value for a supervisor is similar to a regular IP phone because supervisors normally do not participate in handling incoming contact center calls.

1. The BHCA factors for these devices might not be the same. For example, the supervisor's BHCA value is less than an agent's BHCA value.

Table 7-2 contains only a subset of the call processing devices for IPCC Express device weight values. The devices shown here are limited to the scope of the IPCC Express sizing. In calculating the total device weight, the system architect might have to include other configured devices dependant on Cisco CallManager, such as gateways and IP phones. For a comprehensive list of all the devices and their weight values, refer to the *Cisco IP Telephony Solution Reference Network Design* documentation (available online at <http://www.cisco.com/go/srnd>).

One primary difference between the IPCC Express and Cisco CallManager sizing approaches is that the Cisco CallManager approach requires a BHCA value in order to calculate the device weight. In contrast, the IPCC Express point system considers the BHCA per agent to be medium-to-high by contact center standards, which produces a conservative slant on the server impact to avoid situations where the server is too heavily loaded to perform satisfactorily. The impact of BHCA on call sizing, described in the section on [Planning Resource Requirements for Call Center Sizing, page 5-5](#), emphasizes the importance of using proper call sizing guidelines to calculate IPCC Express server capacity.

Sizing the Cisco CallManager Server Using Device Weights

This section presents an example using manual calculations to determine the Cisco CallManager server sizing requirements. This example is for illustration purposes only. In practice, you would use the latest Cisco CallManager sizing tools to size and select the appropriate Cisco CallManager servers for your system. Check with your Cisco Systems Engineer (SE) or Partner for the latest IPCC Express and Cisco CallManager capacity sizing tools.

As a very simple example of the Cisco CallManager server sizing process, consider the 25-agent IPCC Express example covered previously. For this example, the Cisco CallManager device weight calculations require the following metrics (at a minimum):

- 25 agents
- 800 BHCA coming directly from the PSTN

- 4 CTI ports for call treatment
- 7 CTI ports for queuing 21% of all calls entering the IPCC Express script

Using the IPCC Express sizing process illustrated in [Table 7-3](#), we can determine the device weights for the IPCC Express capacity of this example system.

Table 7-3 Example of Sizing a 25-Agent IPCC Express System

IPCC Express Device	Equivalent Cisco CallManager CTI Device	CTI Device Quantity	Average BHCA per Device	Cisco CallManager Device Weight Value	Comments
Agents	Third-party IP phones	25	$800 / 25 = 32$	$(25 \text{ agents}) * (\text{base device weight} = 2) * [\text{BHCA Factor} = 32/6 = 6] = 300$	This example assumes that agents do not have media termination.
IPCC Express (IVR ports)	CTI port	4	$800 / 4 = 200$	$(4 \text{ ports}) * (\text{base device weight} = 2) * [\text{BHCA Factor} = 200/6 = 34] * (\text{Call Handling Multiplier for transfer} = 2) = 544$	<ul style="list-style-type: none"> • 800 BHCA was used as the rate because all calls entering through the route point will receive some call treatment. • A transfer call handling multiplier of 2 was added because we assume every completed or queued call will be transferred to an agent. • Abandoned calls in queue are not considered in this calculation.
IPCC Express (Queue ports)	CTI port	7	$(21\% \text{ of } 800 \text{ BHCA} = 168) / 7 = 24$	$(7 \text{ ports}) * (\text{base device weight} = 2) * [\text{BHCA Factor} = 24/6 = 4] * (\text{Call Handling Multiplier for transfer} = 2) = 112$	21% of the total BHCA was used as the rate because Erlang C calculations showed that 21% of all incoming calls will be queued.
JTAPI trigger (one IPCC Express script)	Route point	1	800	$(1 \text{ route point}) * (\text{base device weight} = 2) * [\text{BHCA Factor} = 800/6 = 134] = 268$	The route point BHCA accounts for all 800 because it redirects all incoming calls to available CTI ports (that is, IPCC Express sessions).
Cisco CallManager Totals		$25 + 4 + 7 + 1 = 37$		$300 + 544 + 112 + 268 = 1224$	

The results in this example show that our IPCC Express application requires the following:

- 37 CTI devices configured on Cisco CallManager
- A total of 1224 Cisco CallManager device weight units

The 1224 device weight units can fit on either a Cisco MCS-7825-x or MCS-7835-x server platform running Cisco CallManager. These totals are specific to what the IPCC Express requires from Cisco CallManager in order to support the impact due to the contact center. These values do not account for other supporting Cisco CallManager devices (such as gateways, transcoding resources, and so forth), all of which must be included in sizing an end-to-end IP Telephony solution.

Regardless of the device weight capacity of the Cisco CallManager server, you must also observe the Cisco CallManager CTI scalability limits, which are as follows:

- 800 CTI devices per Cisco CallManager standard server (2500 CTI devices per MCS-7845 or equivalent server)
- 3200 CTI devices per Cisco CallManager cluster with standard servers (10,000 CTI devices per cluster with MCS-7845 or equivalent servers)

where a CTI device is a CTI route point, a CTI port, or a third-party controlled hardware IP phone or a softphone.

Therefore, the purpose of calculating total CTI devices (37 in our example) is to ensure that we do not exceed the maximum number of CTI devices per Cisco CallManager server or cluster. To Cisco CallManager, these CTI devices could be a combination of IPCC Express and IP IVR ports, JTAPI triggers, and desktop agents and supervisors. A best practice is to balance devices and agents (an agent includes the weight of an IP phone plus one line) equally across all servers in your Cisco CallManager cluster.

For more information on device weight calculations, hardware platform server weight capacities, and device limits, refer to the *Cisco IP Telephony Solution Reference Network Design* documentation, available online at

<http://www.cisco.com/go/srnd>.

**Note**

You must calculate the Cisco CallManager server capacity requirements by using the latest Cisco CallManager sizing tools available. Check with your Cisco Systems Engineer (SE) or Partner for the latest IPCC Express and Cisco CallManager capacity sizing tools.



Bandwidth, Security, and QoS Considerations

This chapter presents some design considerations for provisioning network bandwidth, providing security and access to corporate data stores, and ensuring Quality of Service (QoS) for IPCC Express applications.

Estimating Bandwidth Consumption

Bandwidth plays a large role in deployments involving:

- The centralized call processing model (IPCC Express at either the central site or remote sites)
- Any call deployment model that uses call admission control or a gatekeeper

Remote Agent Traffic Profile

IPCC Express signaling represents only a very small portion of control traffic (Cisco CallManager CTI and ICD subsystems) in the network. For information on TCP ports and Differentiated Services Code Point (DSCP) marking for IPCC Express ICD and CTI traffic, see the sections on [Serviceability and Security, page 8-2](#), and [QoS and Call Admission Control, page 8-4](#).

Bandwidth estimation becomes an issue when voice is included in the calculation. Because WAN links are usually the lowest-speed circuits in an IP Telephony network, particular attention must be given to reducing packet loss, delay, and jitter where voice traffic is sent across these links. G.729 is the preferred codec for use over the WAN because the G.729 method for sampling audio introduces the least latency (only 30 msec) in addition to any other delays caused by the network.

Where voice is included in bandwidth, system architects should consider the following factors:

- Total delay budget for latency (taking into account WAN latency, serialization delays for any local area network traversed, and any forwarding latency present in the network devices). The generally agreed-upon limit for total (one-way) latency for applications in a network is 150 msec.
- Impact of delays inherent in the applications themselves. 25 seconds is the initial IPCC Express agent login setup time with no WAN delay. The overall time to log in agents and base delay adds approximately 30 sec of delay per 70 msec of WAN delay.
- Impact of routing protocols. For example, Enhanced Interior Gateway Routing Protocol (EIGRP) uses quick convergence times and conservative use of bandwidth. EIGRP convergence also has a negligible impact on call processing and IPCC Express agent logins.

Use [Table 8-1](#) to estimate the number of IPCC Express agents that can be maintained across the WAN (with IP Telephony QoS enabled). These numbers are derived from testing where an entire call session to IPCC Express agents, including G.729 RTP streams, is sent across the WAN. Approximately 30% of bandwidth is provisioned for voice. Voice drops are more of an issue when you are running RTP in

conjunction with Cisco Agent Desktop and other background traffic across the WAN. These voice drops might occur with a specific number of agents at a certain link speed, and those possible scenarios are denoted by the entry N/R (*not recommended*) in [Table 8-1](#).

Table 8-1 Number of Remote Agents Supported by IPCC Express Across a WAN Link

Frame Relay	128 KB	256 KB	512 KB	768 KB	T1
G.729	3	7	15	25	38
G.711	N/R	N/R	N/R	N/R	14

In remote agent deployments, QoS mechanisms should be used to optimize WAN bandwidth utilization. Advanced queuing and scheduling techniques should be used in distribution and core areas as well. For information on QoS traffic classification, see [QoS and Call Admission Control, page 8-4](#). For provisioning guidelines for centralized call processing deployments, refer to the *Cisco IP Telephony Solution Reference Network Design* documentation, available online at

<http://www.cisco.com/go/srmd>.

Serviceability and Security

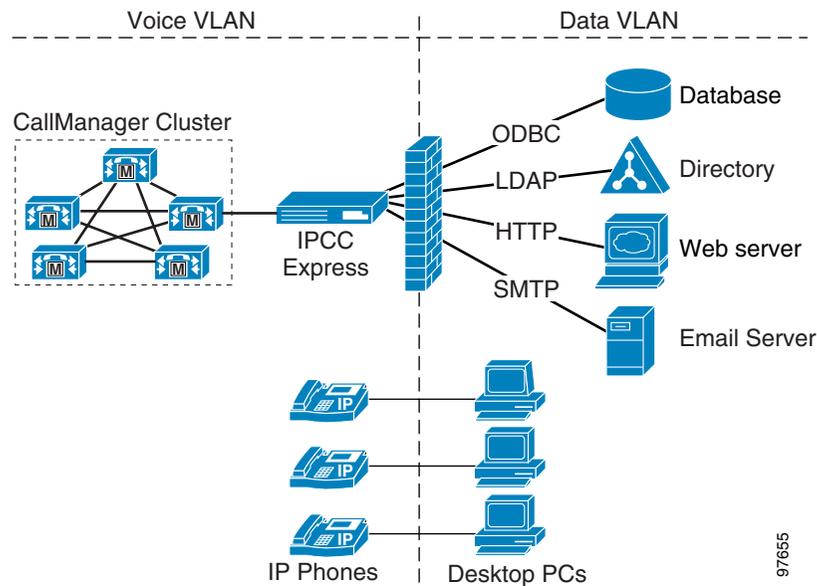
Security can be implemented on many levels. Applications security is clearly dependent upon security implemented at the infrastructure level. For more details on security at the network infrastructure level, refer to security design considerations in the *Cisco IP Telephony Solution Reference Network Design* documentation, available online at

<http://www.cisco.com/go/srmd>.

Corporate Data Access

Aside from call routing, IPCC Express or IP IVR scripts often process enterprise data from existing corporate data stores such as a database or a corporate directory server for functions such as account authorization and order status. Often, these data stores already exist and share data with other enterprise applications. [Figure 8-1](#) shows an example of a network where voice and data components reside in separate VLANs and are separated by a firewall.

Figure 8-1 IPCC Express Accessing Data Stores



IPCC Express can communicate with these external sources through its subsystems, provided Network Address Translation (NAT) is not used. Table 8-2 and Table 8-3 list the various IPCC Express subsystems, the interfaces used for this communication, and the common ports associated with these interfaces.

Table 8-2 Enabled Ports on the IPCC Express Server

Common Functionality	Port	Comments
Telnet	TCP 23	On by default
HTTP	TCP 80	Required for system maintenance
DCX500	TCP 102	DCX500 - DC Directory
SVCHOST	TCP 135	Windows Service Loader
NETBIOS-SSN	TCP 139	NETBIOS Session Service
INETINFO	TCP 443	IIS Process
Microsoft-DS	TCP 445	Microsoft CIFS
WFEEngineService.exe	TCP 789	WFEEngineService Process
MSTask.exe	TCP 1039	Windows Task Scheduler
sqlservr.exe	TCP 1042	SQL Server Process
WFEEngineService.exe	TCP 1099	WFEEngineService Process
MS-WBWT-SERVER	TCP 3389	Terminal Server

Table 8-3 Application Features Supported by IPCC Express Subsystems

Common Functionality	IPCC Express Subsystem	Interface / Protocol	Port	Comments
Call handling	JTAPI	CTIQBE	TCP 2748	
Call queuing	JTAPI	CTIQBE	TCP 2748	
	ICD	None		Queuing functions are processed internal to IPCC Express.
IP phone agent login	HTTP	HTTP	TCP 8080	The Cisco Agent Desktop agent login via the phone display is an IP phone service linked to an HTTP trigger on IPCC Express.
Prompt recording and playing	JTAPI	CTIQBE	TCP 2748	
	Media	Media	UDP	Media resources require CTI ports for streaming connections.
Database query for account verification or order status	Database (JDBC)	JDBC / SQL	TCP 1433	
Enterprise data to be sent to Cisco Agent Desktop	Enterprise data	CORBA	TCP port ranges: 59000, 59002-59004, 59010-59011, 59020-59021 ¹	Used by Get/Set Enterprise Server Data steps.
Agent login and state control	ICD	IPCC Express CTI (subset of GED-188)	TCP 42027	Port number is configurable.
Web-enabled processing	HTTP	HTTP	TCP 8080	TCP 8080 is the default setting for the Apache Tomcat Servlet Engine, but it can be modified.
Email notification	Email	SMTP	TCP 25	
Custom Java classes		RMI	TCP 1099	TCP 1099 is the default port for Java Remote Method Invocation (RMI) calls.
IPCC Express real-time reports		RMI	TCP 1099	

1. For more information, refer to the Cisco Agent Desktop and Supervisor Desktop documentation available online at http://www.cisco.com/univercd/cc/td/doc/product/voice/sw_ap_to/apps_3_0/english/.

QoS and Call Admission Control

Quality of Service (QoS) becomes an issue when more voice and application-related traffic is added to an already growing amount of data traffic on your network. Accordingly, IPCC Express and time-sensitive traffic such as voice need higher QoS guarantees than less time-sensitive traffic such as file transfers or emails (particularly if you are using a converged network).

QoS should be used to assign different qualities to data streams to preserve IPCC Express mission-critical and voice traffic. The following are some examples of available QoS mechanisms:

- Packet classification and usage policies applied at the edge of the network, such as Policy Based Routing (PBR) and Committed Access Rate (CAR).
- End-to-end queuing mechanisms, such as Low Latency Queuing (LLQ). Because voice is susceptible to increased latency and jitter on low-speed links, Link Fragmentation and Interleaving (LFI) can also be used to reduce delay and jitter by subdividing large datagrams and interleaving low-delay traffic with the resulting smaller packets.
- Scheduling mechanisms such as Traffic Shaping to optimize bandwidth utilization on output links.

Classifying IPCC Express and Application-Related Traffic

Table 8-4 and the following section list TCP ports and DSCP markings for use in prioritizing IPCC Express and Cisco CallManager mission-critical CTI traffic. The performance criteria used in classifying such traffic should include:

- No packet drops on the outbound or inbound interface of the WAN edge router
- Voice (G.729) loss under 1%
- One-way voice delay under 150 msec

A detailed description of QoS is not within the scope of this design guide. For QoS design recommendations, refer to the Quality of Service design guide available online at

<http://www.cisco.com/go/srnd>.

Table 8-4 QoS Classifications for IPCC Express Interfaces

IPCC Express Component	Interface / Protocol	Port	DSCP Marking
CTI messaging between IPCC Express JTAPI subsystem and Cisco CallManager (both directions)	CTIQBE	TCP 2748	AF31 or EF
CTI (JTAPI) messaging from Cisco Agent Desktop to Cisco CallManager	CTIQBE	TCP 2748	None
HTTP	HTTP	TCP 8080	None
Database	JDBC / ODBC	TCP 1433	None
Email	SMTP	TCP 25	None
Messaging data between IPCC Express and Cisco Agent Desktop	CTI	TCP 42027	None

As Table 8-4 shows, CTI signaling is the only traffic that is automatically DSCP marked. This marking can impact the overall response of the IPCC Express application, depending upon what processing is done prior to connecting calls to an agent. For example, suppose that the IPCC Express application requires a database query to extract and pass the account information as enterprise data to the agent desktop. Because the ODBC and RMI data are not marked, they would be tagged as *best effort*.



Server Capacities and Limits

Criterion	Cisco MCS-7845H-2.4-CC1 (dual CPU, using Windows 2000 Advanced Server OS)	All Other Supported Servers
Number of agents	150	75
Number of supervisors (If a supervisor takes a call, the supervisor counts as an agent.)	30	10
Number of IVR ports	300	150
Number of automatic speech recognition (ASR) ports	100	50
Number of text-to-speech (TTS) ports	200	50
Number of Contact Service Queues (CSQs)	75	25
Number of skills	100	50
Number of skills that an agent can associate with	50	50
Number of CSQs that an agent can associate with	25	25
Number of skills that a CSQ can associate with	50	50
Number of CSQs that a call can queue for	25	25
Number of simultaneous Historical Reporting sessions	2	1
Number of simultaneous recording sessions	32	16
Number of simultaneous silent monitoring sessions	32	16

These limits apply to an entire system. Do not exceed them even if a dedicated Call Statistics, Recording, and Monitoring Server or dedicated Call Monitoring Servers are installed.



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